# 13
# SPINS AND SPIRALS

## AIM

To teach the student how to recognize the onset of a spin or spiral dive and learn how to recover from these conditions of flight.

## INSTRUCTIONAL GUIDE

Students often approach this exercise with some apprehension. Instructors should attempt to remove this by explaining that there is no mystery about it, and later by demonstrating how easy it is to recover at any stage of the spin or spiral dive. Even so instructors should spread this exercise over a number of lessons rather than concentrate it in one long one.

Instruction and practice in the fully developed spin is not a mandatory exercise when the student is being taught to fly on most types of aeroplanes. However, whether the full spin is demonstrated or not, and even though a student may have experienced the incipient spin while practicing stalling, they must be given sufficient further instruction in the incipient spin stage in order to be fully familiar with the recognition and prevention of the spin before it develops fully.

The first demonstration of a spin or spiral dive is best done at the end of the lesson preceding that in which the exercise is to be dealt with in detail. Whilst no real instruction should be given during this demonstration the instructor should keep the student informed of what is going on. Talking in a normal relaxed manner during the manoeuvre will help greatly to keep the student relaxed.

During a rapid spin it is not unusual for students to become confused as to its direction. This does not normally happen when the aeroplane is deliberately placed in a spin, but in an unexpected spin impressions gained may be quite erroneous. Similarly many students will be convinced that they are spinning when the aeroplane is actually performing a spiral dive. For these reasons it is imperative that any impressions gained during these manoeuvres should be confirmed by the instruments.

The most important points are the confirmation of the direction of spin by the turn indicator, and confirmation by means of the airspeed indicator as to whether the aeroplane is actually in a spin or a spiral dive.

When the type of aeroplane in use permits spinning, the emphasis should first be placed on the fully developed spin. When the student has mastered the recovery from this condition, the emphasis should be placed on early recognition of the various conditions that can lead to a spin,and the clean recovery at the incipient stage. Deliberate spirals should be done only as a dual exercise. Instructors must ensure that the aeroplane being used for training is suitable for the demonstration of the spiral dive. The main consideration is the structural limitations imposed on the particular type of aeroplane. In this manoeuvre the airspeed builds up so rapidly that it is possible to overstress the aeroplane with poor recovery technique. For these reasons it is imperative that the instructor be completely familiar with the aeroplane's performance in this manoeuvre before attempting to demonstrate it.

When carrying out these exercises it is essential that a check be carried out to ensure that it is safe to do so, i.e. check for traffic below.

The aeroplane must be clear of inhabited areas and normally in an area designated for the practice of such exercises. In addition it should be at a height sufficient to ensure recovery by 3,000FT above ground level. The pre-spinning check will vary from aeroplane to aeroplane but will normally be similar to that used as a pre-stalling check in that particular aeroplane. In most aeroplanes flaps and undercarriage must be retracted during both the spin and spiral. The attitude indicator should be caged (if possible) during spinning, though it is usually preferable to leave it un-caged whilst practicing a spiral dive in order to impress on the student their indications during this manoeuvre. In all cases a 360° turn to ensure that all is clear around and below should be carried out immediately prior to commencing each exercise.

# PRE-FLIGHT BRIEFING CONSIDERATIONS

## CAUSES OF A SPIN

A spin is a condition of stalled flight in which the aeroplane describes a spiral descent. During a spin it is simultaneously rolling, pitching and yawing, its movement being usually automatic until recovery is initiated by the pilot.

It must be made quite clear to the student that a spin is not a normal condition of flight. The wings are stalled and the aeroplane does not react to the controls in the usual way. The airspeed is relatively low and does not increase until recovery action is initiated. An aeroplane is made to spin, whether accidentally or deliberately, by faulty use of the controls particularly the rudder.

Ensure that the student has absorbed the stalling demonstrations to such an extent that he or she quite clearly understands the forces acting at the stall and particularly autorotation.

## DEVELOPMENT OF A SPIN

Brief the student on the development of the spin as applicable to the type of aeroplane being used. Generally aeroplanes do not go directly from the stall into a spin, but there is usually a transition period which may vary considerably from aeroplane to aeroplane. When a wing drops at or near the point of stall the aeroplane's nose begins to yaw towards the lower wing tip, and as the angle of bank increases the nose will drop below the horizon. If no preventative action is taken the nose will continue to drop, sometimes sharply, the rate of rotation will increase and the spin will develop fully.

## CHARACTERISTICS OF A SPIN

The student should be briefed on what to expect from the particular aeroplane during the spin. Generally there is a steep attitude, autorotation is maintained continuously, buffeting is usually evident and the airspeed remains almost constant at a low figure. The aeroplane may pitch regularly. If it does, the rate of rotation normally decreases as the nose comes up in relation to the horizon and increases as the nose sinks.

The effect of the position of the Centre of Gravity (CG) must be pointed out to the student if movement of this position within the limits laid down has a great effect on the spinning characteristics of the aeroplane. Normally a forward CG results in a steeper spin with a high rate of descent. A forward CG makes recovery much easier and may even prevent a spin altogether, resulting in a spiral dive. An aft CG tends to flatten the attitude resulting in a lower rate of descent. The recovery action to be taken when an aeroplane is spinning in a fl at attitude is the same as the normal recovery technique with respect to the actual control movements. However, in the flat spin case it is essential to ensure that full control movement is applied in the recovery action and that this is maintained if necessary, for a much longer period than normal. In some aeroplanes it takes many turns to recover from a flat spin.

## APPLICATION IN FLIGHT

Brief the student on the manner in which you intend to demonstrate the spin and recovery. Explain the sequence of events e.g. pre-spinning check, approach to stall, use of controls to initiate spin and during spin and actions to recover from the spin.

Ensure that the student understands that once the aeroplane has entered the spin, recovery involves very positive use of the controls. The rudder is applied to its full extent to reduce yaw and after a brief pause the elevator is moved forward progressively until the spin stops. Full rudder must be maintained throughout the process of recovery. The increase in rotation speed is an indicator that the recovery process is working. The rudder must be centralized promptly as soon as the spinning stops and wings levelled with aileron, then easing gently out of the resulting dive. The student must be told that if a spin is entered with power on, the throttle must be closed immediately. Power should not be increased until a recovery has been effected and the nose of the aeroplane is at least level with the horizon.

It is important to emphasize that sufficient time must be allowed for the recovery action to take effect and this is particularly important where the spin has become flat. Aeroplanes which are difficult to recover from a spin are not used for civil flying training, and therefore a student should not be worried at an early stage by being briefed on the actions to be used if the aeroplane continues to spin in spite of normal recovery action. However, when the student is quite confident in spin recoveries, brief on these emergency recovery procedures.The student must understand that to recover from a spin the yaw must be reduced and the aeroplane somehow placed into a steep nose-down attitude. In all cases full opposite rudder must be maintained whilst carrying out the following supplementary action:

(i) Pull the control column fully back, hold it there for five seconds then push it fully forward

(ii) Push the control column sharply forward, pause a second, fully back, pause a second then fully forward and so on. When power is available the throttle should be opened as the control column is moved forward and closed as it is moved back. The object is to induce a rocking motion until a steep nose-down attitude, which will un-stall the wings, has been achieved

(iii) The effect of the ailerons will vary between aeroplanes. Putting the control column (or control wheel) in the forward corner (i.e. in-spin aileron) opposite to the rudder will probably have the best effect

(iv) As a last resort lower flaps.

## RECOVERY AT THE INCIPIENT SPIN STAGE

Brief the student that you will be demonstrating the entry to the spin in the normal manner. Point out that before the spin develops fully you will be recovering by ensuring the throttle is closed and the controls are centralised followed by recovery from the ensuing unusual attitude.

## CAUSES OF A SPIRAL DIVE

A spiral dive is a condition of flight during which the aeroplane is performing a steep turn with an excessive nose-down attitude coupled with a very rapid build up in airspeed. Any attempt to reduce speed by raising the nose with the elevators will only result in tightening and aggravating the spiral, causing excessive loading on both the airframe and pilot.

The spiral dive is frequently caused by a poorly executed spin entry. For this reason it is imperative that the differences between the spin and spiral be emphasized. Another common cause of the spiral dive is that during the early attempts at instrument flying the student frequently fails to maintain a turn or directional control within safe limits.

For this reason the student must be thoroughly briefed on the instrument indications to be anticipated during the exercise.

## APPLICATION IN FLIGHT

Brief the student on the technique you will be using to enter the spiral dive and the use of the controls during the recovery. Emphasize that prompt recognition of the condition is essential as the speed will build up very rapidly and will, if not checked, exceed the maximum permissible.

## AIRMANSHIP

An unintentional spin or spiral dive should never occur.

When intentional spins or spirals are practiced, a safety check should always be carried out and a good lookout maintained during the whole exercise.

During these manoeuvres great care must be exercised in the use of controls. No harsh movements should be made, especially when high speeds are involved, as the structural limitations of some aeroplanes.

Prior to flight it is essential to check that the student can input full rudder and elevator travel with the safety harness fully tightened.

## AIR EXERCISE

(a) The student's first spin

(b) Spin from level flight and recovery

(c) Recovery from the incipient stage

(d) Spins from descending turns

(e) Recovery from spiral dive

## THE STUDENT'S FIRST SPIN

Carry out the pre-spinning checks, allowing the student to participate. Prior to the actual entry remind the student that in this particular aeroplane type the spin is just another condition of flight. Make the entry as smooth as possible and do not allow the aeroplane to rotate for more than two complete turns. Whilst not giving any specific instruction, point out the direction of rotation in the spin and subsequently the ease of recovery.

## SPIN FROM LEVEL FLIGHT AND RECOVERY

Carry out the checks before spinning. Demonstrate the spin in both directions with the engine idling. Commence the manoeuvre as for a practice stall but just before the point of stall smoothly apply full rudder in the direction in which it is desired to spin, simultaneously moving the control column fully back. During the spin hold on full rudder and keep the control fully back. Point out the attitude, the direction of rotation and the indications of the instruments, particularly the turn indicator, airspeed indicator and altimeter.

Whilst entering and during the spin the ailerons should normally be held neutral though on some aeroplanes out-spin aileron (i.e. control column to the left during a spin to the right) may be used to advantage. In a few aeroplanes in-spin aileron may be applied to advantage in entering and maintaining the spin.

To recover, first ensure that the throttle is closed,, ailerons neutral and the direction of turn identified. This is followed by application of full opposite rudder. After a brief pause ease the control column forward progressively until the spinning stops. Centralize the rudder and ease gently out of the resulting steep dive, levelling the wings. Stress that the use of power before the nose is on or above the horizon will only result in an increased loss of height.

Point out the large height loss.

## RECOVERY FROM THE INCIPIENT STAGE

Carry out the pre-spinning checks. From a straight glide use the controls as for the entry to a fully developed spin. As soon as the aeroplane has stalled and commenced to yaw take the appropriate recovery action. Increase power, apply sufficient rudder to prevent further yaw and ease the control column forward sufficiently to un-stall the aeroplane. Point out that if power is to materially assist recovery action it must be applied before the nose of the aeroplane has pitched too far below the horizon otherwise its use will only increase the loss of height.

## SPINS FROM DESCENDING TURNS

Carry out the pre-spinning checks. From a gliding turn at low speed apply excessive rudder in the direction of turn, prevent any increase in bank with the ailerons and move the control column back to maintain the nose position until rotation commences. Take normal recovery action.

Emphasize the danger of misusing the controls and allowing the speed to reduce during a gliding turn, pointing out that a gliding turn is frequently carried out near the ground.

Some aeroplanes will not spin readily as a result of such manoeuvres. When teaching a student on these types the instructor should use discretion in deciding whether or not to demonstrate this exercise, as it has to be convincing to be of value.

## RECOVERY FROM SPIRAL DIVE

Complete checks before spiralling. Commence the spiral demonstration without power at a low speed. Initiate the spiral dive much the same as a spin entry but do not apply full rudder or move the control column fully back. In some aeroplanes it is also advantageous to roll the aeroplane towards the required direction of the spiral. Allow the nose to get well below the horizon with the speed increasing then move the control column back. Point out that the spiral tightens as the control column is moved back, that the airspeed is increasing rapidly and the angle of bank is increasing. Point out the indications of the instruments, particularly ASI, altimeter, turn needle and attitude as shown by the attitude indicator if this has not toppled.

To recover, stress the necessity of first ensuring the throttle is closed then levelling the wings, and then ease out of the subsequent dive. Remind the student that any attempt to recover without first levelling the wings will only tighten the spiral and increase both forward and vertical speed.

Extreme care must be taken when allowing the student to practice this manoeuvre to ensure that speed and loading limitations are not exceeded. Rolling 'G' can easily damage an aeroplane.

## COMMON FAULTS

Many students forget to close the throttle after entering a spin or spiral dive from a flight condition in which power was being used. This error must be corrected as the height loss will be increased markedly.

Students often attempt to identify the behavior of the aeroplane from the position of the controls. This is not a reliable indication. The spin or spiral must be identifi ed from:

(i) The flight conditions immediately prior to spin or spiral, i.e. proximity to the stall or high speed, and appropriate attitude

(ii) The high rate of descent, high rate of turn, and airspeed either building up or remaining steady at a low figure.

In the initial attempts at spin recovery many students fail to centralize the rudder when the rotation stops. This may result in an aeroplane attempting to spin or spiral dive in the opposite direction. Others fail to move the control column forward sufficiently or are not smooth with this movement. Watch for and correct these points.