The Honourable Company of Air Pilots

UNUSUAL ATTITUDE AND SPIN RECOGNITION AND RECOVERY TRAINING

A GUIDE FOR INSTRUCTORS

UNUSUAL ATTITUDE AND SPIN RECOGNITION AND RECOVERY TRAINING

Let he who loses his airspeed beware, lest the ground rise and smite him!
Gospel according to Captain Frank Morgan

WARNING

The Aircraft Flight Manuals outline the entry information on intentional spins and the correct spin recovery of that aircraft type. Whilst this document contains best practice the Aircraft Flight manuals for the particular aircraft type are the overriding document and pilots must to ensure they are aware of the recommended spin entry and recovery technique for the aircraft they are currently flying. It goes without saying that a thorough check of loose articles is paramount, and superfluous articles should not be taken into the cockpit. Keys, coins, phones etc. should not be carried in unzipped pockets. When conducted properly upset prevention and spin training is perfectly safe, however it does not take any prisoners…

It is imperative to ascertain that the aircraft to be used for this exercise is certificated for and capable of performing these manoeuvres. Particular attention should be given to the weight & balance calculations, ensuring the Aerobatic or Utility (as appropriate) envelope is used. Sufficient height margins should be allowed at all stages of the exercise.

INTRODUCTION

Upset prevention and recovery is a fundamental part of a pilots training to give them the skills and confidence required to return the aircraft to a steady state when control of the aircraft's desired attitude is lost either through a poorly executed intentional manoeuvre, an external factor (e.g. turbulence) or following the recovery from an incipient spin.

Recovery from the incipient spin is part of the Private Pilot training course. It is, therefore important that most of the student's training in this exercise is focused towards his/her ability to recognise and recover at the incipient stage.

Recovery from a fully developed spin is no longer required for the Private Pilot training Course. Instructors may wish to demonstrate recovery from a fully developed spin to their students should they wish. It is highly desirable that instructors maintain their proficiency in spinning.

When teaching upset prevention and spin training the <u>suggested</u> order would be:

1. Teach Unusual Attitude Recovery
2. Teach the full spin recognition and recovery
3. Teach the incipient spin recognition and recovery

In order to fully understand the intricacies of incipient spin recovery it is necessary to have a knowledge of the full spin, and indeed the full spin recovery actions need to be taken if recovery is ineffective at the incipient stage.

The aim of these exercises are to learn to recognise what is happening to the aircraft, and to use the correct technique recover the aircraft. This will result in the minimum height being lost, but **it must be**

emphasised that height will be lost during all the recoveries: a minimum height loss technique is not a zero height loss technique: height is traded for aircraft control.

THREAT & ERROR MANAGEMENT

For all the exercises a set of HASELL + (known as *hasell plus* checks) checks should be conducted. Consult the flight manual or any specific details such as fuel pump / selector configuration, and the recommended trim settings but consider the following elements in more detail than you may usually do: (When conducting a number of spins or UAs it is acceptable to abbreviate items that are unchanged, but **height must always be checked**). Do not play lip service to any of these checks, otherwise a safe recovery may be compromised!!

Height – Sufficient to perform the planned manoeuvre, plus sufficient height to affect the recovery to be fully recovered by base height – (i.e. the height you will never go below during the exercise - probably 3000' AGL). The flight manual should give height loss per turn during spinning, but a typical training aircraft uses 500ft per turn plus a further 2000ft margin for recovery, so a 3 turn spin should be entered not below:

(3 x 500ft) (planned manoeuvre height loss)
+
2000ft (recovery margin)
+
3000 (base height)

= 7500ft AGL

This is an example calculation. Flight Manual data should take primacy, but remember the calculated heights are minimums; it is prudent to add an additional margin.

For incipient spinning exercises calculate for a 1 turn spin

For UA recovery exercises allow 2000 feet above base height

If a parachute is worn a suitable minimum abandoning height should be briefed – typically 3000 ft. AGL. Below this height, if still spinning, the aircraft must be abandoned.

Airframe – Flaps up, trim set neutral or for cruise speed (unless Flight Manual dictates otherwise)

Security – Remove or secure all loose articles, including pens, fuel samplers, charts etc. Placing something in an unzipped pocket or doorless glove box is **not** secure. Have a thorough search for loose objects before flight.

Engine – Be aware of any specified fuel tank / pump selections, and mixture / RPM settings. Ensure temperatures and pressures are within limits. Some aircraft have a limitation on fuel quantity or maximum imbalance between tanks

Location – A good clear area away from, active airfields, built up areas, controlled airspace, and clouds and Danger Areas (Use the mnemonic ABCD). A lot of height will be lost. Avoid areas of high traffic density.

Lookout – Paramount! An aircraft several thousand feet below will be a threat in this exercise. Perform at least 360 degrees of lookout turn.

The **+** (plus) elements cover additional considerations for full and incipient spinning.

-Good horizons throughout the entire height range

-No icing present or misting on the canopy

-Not over a monochromatic surface such as 8/8 cloud or a glassy sea (this allows you to tell when rotation has stopped)

-Commander's brief, to include who will perform the entry and recovery, delayed recovery actions, method of taking control if the intercom fails (place arm across student's chest, and SHOUT), plus a parachute brief if worn.

This brief can be conducted on the ground or before a series of spins, but as a minimum brief who will enter, who will recover, and at what point recovery will be initiated.

UNUSUAL ATTITUDE (UA) DEFINITION

A UA is simply an attitude the aircraft adopts that was not selected or desired by the pilot. It can occur as a result of mishandling an intentionally flown manoeuvre, from an external factor such as turbulence, or result from the incipient or full spin recovery drill. For this reason, UA recoveries should be taught and practiced before full or incipient spinning is taught.

UNUSUAL ATTITUDE (UA) RECOVERY

Recovery from an incipient spin will frequently result in the aircraft ending up in a UA, and indeed entry to a UA may be a precursor to the aircraft entering a full or incipient spin, so UA recovery needs to be taught first. Note that the UA recovery should not be used if buffet or undemanded roll is present – this would require Incipient Spin Recovery.

UA RECOVERY WITH NOSE NEAR OR ABOVE THE HORIZON

1. Apply full power
2. Roll wings level then pitch to straight & level flight
3. Set cruise power once the aircraft is S&L and at a sensible speed (i.e. around normal cruise speed).

RECOVERY WITH NOSE WELL BELOW THE HORIZON

1. Close the throttle
2. Roll wings level then pitch to straight & level flight
3. Set cruise power once the aircraft is S&L and at a sensible speed.

Note 1: ‘Near’ and ‘Well Below’ are subjective terms depending how quickly your particular aircraft picks up speed in a dive. As a guideline ‘Well Below’ could be considered any attitude steeper than the normal approach attitude

Note 2: A sensible speed may be considered to be the at or slightly below the normal cruise speed, and below Va.

RECOVERY WITH THE AIRCRAFT BEYOND 90° ANGLE OF BANK

Recovery from an incipient spin may well result in the aircraft ending up beyond 90° angle of bank, even to the extent of being completely inverted. The nose is also likely to be below the horizon with the speed building rapidly. It is vital that the temptation to ‘pull through’ to straight and level flight is resisted. Such action is likely to lead to a massive height loss, exceedance of Vne, exceedance of G limits and potential in flight structural failure.

The correct technique is:

1. Close the throttle
2. Roll the aircraft in the shortest direction to a wings level attitude (if you get confused about which way to roll, just roll in any direction. The end result will be quicker than if you spend time trying to work it out). Do not apply any pull force on the elevators whilst rolling, it can reduce the roll rate and also pull the nose further below the horizon. Use the mantra “unload for control”
3. Gently ease out of the dive respecting G limits
4. Set cruise power once the aircraft is S&L and at a sensible speed.

In all cases be aware of Va (maximum manoeuvre speed), and ensure full aileron deflection is not applied above this speed. Furthermore, do not be tempted to pull more than the G limit to minimise height loss. The risk of structural failure is usually higher than that of hitting the ground.

However, in extremis, if the exercise has gone badly wrong and Vne is likely to be exceeded it is preferable to pull more than the permitted G to keep the speed within limits, as airframes are more structurally tolerant to over-G than over – speed situations. It should be emphasised that this is a lifesaving measure and will result in the aircraft requiring a costly inspection. Your role as an instructor is to ensure the aeroplane stays within its flight envelope at all times.

Note: During aerobatic training in high performance, dedicated aerobatic aeroplanes it is sometimes taught to push up to the horizon if inverted. This is not an appropriate technique for this level of flying training as most aircraft types are not suited to pushing negative G either in terms of structural strength, control response or seat harness design, and furthermore negative G is extremely

physiologically uncomfortable to the uninitiated, and even if the aircraft were capable the pilot is unlikely to be able to pushing sufficiently hard for this technique to be effective.

The RAF Central Flying School teach the rolling to erect flight and then recovering from the dive technique, which is a good reason for us to do the same!

RECOVERY WITH THE AIRCRAFT IN THE VERTICAL OR NEAR VERTICAL

Note that not all aircraft types are capable of this: it is aimed primarily at organisations conducting training in aerobatic aeroplanes such as the T67 Firefly or similar.

The vertical can be defined as a nose up attitude (not necessarily 90 degrees nose up) with the airspeed below, or rapidly falling towards a speed below which the controls could not effect a recovery. For most light piston aeroplanes this would be approximately 60kt.

The vertical recovery technique is:

1. Leave the throttle alone
2. Centralise and brace the controls with both hands and firm foot pressure.
3. Allow the aircraft to fall into a nose low attitude and recover as per a UA with the nose well below the horizon. No attempt should be made to recover to S&L until the nose has stopped dropping otherwise there is a risk of entering a stall or spin.

Note: If you close the throttle with the nose in the vertical the engine may stop. The aircraft may also enter a tailslide, which is why it is vital to firmly brace the controls centrally with both hands and feet to prevent the control surfaces slamming to the stops.

NOTES ON TEACHING UAs

Begin with a thorough ground brief of the techniques, using a model. In the air, demonstrate a number of UAs as a warm up, and explain that the attitude doesn't need to be severe. Ensure the HASELL checks are completed.

Each specific UA should taught & practiced in turn

The FI sets up the UA then hands control to the student for recovery – the handover / takeover drills need to be very slick – consider setting up the UA with the student following through.

Be prepared to recover yourself if the student hesitates or an aircraft limit is approached. It is prudent not to use more than a midrange power setting when entering an academic UA. Always start at an appropriate speed to allow sufficient time for the student to recover safely, and in the case of the vertical UA avoid the true vertical to reduce the likelihood of a tailslide occurring.

DEFINITION OF A FULLY DEVELOPED SPIN

The definition of a full spin is a condition of stalled flight where the aircraft describes a spiral descent. During a spin the aircraft will be simultaneously rolling, yawing and pitching about a vertical spin axis during its descent and, when established in a full spin, the forces acting on it will be a balance between aerodynamic forces, inertia forces and gyroscopic effects.

A suitable sequence would be:

1st spin: Teach the spin entry, maintenance and external indications. FI recovers ‘silently’.

2nd spin: Student enters and maintains the spin. FI teaches the internal indications and recovery

3rd spin: Student practices entry, maintenance and recovery. (FI says when to recover – typically after 2-3 turns)

Note – do not press on with the exercise if the student feels unwell at any point. It is also a good idea to fly a demonstration spin if the student has not seen one before. This can be conducted on a previous sortie.

It may be useful, before the first airborne exercise, to ask the student to practice moving the control column / yoke fully back and forwards on the ground ensuring they do not inadvertently apply any aileron inputs.

SPIN ENTRY

Ensure the HASELL+ checks are completed.

The aircraft flight manual should be consulted for the correct entry technique. Some aircraft will require the power to be at idle, others need a small amount of power to be applied at entry. At the correct entry point prescribed in the flight manual smoothly apply full rudder in the direction you with to spin and simultaneously apply full up elevator. This is known as full pro-spin controls.

SPIN MAINTENANCE

Hold full pro-spin controls hard against the control stops

Monitor Height

EXTERNAL INDICATIONS

Nose low attitude (lots of ground visible – hardly any sky)

High rate of rotation

INTERNAL INDICATIONS

Speed low and fluctuating, but not increasing

Very high rate of descent

A turn needle or turn co-ordinator will indicate the direction of spin. (A turn co-ordinator will only indicate correctly in an erect spin.)

(Note: Increasing airspeed would indicate a spiral dive)

FULL SPIN RECOVERY

1. Check throttle fully closed
2. Check ailerons central
3. Check direction of rotation: which way is the world spinning or you know which way you entered the spin. If a turn indicator (turn needle) or Turn Coordinator is fitted, then this instrument can be relied upon to confirm the direction of the spin.
4. Apply full rudder in the opposite direction to rotation.
5. Move the control yoke / column forwards until the spin stops, keeping the ailerons neutral.
6. As soon as the spin stops centralize the rudder and recover from the ensuing UA

WARNING: This is a generic spin recovery technique, you must to check with each individual aircraft flight manual the exact technique applicable to your aircraft.

SPIRAL DIVE RECOVERY

A spiral dive can look similar to a spin in terms of nose down attitude, rotation, and large height loss but unlike a spin, airspeed and G force will be increasing. To recover:

1. Close the throttle
2. Rudder central
3. Level the wings with aileron
4. Ease out of the dive

(Spiral dive recovery should have been completed during the steep turns exercise, but it is a sound idea to revise it again during UA and Spin recovery training.)

DEFINITION OF AN INCIPIENT SPIN

The aerodynamic definition of incipient spin is that period between the beginning of an advanced stall and the aircraft entering the mature stage of a spin. The EASA definition of an incipient spin is as follows:

A transient flight condition in the post-stall regime where an initial, undemanded roll in excess of 45˚ has resulted from yaw asymmetry during a stall and which, if recovery action is not taken, will lead rapidly to a developing spin. Prompt recovery during this incipient spin stage will normally result in an overall heading change, from pre-stall conditions, of not more than 180˚.

It is important not to treat these as a ‘by numbers’ definition. A more pragmatic definition (used by the RAF Central Flying School) is when the aircraft is experiencing buffet and undemanded roll, or has completed less than one full turn of a spin. Remember the undemanded roll isn’t just the aircraft rolling with no aileron input: If you make an aileron input and the aircraft doesn’t respond at all, or the roll produced is less or more than expected, or in the wrong direction a state of undemanded roll exists.

RECOGNITION OF AN INCIPIENT SPIN

The incipient stage of the spin is that interval after the entry and just prior to the spin progressing to the developed stage. This could be anything from the positive “wing drop” at the stall, to the first 360° of roll in a spin. Remember also the previous definition of undemanded roll: the wings may not have

rolled at all, but all the ingredients for an incipient spin are there and the recovery actions below should be taken

RECOVERY FROM AN INCIPIENT SPIN

Before take off teach the student the flying controls central position (for all 3 controls). It must be emphasised that this position may not be the same as the zero force or trimmed position and must be learned through muscle memory and noting the position of the control column / yoke against the leg. The exact central position for the elevator can be determined by holding the elevators in line with the tailplane, or for an all-moving tail aircraft the position where the anti-balance tab is in line with the tailplane with the elevator trim set to neutral.

A good way for the student to practice this is to have them perform a full and free check (including the rudder, if the aircraft type allows) and then verbally prompt “centralise”. Repeat as many times as required to learn the correct position.

Prompt the candidate to visually centralise the flying control surfaces and note the position of the cockpit controls. This is the position required to achieve an incipient spin recovery and must be selected regardless of the trim forces. It must be emphasised that the central position is not the zero force position – in an incipient spin there will probably be some control force present.

To recover from the incipient spin:

1. Centralise the controls

Once the undemanded roll has ceased

2. Recover from the UA

Resist all temptation to use aileron or rudder to stop the wing dropping, it will only make things worse!

GUIDANCE ON ENTERING PRACTICE INCIPIENT SPINS

Ensure the HASELL + checks are completed before each incipient spin

The FI must be competent in setting up a practice incipient spin. There are 2 main methods:

1. Apply full pro-spin controls, as if you were entering a full spin, but centralise the controls as soon as the aircraft departs, and certainly before one full roll is complete. This is a useful and predictable method for teaching the ‘centralise’ recovery technique.

2. The second method to enter a practice incipient spin is from a steep, slightly nose high turn with cruise power set and gently pulling to the buffet. This is used to emphasise to the student that the aircraft can depart into a spin even without the application of full pro-spin controls – this is a key learning point for the student.

If a little rudder is fed in it should be possible to:

a) Apply aileron and have no roll develop. (Apply a little rudder in direction of turn and attempt to roll wings level)

b) Apply aileron and have the aircraft roll the wrong way (Apply coarse, but not full rudder in the direction of turn and make a coarse aileron input to attempt to roll wings level)

c) Apply aileron and have the aircraft roll more slowly or quickly than would be expected for the aileron input.

The comments in parentheses are suggested starting points to see which works best for your aeroplane. A little practice should determine which way your particular aircraft favours rolling, and therefore which direction to set up the turn.

The key point is that the student learns that it does not take the application of full pro-spin controls for a spin to occur. This technique requires a little more finesse from the instructor but can produce more realistic entry scenarios.

A final thought: There is a lot of material to be covered, but do not be tempted to cram too much into a single flight to the detriment of student learning and enjoyment.

This guide was produced jointly by the Flying Instructor's Working Group of the Honourable Company of Air Pilots and the Royal Air Force Central Flying School