19 - SPINNING AND SPIRAL DIVES

The exercises in this section have similar aims to those in the previous section on stalling. These are to:

- recognise when spins can occur
- recognise a spin's characteristics
- learn and apply the correct recovery action with minimum loss of height
- avoid inadvertent spins by developing safe flying habits
- recognise the difference between the spin and spiral dive, and apply the appropriate recovery action.

Many trainees are apprehensive about spinning. Sufficient practice and familiarity with the manoeuvre and the recovery techniques will help ensure that, if they spin inadvertently when they are solo, they won't be so frightened or disorientated that they become incapable of taking the correct recovery actions.

For the first few demonstrations the trainee should not have his hands and feet on the controls. This lessens the chances of a panicky trainee - who may never have experienced a spin before - attempting to over-ride the instructor on the controls. This may not sound particularly dangerous, but when people are scared they can become incredibly strong. Trainees should only be allowed to follow through on the controls when they are judged to be reasonably familiar with the sensations, and to have no adverse reactions.

Prior to spin training proper, don't allow trainees to spin accidentally. If it looks as if they might, take control and return the glider to a safe attitude.

When practising spins it is important that the instructor takes the glider's particular characteristics into account; they have a bearing on the minimum heights for the various exercises. Some gliders spin fast and very nose down; some lose more height per turn; some start behaving differently after they've done more than a few turns. Cockpit weight/CG position is a big factor in how they behave. Weather conditions may also play a part. Do you know how the glider spins when it's been rained upon? It may behave like a completely different glider. Any 'minimum safety height' for initiating a spin has to include a safety margin which takes some account of these variables.

The Spin

BRIEFING POINTS

If the glider stalls asymmetrically due to yaw, air turbulence, non-symmetrical wing profiles or (most commonly) misuse of the ailerons, one wing will stall before the other and drop. This increases its AoA and its drag, which in turn increase the yaw rate, stalling the wing further. At the same time the upgoing wing's AoA decreases, making it less likely to stall and reducing its drag.

Unless the glider is unstalled, it will start to rotate automatically (Autorotation); rolling, yawing and pitching simultaneously and describing a steeply descending helical path (figure 1 overleaf).

A stall with wing drop can result in a spin if the glider remains stalled, or a spiral dive (discussed opposite) if it unstalls. The characteristic symptoms of the spin (i.e. those which are obvious without input from the pilot) are:

- a usually nose-down and rapid rotation of the glider (if the spin is unstable the rate of rotation and the pitch attitude may change periodically)
- low or flickering indicated airspeed (IAS)
- very high rate of descent
- no increase in G.

Spin recovery action

- **full opposite rudder** - to reduce the amount of yaw, and indirectly (as a result of roll coupling) to help pitch the nose down
- **centralise the ailerons** - to reduce the downgoing wing's AoA
- **move the stick progressively forwards until the rotation stops** - to unstall the glider, even though the nose is already pointing steeply downwards. In powered aircraft it is usual to pause between applying opposite rudder and moving the stick forward. In gliders this isn't necessary
- **centralise the rudder when the rotation stops** to prevent a spin in the other direction, and also to prevent high sideways loads on the fin as the speed increases
- **recover from the ensuing dive**.

The Spiral Dive

In a spiral dive (figure 1):

- the speed increases rapidly
- G increases if the stick is held back or moved back
- the rate of rotation is markedly slower than most spins
- the controls feel heavy, but are effective.

Spiral dive recovery

- roll the wings level using coordinated ailerons and rudder
- smoothly recover from the dive.

☑ Excessive speed can build up after spin recovery if the pull-out from the ensuing dive is either late, or too gentle. Likewise, if the pilot fails to recognise a spiral dive for what it is, and/or doesn't roll level before pulling out, the speed can become very high. In both cases there is a strong temptation to use the airbrakes to limit the speed, usually when it is already well past Maximum Rough Air (V_B), but doing so can create additional problems [chapter 11], chief of which is the change in load distribution caused by opening the airbrakes. This reduces the airframe limit load from +5.3G (airbrakes closed), to +3.5G (open). If you do use the airbrakes, be careful.

☑ The best way to slow down from excessively high speeds may be simply to accept a high G loading, and NOT to open the airbrakes [remarks above, and chapter 11 again]. Times when the brakes ought to be opened, regardless of the speed, are just after (preferably just before!) losing control in cloud, or in any situation where the speed is increasing rapidly and the position of 'up' is in doubt.

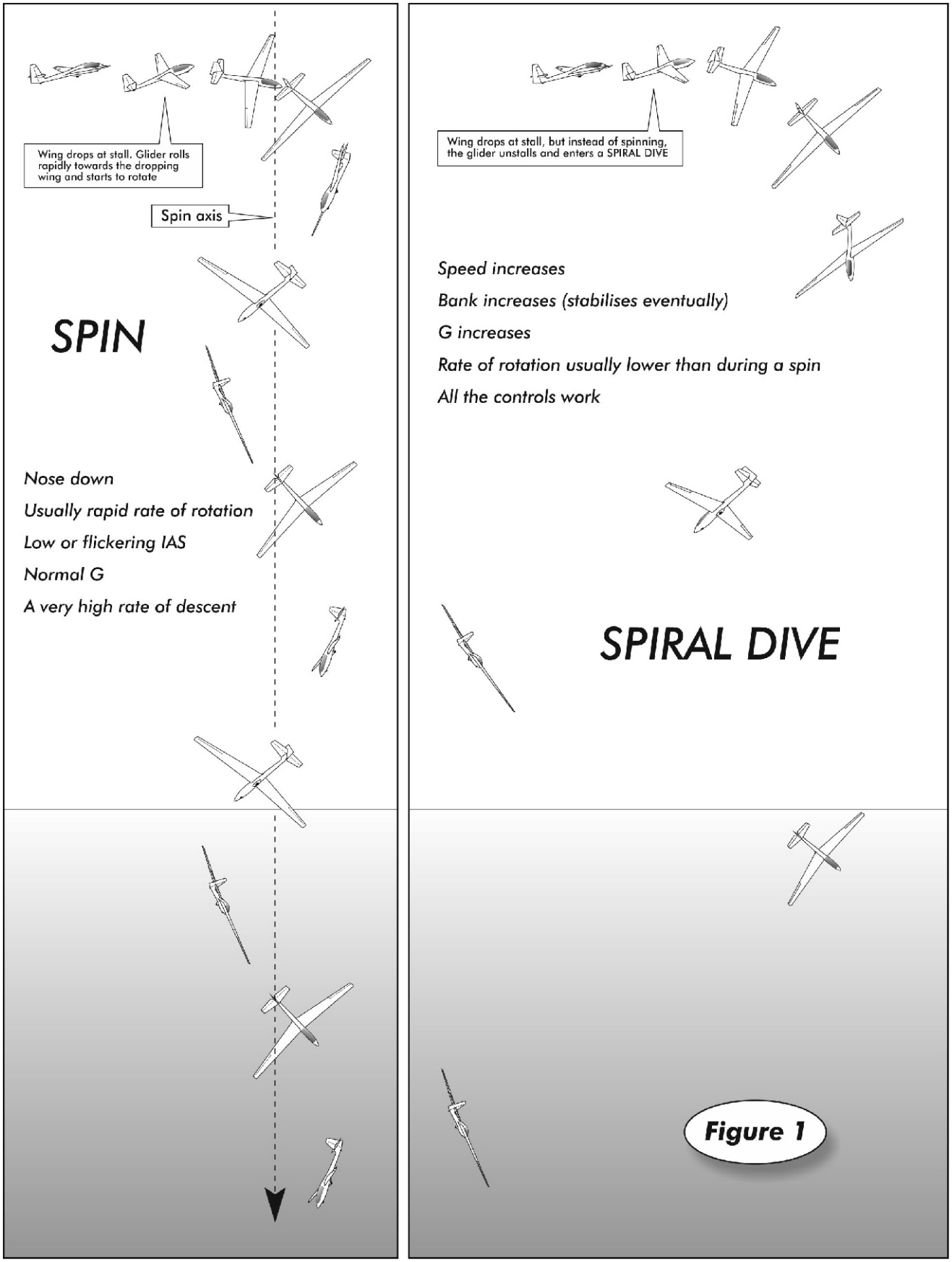

Figure 1

☑ At high speeds and/or high G loadings, avoid pulling out and rolling level simultaneously as the resultant loads on the glider can be very high.

Under-banked over-ruddered turn

Initially, the flying in this exercise is almost a repeat of previous 'stall with a wing drop' exercises. Here, however, it is related to a scenario which has figured in many spinning accidents.

As in the case of a spin or any other potentially alarming manoeuvre, the instructor must fly the first demonstration and the trainee's hands and feet must be off the controls. This will reduce both the amount of stress experienced by the trainee and the possibility of him hauling the stick onto the back stop and then doggedly holding it there, when the correct and necessary action is to move it forward.

- HASSLL check
- describe a scenario in which you have got a little low and /or far away from the site and unintentionally fly slower than usual trying to stretch the glide
- *Notice that the nose is not high - only just above the normal flying attitude*
- *Check height from the altimeter*
- *Reaching the final turn, the ground looks close so you only bank a little*
- *The glider doesn't turn quickly enough so you try to bring the nose round faster with the rudder*
- *This appears to work because the glider looks as if it is turning more quickly*
- *The nose starts to go down. You try to stop it with the elevator, but even with the stick fully back the nose won't come up. We are now spinning*
- *Notice the low or flickering ASI reading (the needle has possibly gone backwards against the stop)*
- *Notice the high rate of rotation*
- *Notice the normal G*
- *The stick is fully back but not raising the nose.*

To recover

- *Full opposite rudder, centralise ailerons, stick progressively forward until the spinning stops .... centralise rudder, recover from the ensuing dive.*

Check the height. Work out the total height loss and estimate the low point.

Spiral dives

Rather than trying to initiate a spiral dive, make use of those occasions when the glider fails to spin and instead enters a spiral dive. Don't delay recovery too long. If the spiral dive doesn't happen accidentally then demonstrate it deliberately.

- *Notice the increasing speed, increasing G, and the lower rate of rotation.*

To recover:

- *Level the wings with coordinated aileron and rudder, and ease out of the dive.*

Further practice

The trainee's understanding of why the glider spins and also his general confidence are greatly enhanced by the ability to spin the glider successfully. If necessary, initially hand over to the trainee in the spin/spiral dive for him to hold it in and then recover on command, but progress quickly to the trainee flying the whole exercise. Include spin entry from a wings level attitude - with the nose a little high, ailerons central, feed in rudder as you move the stick back to its stop. This spin entry technique works reliably with K13s, for example, where using opposite aileron is more likely to result in a spiral dive.

DE-BRIEFING

☑ The dangers of under-banked turns, particularly low down.

☑ How, when starting to turn, an inadvertent spin is initially masked by the turn and may go unrecognised. If any doubt exists, get the stick forward.

☑ The apparent slowness of approach to the deliberate spins fails to simulate the level of pilot workload and distractions which can lead to an inadvertent spin.

☑ Spin recognition and recovery actions.

☑ In all scenarios the approach to the spin is with the nose of the glider below the horizon and not very different from the normal flying attitude!

☑ The need to move the stick forward even though the nose is pointing steeply downwards.

☑ The effect of different CG positions on spin characteristics and recovery.

☑ Spiral Dive recognition and recovery action.

It is the failure of the pilot to move the stick forward when the nose is going down that allows the glider to spin!

ADVICE TO INSTRUCTORS

In the initial stages of spin training, continuous spins of two or three turns are mainly to allow the trainee time to study the spin's characteristics, and to give confidence that the recovery action from a stabilised spin is effective. There is no requirement for these spins to be noticeably close to the ground, so their training value is not compromised if they are completed very high. The majority of spin training will then involve brief spins of about a half a turn with the primary aim of recognising the circumstances in which they can occur, correctly identifying the spin/spiral dive, and practising the correct recovery action.

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.

Instructors should be aware that **very few pilots recover from inadvertent low level spins**, and that **stall/spin avoidance is the chief aim of the training**. It is logically impossible to provide training in inadvertent spins, so its importance lies in making recognition and recovery as automatic as possible. An inadvertent spin low down doesn't give a pilot unfamiliar with spins and their symptoms time to work out what's happened before they hit the ground.

Poor launch heights produce limited opportunities for stall/spin training, but the exercises must not be missed or skimped.

Initially many trainees find spinning very disorientating, so don't include too many of these exercises in any one flight. Thermal soaring to regain height between bouts of spinning may also prove too much.

Make it clear that you are not teaching a manoeuvre as such, but reproducing, under controlled conditions, an abnormal flight situation which we'd normally try and avoid.

Most training gliders are docile. Sometimes both the instructor and trainee will attempt to spin, and fail, and the glider enters a spiral dive instead. Failed spin attempts are opportunities to recognise the ensuing spiral dive, and to practice recovering from it correctly. Recognising that the glider isn't spinning is as important as recognising when it is. Applying full opposite rudder or maintaining in-spin rudder with the glider in a spiral dive can result in structural damage and failure. Be careful!

Spin recovery often happens so quickly that there is insufficient time for much, if any simultaneous patter. The trick is to lead with the patter and say *Full opposite rudder, stick centrally forward* **before** moving the rudder and stick. There is seldom time to refer to the ailerons, but they can be mentioned in flight, between exercises.

Have your hand just in front of the stick during the trainee's spin recovery, in case the forward stick movement gets a bit too enthusiastic. A hand hovering near the airbrakes may also prevent an overspeed, but remember that the glider's loading limitations are lower when the air-brakes are open.

Most pilots, including instructors, think they apply full opposite rudder when in fact all they do is centralise it. This probably stems from too much practice in gliders which immediately recover from spins, or where the rudder forces are much higher. Encourage the trainee to apply full opposite rudder even if it has to be removed immediately. The idea that there is an 'incipient spin' is not helpful. It suggests that spin entry has three separate phases (stall, incipient and full spin), and implies three recovery techniques when, in fact, there are only two. The first is the normal stall recovery, which works for stalls and so called incipient spins, and sometimes even for full spins. The second is the classic spin recovery which we teach because some gliders won't respond very quickly, or at all, without it.

The trainee should be made aware of the variations between gliders and how important it is that he is always aware of the spin and recovery characteristics of every glider he ever flies.

Never tell a trainee that a particular glider or glider type won't spin. Nobody really knows. It's true that some gliders are more reluctant to spin than others, but the 'unspinnable' one may have never been flown in conditions where it would. Instructors should try and perfect the exercises which simulate inadvertent spin entry, because not being able to do them may suggest to the trainee, inaccurately, that all gliders are hard to spin. Remember that the thing we strive so hard to achieve for demonstration purposes is produced effortlessly by pilots who spin in without ever realising what happened.

Any given glider's spin characteristics are related to several factors, some not immediately obvious. The most important one is the CG position [see Gliding, the BGA Manual]. The further aft the CG (i.e. the lower the pilot(s) weight), the easier it is to spin and the harder it is to recover. Conversely, the combination of a plump trainee and a fat instructor may move the CG forward to the point where the elevator lacks the authority to maintain the necessary high AoA. After half a turn the nose drops - even with full back stick - and the glider enters a spiral dive. The 'spinning glider' appears to recover all by itself. This is NOT an indication that it won't spin, simply that conditions weren't favourable for it to do so.

Airbrakes can have a stabilising effect on a spin, but they may make recovery more difficult.

Flaps and their effects vary from glider to glider. In general, lowering the flaps (thermal or landing) makes the glider more prone to spin, whereas raising them (cruise settings) will tend to discourage it. The best example is the ASW20 which is very reluctant to spin at all with neutral or negative flap, but spins like a top with landing flap and gear down. No glider gets a UK Certificate of Airworthiness © of A) unless the recommended spin recovery action, as outlined in this chapter, results in recovery within one and a half turns. Not instant, perhaps, but obviously guaranteed - and academic if you spin at 300' AGL!

FURTHER SPINNING EXERCISES

CHANGING EFFECT OF THE RUDDER AT THE STALL

Good co-ordination is the essence of safe flying. From the outset the trainee is taught the safe habits of co-ordination and correct use of the rudder. It is important to demonstrate to the trainee the danger of misusing the rudder.

This exercise shows the trainee the primary and secondary effects of the rudder at the typical cruise speed, and how misuse of the rudder at lower speeds produces different and dangerous effects. This exercise is more one of spin prevention than simple stall avoidance.

BRIEFING POINTS

The demonstration may be dramatic and self evident (in retrospect), but a thorough pre-briefing is needed for this exercise. Debriefing is essential.

Complete the HASSLL checks. Fly at normal flying speed.

- *Keep your hands and feet clear of the controls*
- *Notice we are flying at normal flying speed*
- *I am going to apply full left rudder*
- *I want you to tell me how much the glider yaws and rolls*
- apply full left rudder
- wait for two or three seconds
- *How much yaw and how much roll was there?* (Figures in the order of 30° yaw and 10° roll or 'lots of yaw and not much roll' are acceptable)

If the trainee isn't quite sure what happened, repeat the exercise before continuing with the next.

- fly the glider at 1kt above the stall. The glider may need to be 'on the buffet' for this to work
- *Notice that we are now flying near the stall*
- *I am going to apply full left rudder again*
- *Tell me how much yaw and roll you see this time*
- apply full left rudder
- wait

- *How much yaw and roll?* (70° roll and 15° yaw or 'a lot of roll and not much yaw')
- *Stick forward to unstall the glider* (Centralise the rudder).

Emphasise that misuse of the rudder near the stall makes the glider spin.

DE-BRIEFING

Emphasise that, although trained never to use excessive rudder, there can be psychological pressures (such as being low with the turn still incomplete) and misleading visual rewards (an apparent increase in the rate of turn) which may unconsciously lead the pilot to over-rudder.

Due to high workload, even the most experienced pilot may find himself over-ruddering subconsciously in order to get the glider round eg; when soaring at low altitude, doing a low circuit turn, or a field landing.

Misuse of the rudder is not only inefficient, but if the glider is at/or near the stall, it can cause it to spin.

The only protection is to take care to ensure the glider is being flown accurately, well away from the stall!

ADVICE TO INSTRUCTORS

The reason for asking the trainee to say how much roll and yaw occurs is to make sure that he has seen the effect for himself, and to ready him for the second part of the exercise. Don't be surprised to find that the first part of the demonstration has to be repeated. This exercise can be a useful, life-enhancing reminder to pilots who tend to over-rudder turns, particularly the final one!

SPIN OFF A STEEP OR THERMAL TURN

Spin training may have concentrated on the spin from an under-banked turn. The purpose of this demonstration is to show that the glider will spin from a well-banked, unbalanced turn at airspeeds normally considered to be safe.

BRIEFING POINTS

A pre-flight briefing is essential for all the exercises that follow. The scenarios that lead to spinning aren't always as neatly encapsulated as the names of the exercises might suggest.

Complete the HASSLL check.

- describe and demonstrate a scenario in which an attempt is made to soar low down, in a narrow thermal. The speed should be well above the normal flying speed
- turn with 45° of bank and at a speed close to the accelerated stall for that angle. (AS-K13 = 48kt, Ka7 = 47kt)
- *Notice the speed is Xkt, well above the normal flying speed*
- *the nose looks to be safely below the horizon*
- without explaining your actions, gradually increase the rudder in the direction of the turn, whilst at the same time maintaining the attitude with the elevator, and the bank angle with the ailerons. (You might have to cheat slightly here. For example, an AS-K13 is more likely to spin if, without moving the ailerons to hold off any increase in bank, you simply move the stick smartly to the back stop)
- the glider spins
- recover!

DE-BRIEFING

Emphasise that the glider will spin from an unbalanced turn at speeds well in excess of the unaccelerated stall speed.

Discuss how inaccurate flying helped initiate the spin, and in particular point out that some of the more usual symptoms were not present. For example, did you notice any pre-stall buffet? It may not be obvious.

ADVICE TO INSTRUCTORS

For this demonstration to work the speed and steep angle of bank must be steady. The spin entry is likely to be far more dramatic than from an unaccelerated flight condition.

The exercise should have been taught as a part of spinning. It is included here in case it has been overlooked.

It is necessary to pull back on the stick and hold it back as the wing drops and the rudder is applied. This is realistic, since the majority of spins are triggered by misuse of the elevator. When pilots are not aware of what's actually happening they often revert to 'get the nose up at all costs'.

STALL & SPIN FROM A NORMAL APPROACH ATTITUDE FOLLOWING A CABLE BREAK

This exercise shows that during reduced G the glider will fly at below the normal stalling speed, and that turning before the glider has accelerated to a safe speed after a launch failure can cause the glider to spin. It also demonstrates that after a push-over manouevre the airspeed can be less than the attitude might suggest.

BRIEFING

☑ Gliders have spun from turns commenced after a wire launch failure (and in other similar circumstances).

☑ Review the relationship between G and the stalling speed - including reduced G.

☑ Discuss the recovery action in the event of a wire launch failure:

- the attitude required to regain approach speed
- avoidance of turns or use of airbrakes until approach speed is reached
- the desirability of landing straight ahead if possible.

☑ Point out that a spin from a very nose up stall may produce such a rapid rate of rotation initially that the spin recovery may take longer than usual. This can easily be checked by provoking a spin from a straightforward but relatively shallow straight stall and then compare it with spin entry from a much steeper stall. Check this out at altitude first!

Exercise, part one

This is to remind the trainee of what the normal approach attitude looks like (typically 50-55kt).

Exercise, part two

Complete the HASSLL check.

- describe a wire launch failure where the nose is lowered to the normal gliding attitude. If the speed decays to below the normal 1G speed during the push-over, then the glider will mush-stall when held in the normal approach attitude
- increase the speed to 70kt. Raise the nose to the attitude appropriate for a wire launch
- maintain this attitude until the glider is close to the stall
- say *The cable has broken*
- positively lower the nose to the normal airbrakes closed approach attitude and then pull back on the stick to maintain the attitude
- if the timing is right then the glider will settle into a mushing stall
- if possible, maintain the stall for a few seconds, and then recover in the normal way.

Exercise, part three

Complete the HASSLL check.

- describe a wire launch failure where the nose is lowered after the failure, but a turn is begun before the glider has had time to accelerate to a safe speed
- increase speed to 70kt. Raise the nose to the attitude appropriate for a wire launch
- maintain this attitude until the glider is close to the stall
- say *The cable has broken*
- positively lower the nose to the normal airbrakes closed approach attitude and immediately commence a coordinated turn
- bring the stick back to maintain the normal approach attitude
- the glider instantly stalls, and if the controls remain deflected, as for the intended turn, the wing may drop
- if possible allow a spin to develop
- recover using stall, spin or spiral dive recovery as appropriate.

Establish how much height has been lost and relate this to a low level cable break and any wind gradient delaying acceleration to a safe speed.

Exercise, part four

Launch failure in the full climb

- describe a wire launch failure that occurs during the full climb
- dive the glider to about 70kt, and then pull up smoothly into a 45° nose up attitude
- immediately assume that the launch has failed
- lower the nose to the recovery attitude (below the approach attitude)
- wait for the airspeed to increase to the nominated approach speed
- don't turn or open the airbrakes until approach speed is attained
- release the cable.

ADVICE TO INSTRUCTORS

Before attempting any manouevre after a launch failure, the glider must have a safe airspeed. This will require a more nose down attitude than the normal gliding attitude (the recovery attitude). This is necessary to avoid a stall on recovery because speed decays rapidly following a launch failure.

Emphasise that attitude itself is not necessarily an adequate indicator of speed. Although the nose was lowered as the aircraft approached the stall, insufficient time was allowed for the glider to regain flying speed.

You need to keep the G reduced until the airspeed is safely above the normal flying speed.

For part two and three of this exercise the airspeed at the peak of the pushover should be below the 1G stall speed but above the 0.5G stall speed. For example, the speed at the peak of the pushover for an AS-K13 with a normal 1G stalling speed of 36kt, would be approximately 32kt.

Optional exercise

SPIN TO THE LEFT OFF A RIGHT TURN (or vice versa)

BRIEFING POINTS

The demonstration's purpose is to show the risk involved in using opposite rudder before the glider has entered a spin proper, e.g. as the wing drops, and before the glider's unstalled.

- Set up an under-banked turn to the right
- bring the glider to the point of stall, and make sure that a wing drops
- *If the glider stalls and as the right wing drops -*
- *- we apply full opposite rudder*
- *and the glider may spin to the left.*

DE-BRIEFING

If a spin is anticipated and the rudder used when the glider is not actually spinning, there is a distinct risk of a spin developing in the opposite direction to the turn.

- emphasise that in any inadvertent stall situation the priority is to unstall the glider
- that there is a standard recovery for the stall whether a wing drops or not
- that there is a standard recovery for a spin
- for all practical purposes the term 'incipient spin' is redundant

- though full opposite rudder was used in the exercise, any opposite rudder before the glider is unstalled could have the same effect if it was combined with a wind gradient or turbulence.

COMMON DIFFICULTIES

No habitual response ie; the trainee has not yet developed the HABIT of making an immediate spin recovery, nor making an immediate dive recovery once the spin has stopped.

Uncertainty about the extent of HASSLL check required, and in particular where in the sky to look during lookout.

Sickness, disorientation or excessive fright. The exercise will often need to be discontinued and resumed another day. **NB** This excuse cannot be used indefinitely to avoid spinning. If a trainee seems to be sickly rather more often than normal, he may be sensitive to reduced G. Occasionally there can be 'inner ear' balance problems.

Lack of understanding of the placard limits - especially manoeuvring speed, the speed above which coarse control movements can damage the glider.

Fails to make the glider enter a spin. This often results from the trainee's misconception that spinning is something that happens quickly. As a result there is usually a rushed attempt to stall and provoke the spin, followed by a rushed recovery, usually before the glider has done anything very much.

Stalls too steeply and the glider drops through the stall into a spiral dive.

- nose too high initially, with a marked nose drop and auto-recovery
- fails to move the stick fully back and keep it there.

If the bank is allowed to increase during the entry to a spin from a normal or under-banked turn, there may be insufficient elevator power to stall the glider.

Many gliders have very effective ailerons at the stall and may not spin on demand unless the ailerons are held central, or in some other specific position. The effect of aileron position varies greatly from type to type. Pro-spin aileron can enhance the spin on some gliders while out-spin aileron works better on others. K13s and K7s, for example, spin most readily with the ailerons central.

Fails to maintain the spin. Usually due to failure to keep the stick back. This assumes that the glider is a type which can normally be stabilised in a spin.

Inappropriate use of ailerons - especially the inadvertent use of full anti-spin aileron to hold off bank.

Extreme forward CG location - i.e. P2 is near the maximum cockpit weight.

Recovery problems. The trainee:

- confuses spin and spiral dive and takes inappropriate recovery action
- fails to use full opposite rudder
- inappropriate forward movement of the stick - usually too much, too fast
- lack of instantaneous habitual response of forward stick once the spin has been recognised
- fails to recognise when the spin has stopped
- continues with spin recovery instead of dive recovery
- lack of immediate or efficient dive recovery even though the end of spinning has been recognised. The trainee may never previously have encountered such an attitude
- fails to centralise the rudder
- keeps the nose below the horizon after recovery. Speed remains high. Raising the nose would regain some of the lost height.

NOTE Practice and familiarity with spinning will eradicate most of the foregoing faults. [See chapter 18, Further Stalling and Spinning Exercises].