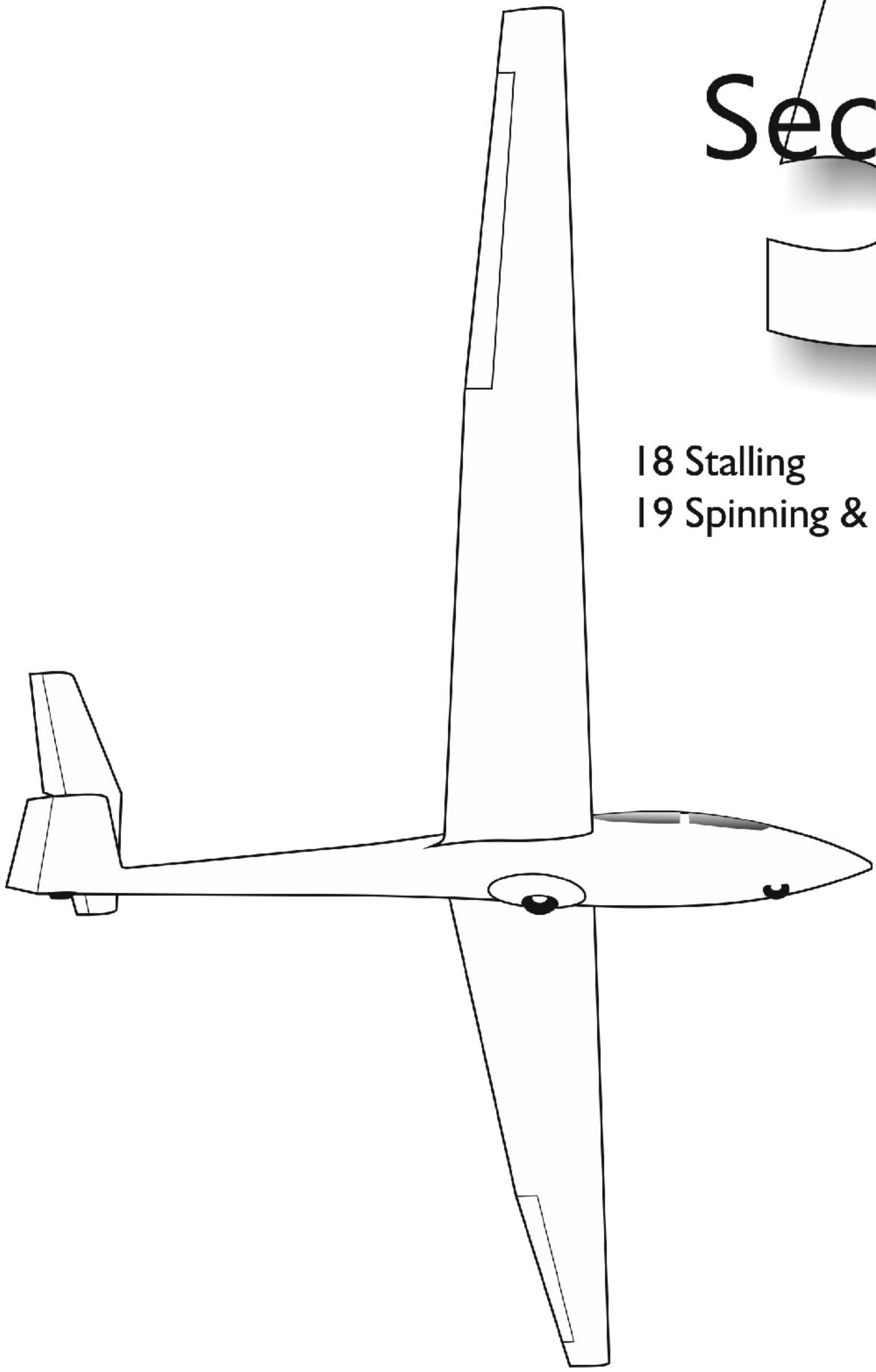
Section 5



18 Stalling

19 Spinning & spiral dives

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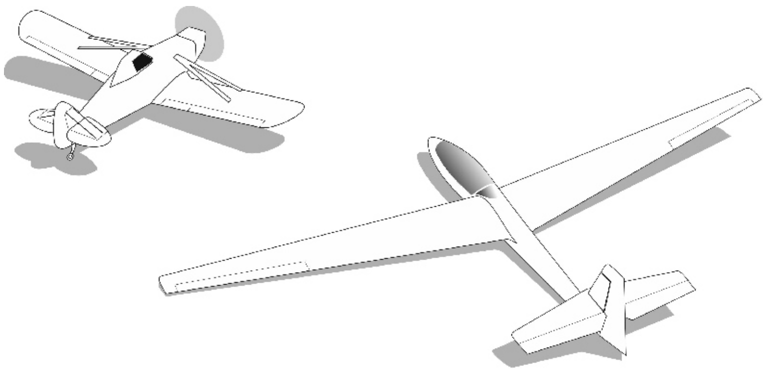

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18 - STALLING

Even though stalling is in itself a benign flight condition, it is still a major contributory factor in gliding accidents, not because the pilots involved didn't know the correct recovery action, but because they didn't realise what had happened. This is why the training must strongly emphasis recognition of, and familiarity with, the symptoms of the stall. Even if the height losses involved in some of the exercises seem uneconomic in relation to the cost of launches, or the number available, do not skimp on stall training; it is accident prevention at its most valuable.

Stalls should be practised often enough to ensure that the trainee's habitual response to stalling is to move the stick forward. However, apart from the stall included in the elevator exercises [chapter 7], more formal and extensive stall training should only be introduced when the trainee is familiar with the sensations of flying and reasonably confident of his ability to control the glider. Beware of doing stalls with markedly reduced G before you have determined whether the trainee is sensitive to it or not.

TRAINING CONTENT

The one symptom present in every stall is the elevator's ineffectiveness at raising the nose of the glider. The instructor's aim is to establish an automatic link in the trainee between this symptom and the need for stall recovery action.

Stall training progresses from gentle, wings-level stalls, to accelerated stalls in turns and climbing attitudes, followed by Further Stalling.

Trainees are often very apprehensive about stalling, and the Effect of Elevator lesson [chapter 7] introduced a gentle 'confidence' stall both to reduce this, and to introduce the important message that the elevator doesn't always raise the nose when the stick is moved back. If the trainee hasn't had this demonstrated, or he appears nervous, introduce a gentle 'confidence stall' before doing the briefing and introduction to the formal stall exercise.

Follow the initial gentle stall demonstration with several more, each time drawing the trainee's attention to one particular symptom of the approaching stall, and follow each by doing the stall and recovery. It isn't always necessary to do a complete HASSLL check between consecutive stalls, but it is essential to keep a good lookout and to check that height remains sufficient.

When introducing slow flying, make it clear that the exercise is to help the trainee recognise the feel of the glider and control response rates near the stall; it is not to develop a skill in 'slow flying'.

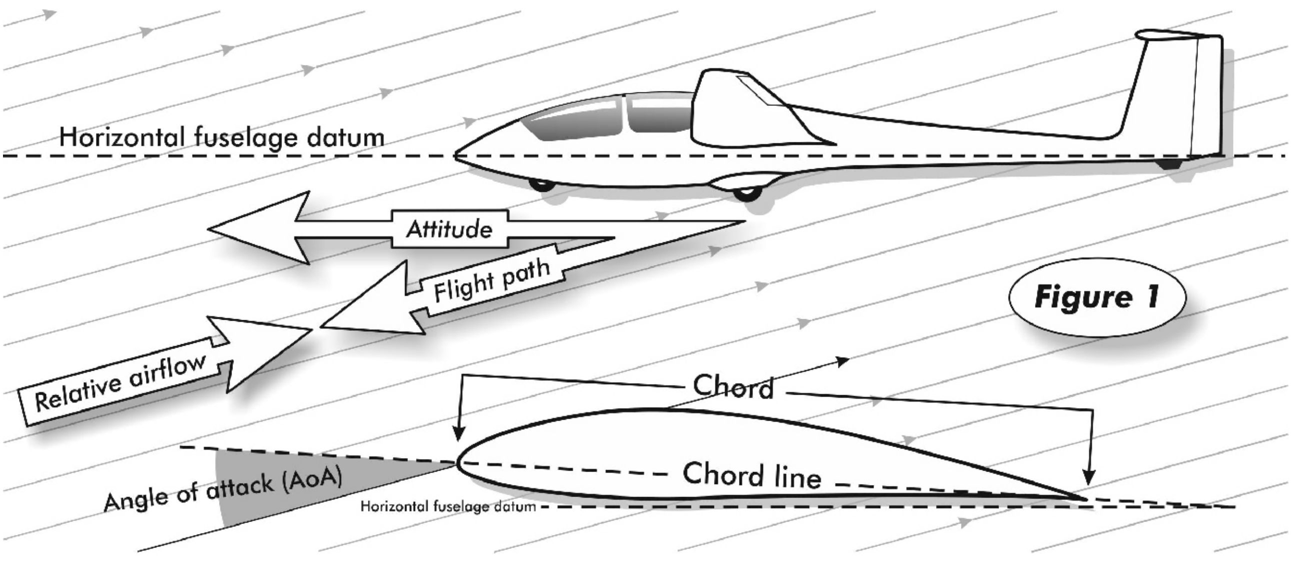
With the exception of wire launch failures, it's unlikely that a pilot will stall inadvertently with the nose held very high, simply because the attitude is so obviously abnormal. The most likely place for an inadvertent stall is close to the ground. For example, the pilot might under-estimate the wind gradient or unconsciously attempt to stretch the glide.

Thermalling low down while trying to select a suitable out-landing field often leads to inadvertent stalls, sometimes with fatal results. A number of factors, including turbulence and wind gradient, can increase the chances of a stall, and delay the recovery. If the strong visual signal of a nose high attitude is absent the pilot is less likely to recognise the onset of the stall. High workload also increases the chances of other symptoms going unnoticed.

To help the pilot avoid stalling in such situations, training should cover the deliberate stall exercises - which suggest that the symptoms are fairly obvious, and are often continued until the glider is fully stalled - and those more subtle stall entries where the emphasis is on recognising the symptoms, and initiating immediate and appropriate recovery action. The more dramatic stalling exercises, and those with the most obvious symptoms, make dramatic and obvious points, but the more stealthy and less dramatic may make the most valuable ones. Stall training should be dominated by exercises which start from near, or below, the normal flying attitude, and which emphasise the value of less obvious symptoms to real-life stall prevention.

Stall training is a continuing exercise, both pre- and post-solo. The aim is for the trainee to:

- recognise the symptoms of an approaching stall and take timely avoiding action
- become familiar with the characteristics of the full stall, and learn how to recover with minimum loss of height
- avoid inadvertent stalling by developing safe flying habits in all phases of flight



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BRIEFING POINTS

AoA and the stall

☑ In normal flight a glider's wings must produce a lifting force near enough equal to the glider's flying weight. The amount of lift generated depends on the aerofoil's camber (overall shape), the wing area, and the speed and angle at which the airflow meets the wing. The angle is called the **Angle of Attack**, or AoA for short (figure 1), and is measured between the aerofoil **chord line** and the **relative airflow**.

☑ If the glider is in steady and fast straight flight, the AoA will be small, but become progressively larger as the glider slows down, or as G increases. There is a **critical angle** for the AoA - aerofoil specific, but typically about 15° - where the lift (strictly speaking, the lift coefficient, or C_L) reaches a maximum value. If the AoA is increased further, lift will reduce, sometimes quite sharply, but the drag level will continue to rise. Technically, the stall is defined as occurring when the C_L has reached its highest possible value, regardless of anything the glider is doing at the time.

☑ The glider's **flight path** is the direction in which it is travelling, as opposed to the **pitch attitude**, which is the direction in which it happens to be pointing relative to the horizontal (see figure 1). There may be no direct relationship between the two. The important point is that **the glider will stall in ANY attitude and at any speed, if the AoA reaches the critical angle**, or to put it another way, the glider will stall if the discrepancy between the attitude and the flight path is large enough.

Stalling speed

☑ The actual value of the stalling speed depends on the following factors:

- **airspeed**
- **wing loading**. If the wing loading increases, so too does the stalling speed. The wing loading depends on:
  - the **glider's flying weight**, also referred to as the All Up Weight or AUW
  - any vertical **accelerations** (**G**) in relation to the glider which alter its effective weight. This include changes in direction (turning, pulling out from a dive), as well as cable tension during a winch launch
- **contamination.** In unaccelerated flight at a given flying weight and with a clean airframe, the stalling speed (V_S) will have a specific value, say 35kt. If the glider enters rain or the leading edge becomes splattered with bugs, for example, the stalling speed can increase by anything from 1kt to 10kt; possibly more if the airframe is covered with ice. The change in stalling speed is glider/aerofoil dependent, and some gliders are more badly affected than others
- **use of the airbrakes**.

Further points

☑ Flying with the glider partially, if not completely stalled, is inefficient, and - excluding the float just before touch-down - dangerous if close to the ground.

☑ The wings of most gliders are designed to stall in a smooth and progressive manner, either through using a different aerofoil section near the tip, or building in 'washout' (figure 2), or both. Airflow breakdown then begins at the upper surface trailing edge, near the wing root, and spreads forwards and outwards as the AoA increases (figure 4). At the same time the drag level rises markedly and the rate of descent increases.

☑ The above feature enables many gliders to maintain some aileron control, however minimal, at, and sometimes just beyond the stall. In general though, as more of the wing stalls, the ailerons become increasingly sluggish and ineffective.

☑ As against the comments above, aileron input close to the stall can result in very rapid roll in the opposite direction to the one intended. This is caused by the downward deflected aileron stalling the tip that was supposed to go up (figure 3).

☑ Secondary effects of rudder inputs at, or just prior to the stall can have much the same effect, except that the glider can roll strongly in the direction of the rudder input.

☑ Depending on the glider's elevator authority and/or the rate at which the stall is approached, the elevator may fail to raise the nose in response to backward movement of the stick, or the nose may drop regardless. **Inability of the elevator to raise the nose or prevent it going down is the most important symptom of a stall.**

☑ As the glider slows down there may be a perceptible change in the airflow noise. While usually quieter, it can also be louder or different in character, and may sound completely different if there is any significant yaw present.

☑ Separated airflow can produce airframe buffet, and turbulent flow across the static ports can cause the ASI readings to flicker.

Summary of stall symptoms

Not all of the following may be present, or all that obvious:

- the nose attitude higher than normal
- the airspeed slow or reducing
- changes in airflow noise
- flickering ASI
- airframe buffet
- changed effectiveness of elevator, ailerons and/or rudder
- unusual control positions for the particular phase of flight. For example, lots of out-turn aileron
- higher rate of descent.

Stall and recovery

If the pilot either fails to notice or ignores the symptoms, the glider will STALL and:

- begin to descend at a very high rate
- the nose may drop
- a wing may drop.

To recover, the AoA MUST be reduced:

- ease forward on the stick (the aimed for attitude needs to be steeper than the normal gliding attitude)
- regain flying speed
- return to the required gliding attitude (for that phase of flight).

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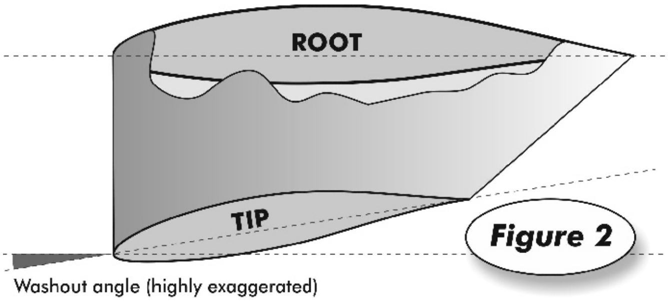

Figure 2

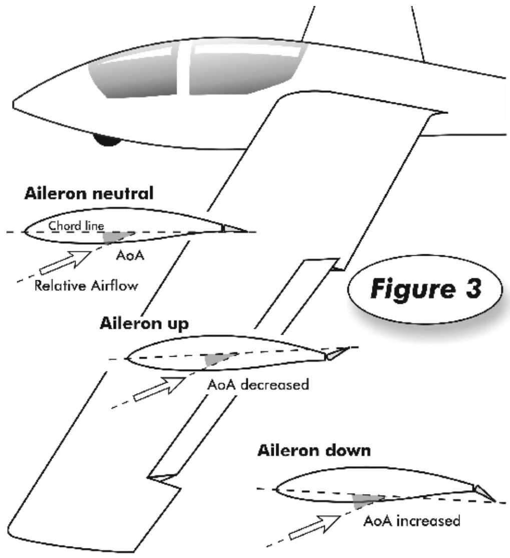

Figure 3

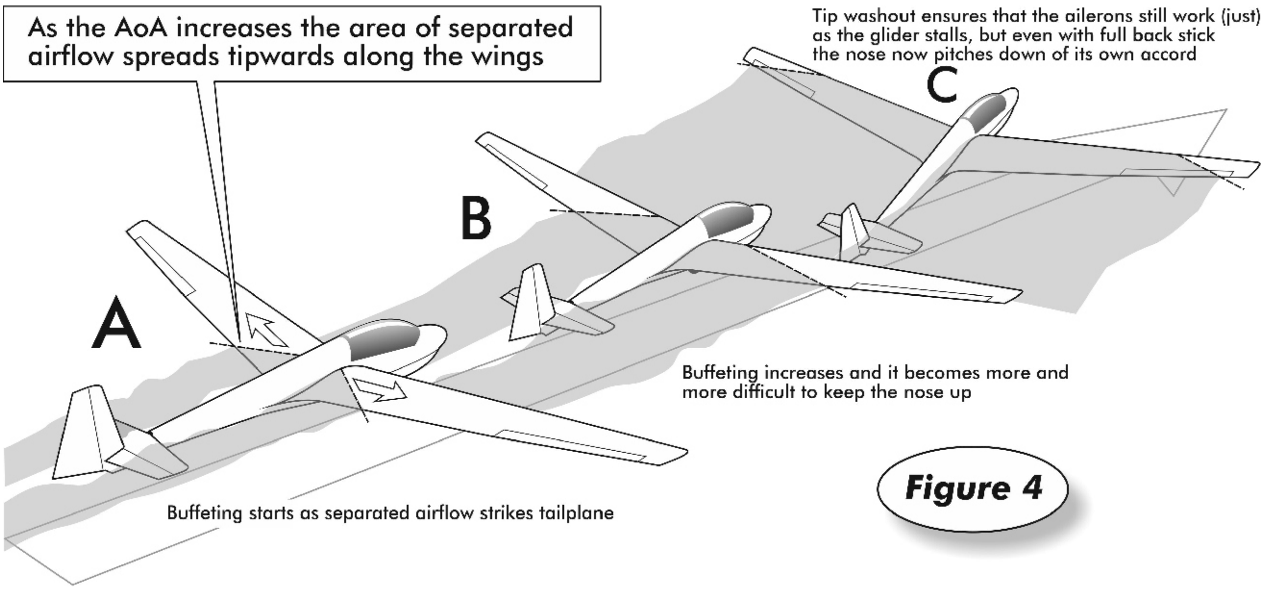

Figure 4

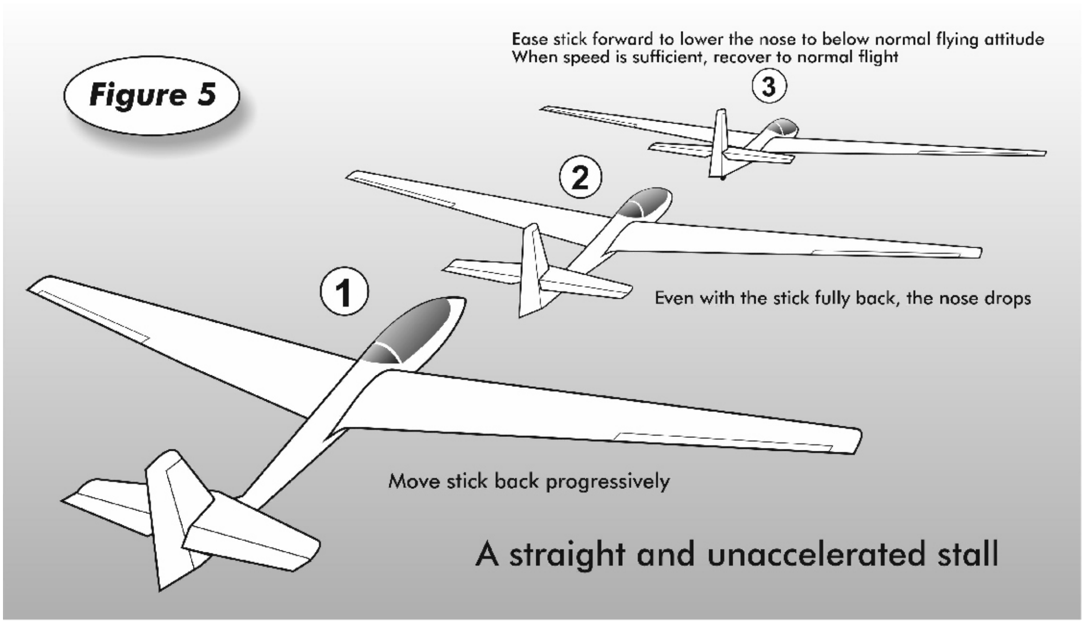

Figure 5

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The degree of forward stick movement and the time and height taken to unstall the glider depends on the circumstances of the stall. For example:

- a stall without a nose drop - a mushing stall - normally requires more forward stick movement for recovery than if the nose is already dropping
- recovery action whilst descending through a wind gradient requires a very much lower nose attitude if flying speed is to be regained.

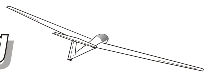
A secondary stall may occur during or after recovery from the first if the recovery is hurried, and if:

- the glider hasn't been allowed to regain sufficient speed for the next manoeuvre, causing it to stall again, or
- the stick is pulled back too harshly during the return to the required attitude, creating unnecessary G. The accelerated stall that results may be vicious.

When a wing drops at the stall it is essential to unstall the glider before attempting to level the wings. Once the glider is unstalled, level the wings with coordinated ailerons and rudder.

Pilots often over-react when 'unstalling' by pushing the stick hard forward, regardless of whether this is really necessary or not. Considerable height can be lost. The instructor should demonstrate and encourage 'least loss of height' recoveries. The rider is that the success of this depends a good deal on the trainee's understanding and appreciation of the situation, and of the aircraft they're flying. On balance **slightly** over-reacting is safer than slightly under-reacting.

The Flying



Include the HASSLL check [chapter 4] in the pre-flight brief.

Initially, ask the trainee to keep his hands and feet off the controls. Only invite him to follow through once he knows what to expect (i.e. you have demonstrated it, perhaps several times), and you are reasonably sure that he won't react badly.

This advice is relevant to all stalling exercises.

UNACCELERATED or 1G STALLS

Demonstrate 1G stalls to introduce the symptoms of the approaching stall, the stall itself, and the recovery. The first demonstration should be followed by several more, each concentrating the trainees attention on one particular symptom of the approaching stall, followed by the stall and recovery.

Stall without a nose drop or ‘mushing stall’

- complete the HASSLL check (some of it can be done prior to take-off)
- bring the nose slightly above the normal flying attitude
- identify the ‘Symptoms of the Stall’ as they occur
- note the airspeed at which buffet begins
- stabilise the glider in this attitude, with a high rate of descent
- emphasise that this is the stall
- demonstrate the recovery action.

Stall with a nose drop

- check that you have sufficient height
- lookout
- repeat the 1G stall but ensure that the nose drops.

Emphasise that:

- because the glider is stalled the nose drops, despite the stick being held back (figure 5)
- although the nose is dropping it is essential to move the stick forward to recover
- once unstalled, the recovery from the dive needs to be smooth in order to avoid a secondary stall.

Stall with a wing drop

- check the height available
- lookout
- repeat the 1G stall, but provoke a wing drop and demonstrate the recovery.

Emphasise that:

- the wings are levelled with coordinated use of ailerons and rudder, BUT ONLY AFTER the glider is unstalled.

TRAINEE ATTEMPTS AT UNACCELERATED 1G STALLS AND RECOVERIES

The aim is for the trainee to fly the 1G stall and to:

- identify the symptoms of the approaching stall
- recognise the stall itself
- recover with the **minimum loss of height**, avoiding a secondary stall.

Slow flying exercises

The primary aim is to give the trainee prolonged experience of the feel of the controls when the glider is in the mushing stall and the nose is not dropping.

- complete the HASSLL check
- the trainee reduces speed very gradually (approximately 1kt/sec) towards the stall. The aim is to try and fly the glider into a mushing stall while keeping the wings level with coordinated controls.

Emphasise;

- the need for coarse aileron and rudder movements
- that the stick is considerably further back than for normal flying speed, even though the glider’s attitude is not that dissimilar to the ‘normal’
- the rate of descent is high, and
- a wing may drop.

Recover from the stall.

Stall with airbrakes or spoilers open

- complete the HASSLL check
- fly the 1G stall with the airbrakes or spoilers fully open
- note the stall' symptoms and the higher stalling speed

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- point out that recovery includes closing the airbrakes or spoilers.

Recover from the stall.

ACCELERATED STALLS

Stall in a turn

- complete the HASSLL check
- enter a normal banked turn (30°) and slow gradually towards the stall
- **point out the unusual control positions required to maintain the attitude and angle of bank**
- note the airspeed at the onset of buffet compared to the unaccelerated stall
- continue until the glider is fully stalled
- recover as for 'stall with wing drop'.

Repeat the exercise, but recover at the buffet stage by relaxing the back pressure on the stick. Explain that this action is to prevent a stall, not recover from it.

Stall in climbing attitude - simulating a wire launch failure

- complete the HASSLL check
- accelerate the glider a little, say to 50kt, and then pitch it up and hold a 30° climbing attitude.

Note:

- the attitude, and the rate at which speed is being lost
- the absence of some of the stall 'symptoms' - until the nose drops
- the severity of the eventual nose drop.

Recover, emphasising the need to move the stick forward despite the nose being down already.

Emphasise:

- that flying speed needs to be recovered before trying to raise the nose
- the need for a smooth recovery to avoid a secondary stall.

Stall in a steep turn

- complete the HASSLL check
- turn steeply (60° of bank), and increase the back pressure on the stick until the buffet becomes marked.

Note the speed compared to the 1G stalling speed.

Reducing the back pressure on the stick immediately reduces the G and is normally sufficient to recover.

More speed than normal is required to sustain a tight turn without stalling.

DE-BRIEFING

☑ Review the symptoms of the approaching stall.

☑ Emphasise that only one symptom needs to be recognised for stall avoidance or recovery to be initiated. (There can be some exceptions to this. For example, buffet may not always be associated with an imminent stall. See Gliding; the BGA Manual).

☑ Discuss the many different situations where a stall can occur, but emphasise that the one thing they have in common is the need to move the stick forward to recover.

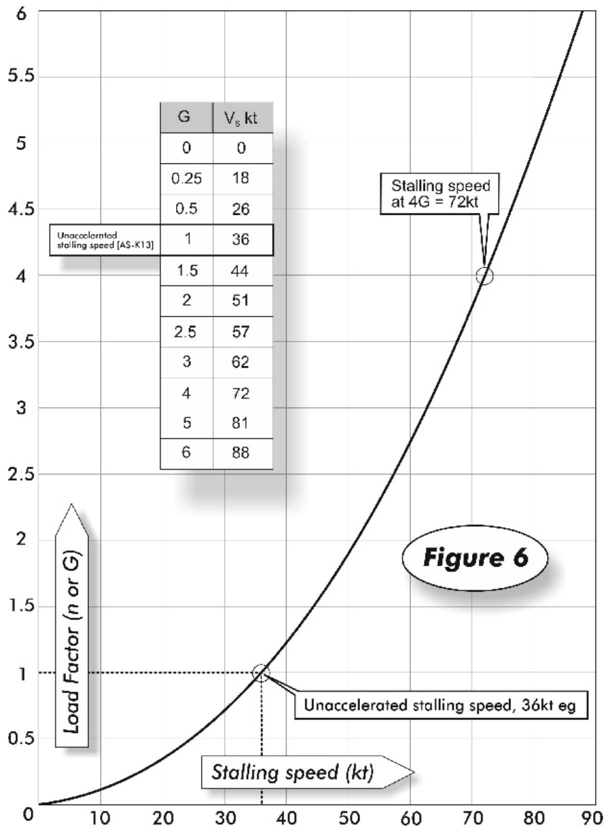
☑ Review the recovery action, including the degree of stick movement required.

☑ The amount of height lost in stalls.

☑ Discuss stalls that result from hurried or premature recoveries. The effect of 'dirty wings' (rain, bugs etc.) on the stalling speed.

☑ After the unaccelerated stalls, brief trainees to avoid stalling unless it is a specific exercise and to recover without prompting if they recognise the symptoms of the stall.

Figure 6 below and the inset table show how the stalling speed changes with G for an AS-K13.



G	V_s kt
0	0
0.25	18
0.5	26
1	36
1.5	44
2	51
2.5	57
3	62
4	72
5	81
6	88

ADVICE TO INSTRUCTORS

The primary objective of the first set of exercises is to train pilots to **recognise and avoid stalling.**

That instructors tend to initiate the stall and spin entry, and then hand over to the trainee for the recovery, may be one reason why pilots can fail to recognise the symptoms of a stall. The trainee needs to experience the response and feel of the controls at this crucial point - knowledge which might one day save his life - and needs to 'have a go'. Stalling in any attitude other than nose high requires more flying skill from trainees. The instructor can get round a lack of it by providing more opportunities for practice, and not limiting them to the recovery only.

Most training gliders are sufficiently vice free, and their stall so innocuous, that it is difficult to convince trainees of just how

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hazardous an inadvertent stall can be. Demonstrating 'Stall in a turn' and 'Stall in a steep turn' in two-seater gliders like the K21, which lack sufficient elevator power, can prove an impossible task, as can teaching spinning. This doesn't detract from their value in providing familiarisation with the symptoms of an approaching stall, but it does limit their usefulness in the teaching of certain exercises.

Stalls with a wing drop

When one wing reaches the critical angle just before the other, an asymmetric stall occurs and a wing will drop. Normal stall recovery action will prevent the wing dropping any further, and as soon as it has started to take effect, the wings may be levelled with coordinated aileron and rudder. Positive use of the elevator gets the wing flying again very quickly and arrests any tendency for a wing to drop.

Yaw in the direction of the downgoing wing can be prevented, or merely delayed, by using the rudder, but it is still the case that inappropriate use of the controls caused the inadvertent stall in the first place. Do not attempt to use the secondary effect of rudder to restore the wings to the level position. This will introduce yaw which can result in the glider entering a spin, often quite suddenly. The priority must be to unstall the glider by moving the stick forward.

Miscellaneous

As modern gliders approach the stall any variations in airflow noise may be very subtle, but the fact that they occur should be mentioned.

It is important that even if an overzealous trainee moves the stick fully forward, you can still reach it. Reduced G combined with loose straps might leave you unable to take control.

[See chapter 30 for related early stalling exercises patter].

FURTHER STALLING EXERCISES

These exercises are intended to augment the trainee's understanding of the glider's handling at or near the stall. The list isn't exhaustive.

During initial training the trainee will have formed basic ideas about how gliders behave, and inevitably linked particular physical sensations with specific aspects or stages of flight. Unfortunately, when manoeuvring close to the stall, some of these links can mislead the trainee, or not be there at all, resulting in mental confusion and/or a dangerous situation. The purpose of the exercises is to arm the trainee against the unexpected by demonstrating some of the less useful and less obvious characteristics of glider behaviour at the most used lower end of the flight envelope.

When to teach

Some of the exercises result in attitudes which may alarm trainees or produce disconcerting sensations. A few of the exercises are in the 'calibrated frights' category, intended to impress upon trainees the dangers that can arise from mishandling the controls. The emphasis here is on 'calibrated' - not a good idea for the instructor to scare the wits out of himself as well - and it is important that instructors choose the correct moment in training to demonstrate such exercises.

With one exception, never demonstrate them before the trainee is fairly confident in both stalling and recovering the glider from basic and steeper stalls, including those with wing drop. The exception is the exercise showing that the sensation of reduced G is NOT a reliable stall symptom. If at any stage of a trainee's stall recovery training, they over-control - creating reduced G - the instructor should take the opportunity to give the appropriate demonstration before any wrong ideas are formed ie., to emphasise what caused the sensation, and the implications of confusing it with other, similar sensations.

As a rule, these exercises should be introduced during the latter part of pre-solo training, but no later than the early solo phase. Repeat them again at the Bronze C stage. They also form the basis of an excellent cure for any bad habits revealed during check flights, and allow the instructor to impress upon the pilot the need for their elimination. It is not a good idea to demonstrate all of them in one session, or even in consecutive flights. They are probably best fitted in among other exercise practice sessions.

At first, all these exercises should be demonstrated with the trainee's hands and feet **off** the controls. Only invite the trainee follow through when he knows what to expect, and you're sure he's not going to react badly.

Considerable height can be lost during some of these exercises.

NOTE: Most of the exercises in this manual have no recommended patter. In the following exercises, patter (as in all the other chapters) is in italics to distinguish between the few key things that should be said, and tips on how to fly the exercise. If a demonstration fails to work or is unconvincing, then you should say *I'm sorry, that didn't work, I'll do it again*.

Exercise No 1 - DIFFERENCES BETWEEN STALLING & REDUCED G

There have been a number of fatal accidents where gliders have dived steeply, sometimes past the vertical, into the ground. No technical problems seem to have been involved, so it is impossible to say exactly why they occurred. But, given the circumstances surrounding some of them, there is a strong possibility that the pilots confused the sinking sensation due to reduced G with the stall and/or became disorientated.

This demonstration aims to:

- determine if the trainee is critically/excessively sensitive to reduced G
- show the trainee that a sinking sensation is an unreliable symptom of the stall
- demonstrate the differences between stalling and reduced G.

The optional extension to the exercise aims to demonstrate:

- how quickly the glider will go into a steep dive if inappropriate stall recovery action is taken
- how disorientating reduced G can be.

BRIEFING POINTS

As with many of the stalling and spinning exercises, a what if scenario often helps to bring home to trainees the points you are trying to make. It is important that there is no confusion in their minds over the differences between being stalled and experiencing reduced G.

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A possible situation

Say that for some reason - a severe gust or a sudden forward movement on the stick - the pilot experiences the sensation of reduced G. If he is oversensitive to, or has not experienced it before, he may feel that the glider is falling away from him and deduce from this that it must be stalled, when it is in fact flying away from him and it is he who is falling. Having got the wrong end of the stick, so to speak, the trainee will:

- take the stall recovery action and
- move the stick forward, increasing the sensation of reduced G
- which will increase his belief that the glider is stalled.

It is hard to believe that under normal circumstances a pilot would continue to keep pushing long enough for the glider to enter a vertical dive, or even inverted flight, but both have happened. After the sensation has reached a certain level specific to that pilot, panic and disorientation may set in. Unable to work out what's really happening, the pilot then becomes unable to recover from the situation.

Sensitivity to reduced G

Most people only ever experience reduced or zero G when they fall over. The normal reaction is to protect the head by throwing the arms forward and tilting the head back, away from the impending impact. This may be accompanied by a sense of panic. It is also completely automatic, which may account for the way in which over-sensitive people react to reduced G. There have been accidents in two seaters where a low level launch failure produced enough reduced G to panic an over-sensitive trainee into pushing forward on the stick so hard that the instructor was unable to take over.

In the rare event that a trainee seems over-sensitive to reduced G, inform the CFI. Affected pilots who want to persevere with flying can sometimes be helped - basically de-sensitised - by practising dozens of reduced G exercises.

The Flying

Complete the HASSLL checks:

- say that you are *First going to stall the glider as a reminder of the stall*
- dive to 55-60kt
- pull up into a moderate (30°) climb.

When stalled:

- *Notice the sensation, low airspeed and ineffective elevator*
- *We are stalled*
- *Stick forward to recover*
- *Now we will look at reduced G*
- dive the glider to 55-60kt and then pull up into a moderate (30°) climb (as before)
- about 5kt above the stall, push over to create the same sensation as in the stall
- *Notice the same sensation, but this time the elevator is effective and airspeed OK*
- *We are not stalled*
- *Stick back to recover*
- *The sensation of reduced G sensation is an unreliable symptom of the stall.*

Exercise No 2 - LACK OF EFFECT OF ELEVATOR AT THE STALL

This particular exercise is designed to impress upon the pilot that if the wing is stalled, the elevator won't raise the nose or stop it from dropping until stall recovery action has been taken.

Flying a glider comprises a series of routines, some of which are used more or less continuously. They may have been learned very early in training and have become habitual ie., unconscious. For example, when we want to reduce the speed we raise the nose by moving the stick back. Similarly, if the nose starts to go down we move the stick back to try and raise it again.

There are good reasons why habits form a major part of our reactions (we wouldn't be able to cope otherwise), and under pressure it's normal to revert to previously learned patterns, to habit, even if the response is completely inappropriate! For example, if the nose drops because the glider has stalled, the 'normal' reaction - using the elevator to raise the nose - will actually make the situation worse.

The 'stick back' response is reinforced by the fact that when pilots learn to fly, one of the first and most basic things they learn is the normal effect of elevator, just as a car driver is taught that the brake pedal is used to stop the car. There's nothing wrong with this, but the car's brakes won't stop the car on ice any more than the elevator will raise the nose at the stall. If the stall is unexpected the pilot is very likely to revert to 'first principles' reactions, and pull harder on the stick in much the same way that in an emergency a car driver will automatically push harder on the brake pedal.

BRIEFING POINTS

☑ Explain that there have been a number of accidents and incidents in which the glider has hit the ground at a high rate of descent - either straight or turning - and the pilots, sometimes very experienced, were convinced that the elevator had become disconnected. In fact, the elevator was connected, but because the glider was stalled the nose couldn't be raised by pulling back on the stick. Had the pilot(s) recognised the symptoms of an approaching stall, and taken the correct recovery action, the accident(s) wouldn't have occurred.

☑ The exercise is to show that the elevator is completely ineffective at raising the nose or preventing it dropping at the stall.

The Flying

Complete the HASSLL checks:

- for greatest emphasis, give this demo at about 700'
- explain that you are going to show how ineffective the elevator is at the stall, and that for this first demonstration, at least, you DON'T want the trainee to follow through on the controls
- dive the glider to 55-60kt. Pull up into a steepish climb and wait for the stall
- as the nose drops, move the stick fully back and knock it against the back stop two or three times

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- No *matter how hard I pull back on the stick I cannot raise the nose*
- *The elevator is ineffective*
- *I must move the stick forward to unstall the glider before I try to raise the nose*
- move the stick forward and recover.

DE-BRIEFING

Point out that the dive and climb were only to set up a stall. Review the practical situations in which the stall might occur eg. failed launch, wind gradient, turbulence, pilot disorientation, pilot inattention etc. The key point is that if the pilot is ever in a situation where **the elevator won't raise the nose or prevent it dropping**, then he should take stall recovery action.

ADVICE TO INSTRUCTORS

The exercise must be demonstrated in a way which makes the principle very clear; it has to be remembered for any occasion where the pilot's workload may be high. The recovery action must not be overridden by the normal reaction of pulling the stick back to raise the nose. To increase this emphasis it is recommended that the height for the demonstration is approximately 700'.

In early demonstrations of stalling there may be a tendency to emphasise aileron ineffectiveness, which is why this demonstration is important.

Exercise No 3 - HIGH SPEED STALL

It is important for trainees to understand that the glider can stall at any speed. For instance, a stall may occur at a speed higher than the normal wings level stalling speed if the glider is turning, or the airbrakes are out, or the wings are contaminated with rain or ice, or the glider is being 'loaded' as in a wire launch, or during any manoeuvre where G increases.

The purpose of the demonstration is to show that:

- the stalling speed is G related
- the high speed G related stall may be more dramatic than the 1G stall
- smooth stall-recovery technique is essential to avoid a pilot-induced secondary stall.

BRIEFING POINTS

☑ Review the factors which can cause the glider's stalling speed to increase, and establish the relationship between load factor and stalling speed.

The Flying

WARNING! If the speed is in excess of 55kt at the start of the pull-out, do not continue with the exercise. Recover normally and try again at a slower entry speed. If the exercise is performed with any yaw present then a high speed spin entry or flick roll will occur.

Complete the HASSLL check:

- *Follow through on the stick*
- dive to 55 - 60kt and pull up into a fairly steep climb
- *I am going to completely stall the glider*
- wait for the nose drop and ease the stick forward as in a normal stall recovery
- *If I recover from the stall normally .. but pull back too soon -*
- as soon as the glider stops pitching down, pull the stick to the back stop
- wait!
- *The glider buffets and stalls at a higher speed - notice the ASI reading*
- stick forward to recover, then smoothly back to normal flying attitude.

It is a good idea to precede this exercise by a 'calibration' stall; a normal unaccelerated stall which will establish the 1G buffet and stall speed. It's more of a reminder than anything else.

DE-BRIEFING

The effect of G on the stall speed. The glider's attitude at or below the normal flying attitude but the glider buffeting - attitude and angle of attack are not the same thing. The circumstances in which a high-speed stall may occur eg; the recovery dive after a spin, hurried completion of stall recovery and raising the nose too soon after cable break recovery. The need to recover gently or exercise smooth control whenever a pullout manoeuvre is required, especially near the ground.

ADVICE TO INSTRUCTORS

This exercise requires considerable skill. It's a useful demonstration, if you can make it work. The lack of elevator authority in some gliders (eg. AS-K21 and Twin Astir) makes it almost impossible.

The demonstration should see the glider in an attitude below the normal gliding attitude, stalled and buffeting, and with about 50kt indicated airspeed (although this can't be sustained indefinitely).

Exercise No 4 - STALLING SPEED INCREASES IN A TURN

A glider can stall while turning for the same reasons that a wings level stall can occur at a higher than normal speed. The purpose of this demonstration is to reinforce the message that the stalling speed is a) not fixed, and b) is independent of attitude. It also demonstrates that the increase in the stalling speed with bank is not linear. For example, doing the demonstration several times with angles of bank of say, 20°, 40° and 60°, will show that the increase in the stalling speed for 20° of bank is markedly less than it is for 60°.

BRIEFING POINTS

Brief as for the High Speed Stall, but once again a 'calibration' unaccelerated stall is an essential lead-in.

The Flying

Complete the HASSLL check:

- enter a turn of about 20° of bank at normal speed
- maintain balanced flight (not skidding or slipping) and a constant angle of bank

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- gradually slow to the stall buffet whilst maintaining constant bank and balanced flight
- *Tell me at what speed the glider buffets*
- the glider buffets but with little or no tendency for the nose to rise. Some gliders may drop a wing at this point. Assuming that this does not happen -
- *We can feel the buffet at this higher speed. By relaxing forwards on the stick -*
- relax the back pressure
- *- the glider recovers*.

Repeat the exercise several times using different angles of bank, but in increments which are obviously different, say 20°, 40° and 60°, as suggested earlier. Draw the trainee's attention to the different speeds at which buffet occurs. As a further exploration, if time allows, maintain a constant angle of bank and change the initial speed. For any given angle the buffet speed will remain the same, reinforcing the message that G and AoA are the critical factors. Additionally, the effectiveness of the controls will change for the worse as the initial speed decreases, reinforcing awareness of the symptoms of an approaching stall.

AS-K13		
Bank angle	**Load factor (G)**	**Stalling speed (kt)**
0°	1	36
20°	1.06	37
40°	1.31	41
60°	2	51

The table above represents the stalling speeds for a typical two-seater glider at various angles of bank.

It is important to coordinate the controls properly during this exercise otherwise it can quickly turn into a the 'Spin off a steep or thermal turn'.

DE-BRIEFING

The higher the angle of bank, the greater the G and the higher the stalling speed. The stalling speed does not increase linearly with angle of bank.

COMMON DIFFICULTIES

HASSLL check. Uncertainty about how much of the HASSLL check is required, and the appropriate areas of lookout. These depend on the exact nature of the stalling exercise, and the degree of certainty about the outcome (ie., height likely to be lost).

Failure to Stall. If you ask the trainee to show you a stall and recovery he will often begin by raising the nose, but fail to continue moving the stick back to maintain the attitude. As the speed reduces the gliders' natural pitch stability gently lowers the nose, often helped by the trainee making a small forward movement of the stick, and soon the speed increases again. The glider has NOT stalled even though the speed may have become very low. This may indicate that the trainee:

- doesn't appreciate that it isn't the initial attitude that causes the stall, and so doesn't attempt to raise the nose or prevent it dropping with back pressure on the stick
- hasn't developed the habit of a brisk recovery action
- is unhappy about 'stalling', possibly because of sensitivity to reduced G.

Failure to stall and recover in the way you expect. This may be due to your failure to make clear exactly what type of stall entry you wanted, and the point at which recovery action should be taken.

Recovery from the dive can often be:

- too soon, before the glider has accelerated to a safe speed
- too late, resulting in a greater loss of height and excessive speed
- too abrupt, bringing the risk of another and more dramatic stall.

Converting power pilots

Power pilots are apt to push the stick to the front stop for stall recovery. This is rarely necessary in gliders, but a good pre-flight brief and your full attention during the exercises is required.

NOTE: The following is an uncommon difficulty, but watch out!

Occasionally a trainee may react with panic to an alarming change of attitude, or to reduced G. In rare cases they may freeze on the controls. Instructors should make sure that trainees are never flying the glider - or even following through - in any situation which they haven't previously experienced with their hands clear of the controls.

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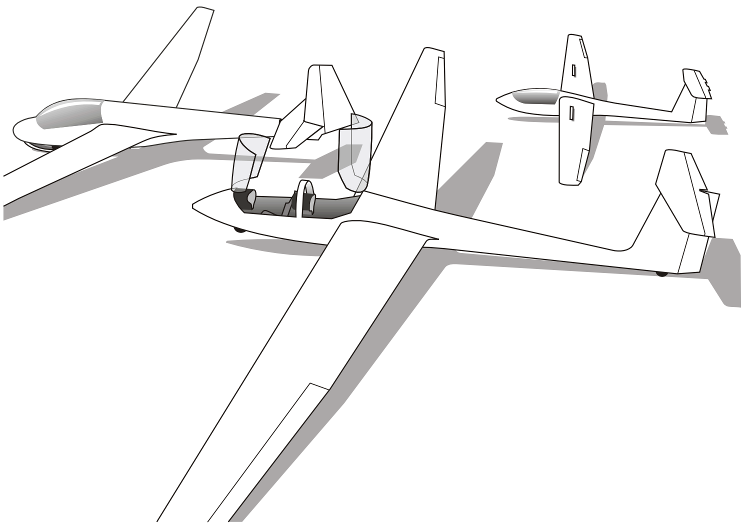

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