

EAGLE FLIGHT TRAINING

LIMITED



Aerobatic Flight

Intro to Spinning

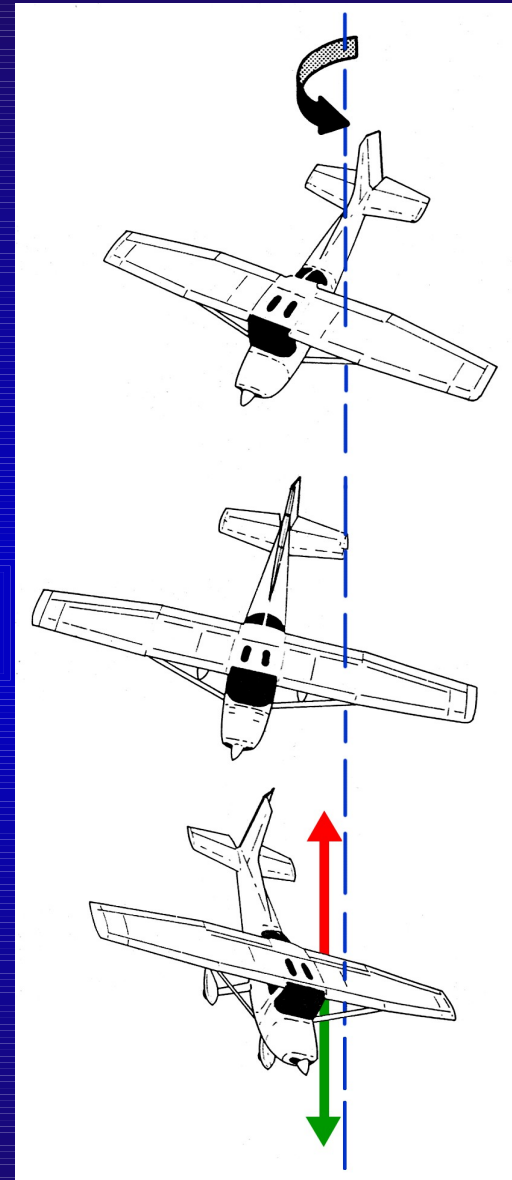
Objective

- ◆ To become accustomed to spinning and recognise and recover from the incipient and fully developed spin with minimum height loss.

Considerations

What is a Spin?

- ◆ A condition of stalled flight where the aircraft is descending along a helical path auto yawing, rolling and pitching



Considerations (cont)

Autorotation is the Basis of a Spin

- ◆ Results from differing angles of attack between the wings when they are operating at or beyond the critical angle
- ◆ Auto roll due to less lift produced by the stalled wing with the greatest angle of attack
- ◆ Auto yaw (in direction of roll) due to the greater drag produced by the stalled wing with the greatest angle of attack
- ◆ Roll → yaw → roll → yaw...= autorotation

Considerations (cont)

Characteristics of a Developed Spin include:

- ◆ Low IAS (which should not increase until recovery is initiated)
- ◆ And a high rate of descent

Causes of the Spin

One Wing Stalling First

- ◆ Pilots actions – aerobatics / out of balance
- ◆ Wind gusts – Changes A of A
- ◆ Ice/Damage – Encourages separation
- ◆ Weight imbalance
- ◆ Aerofoil – Rigging of angle of incidence
- ◆ Flap – different angles
- ◆ Power – Prop-wash changing A of A

Considerations (cont)

Why Practice?

- ◆ To recognise the signs of an approaching spin and practice the best recovery technique to minimise height loss in the event of an inadvertent spin

Inadvertent Spin whilst Stalling

- ◆ One wing stalls before the other
- ◆ Use of aileron near / at the stall
- ◆ Out of balance near / at the stall
- ◆ Power / slipstream
- ◆ Flaps
- ◆ Climbing and descending turns

Principles of Flight

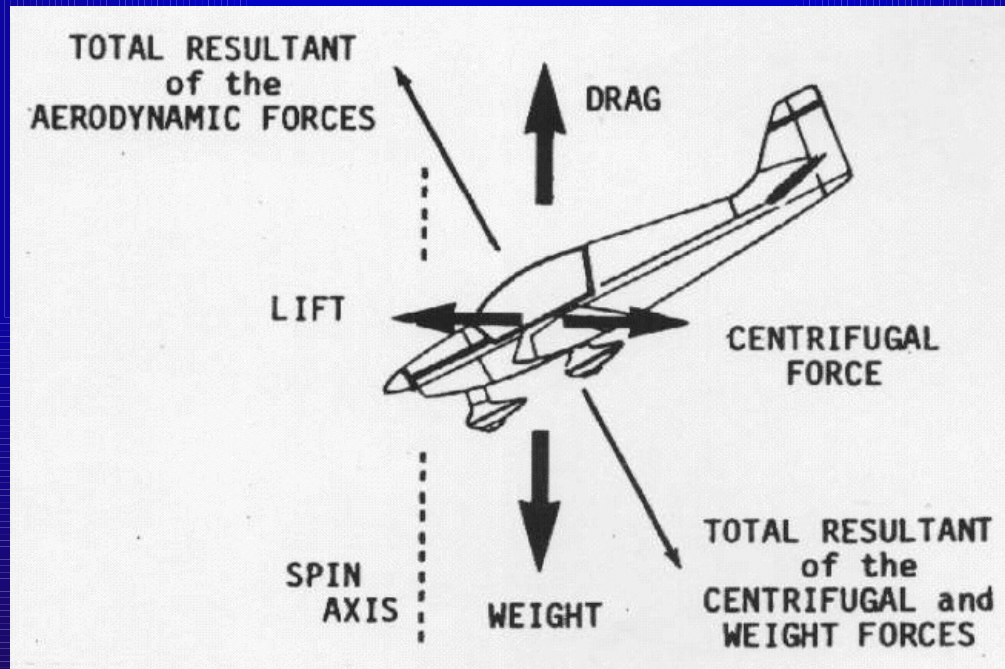
The Three Stages of the Spin

- ◆ The Incipient Spin (the beginning stage where auto roll and yaw occurs)
- ◆ The Fully developed Spin (where the aeroplane has settled into a state of auto roll, yaw and pitch)
- ◆ The Recovery from a Spin (initiated by the pilot who opposes the yaw with rudder and unstalls the wings with forward control column)

Principles of Flight (cont)

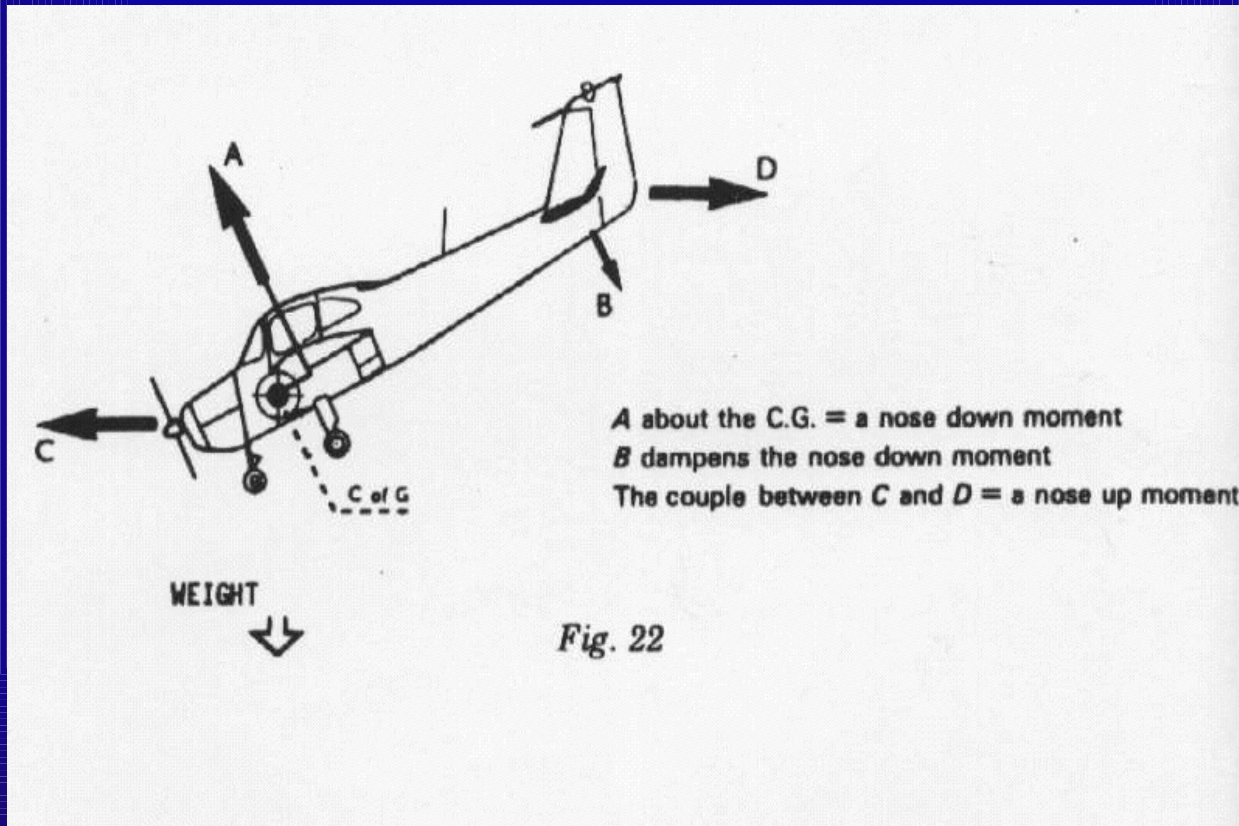
Forces in the fully developed Spin

- ◆ Lift and drag balanced by weight and centrifugal force
- ◆ Lift and drag = nose down pitching moment about C.G
- ◆ Balanced by down-force from the elevator and centrifugal force of mass forward and aft of C.G



Principles of Flight (cont)

Expanded Forces in a Spin



Principles of Flight (cont)

Centre of Gravity Position

- ◆ Forward C.G = \uparrow nose down pitching moment (L+D resultant) giving a lower nose attitude, \downarrow A.o.A, \uparrow rate of descent / rate of rotation & easier recovery
- ◆ Rearward C.G = \downarrow nose down pitching moment (L+D resultant) giving a flatter spin, \uparrow A.o.A, \uparrow drag and a \downarrow rate of descent - overall \uparrow spin stability and more difficult recovery
- ◆ Do not load outside of the aerobatic C.G limits - especially aft

Principles of Flight (cont)

Use of Ailerons in the Spin

- ◆ Changes relationship between pitching, rolling and yawing moments
- ◆ “Pro-spin” aileron - stick opposite to direction of rotation which generally increases the rate of rotation by increasing the angle of attack ($\uparrow D$ & $\downarrow L$) of the inner wing
- ◆ “Anti-spin” aileron - stick in the same direction as rotation which generally decreases the rate of rotation by decreasing the angle of attack of the inner wing ($\downarrow D$ & $\uparrow L$)

Principles of Flight (cont)

Use of Power in the Spin

- ◆ Flatter spin due to the gyroscopic precession forces of the propeller pitching the nose up
- ◆ Increased rate of rotation due to the slipstream over the rudder and the fuselage shielding of the slipstream producing more lift on the outer wing

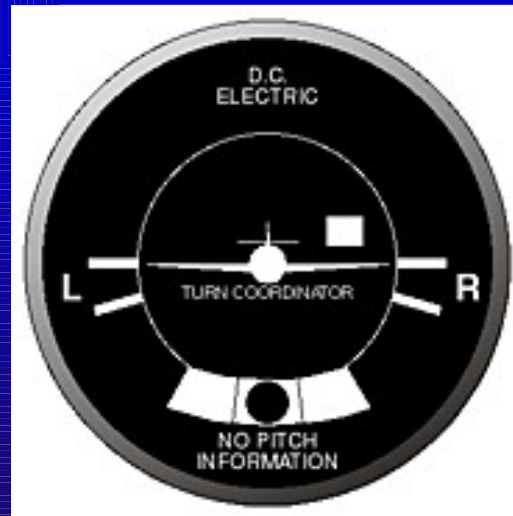
IAS during the Spin

- ◆ The IAS during the developed spin may fluctuate slightly but is always below the stall speed

Principles of Flight (cont)

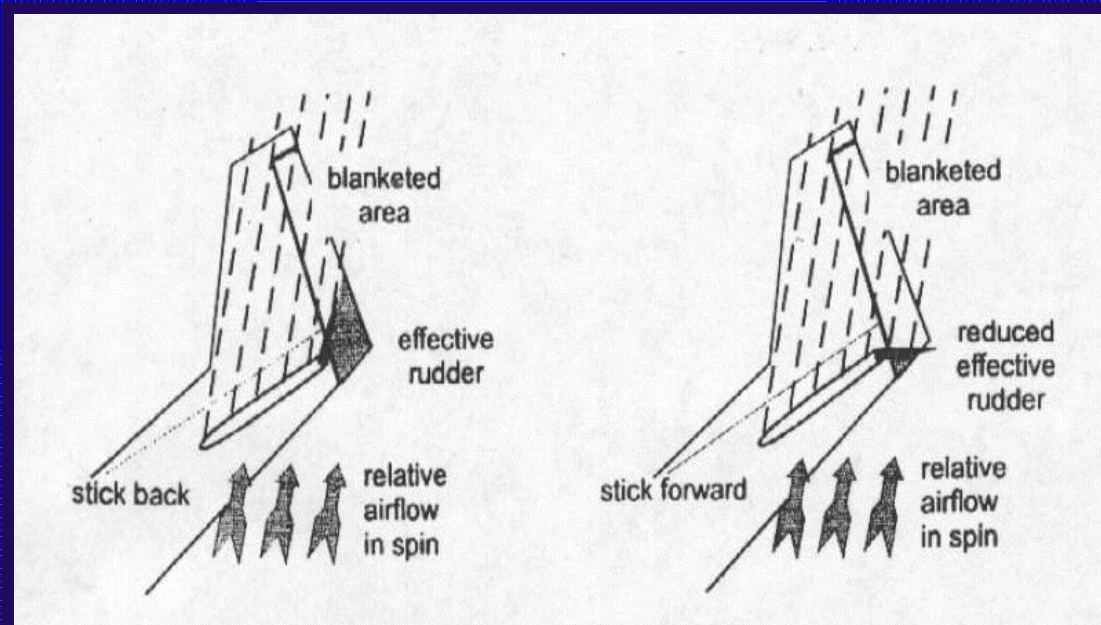
Recovery Technique: (ref AFM)

- ◆ Stop the yaw with rudder opposite to the direction of rotation (determine direction by visual reference and / or turn indicator (not the ball))



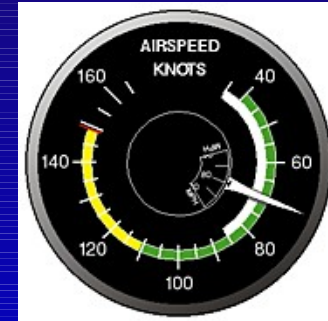
Principles of Flight (cont)

- ◆ PAUSE- There must be a pause between the application of rudder and forward stick due to elevator blanketing
- ◆ Un-stall the wings with forward stick



Principles of Flight (cont)

Upright Spin Vs. Spiral Dive

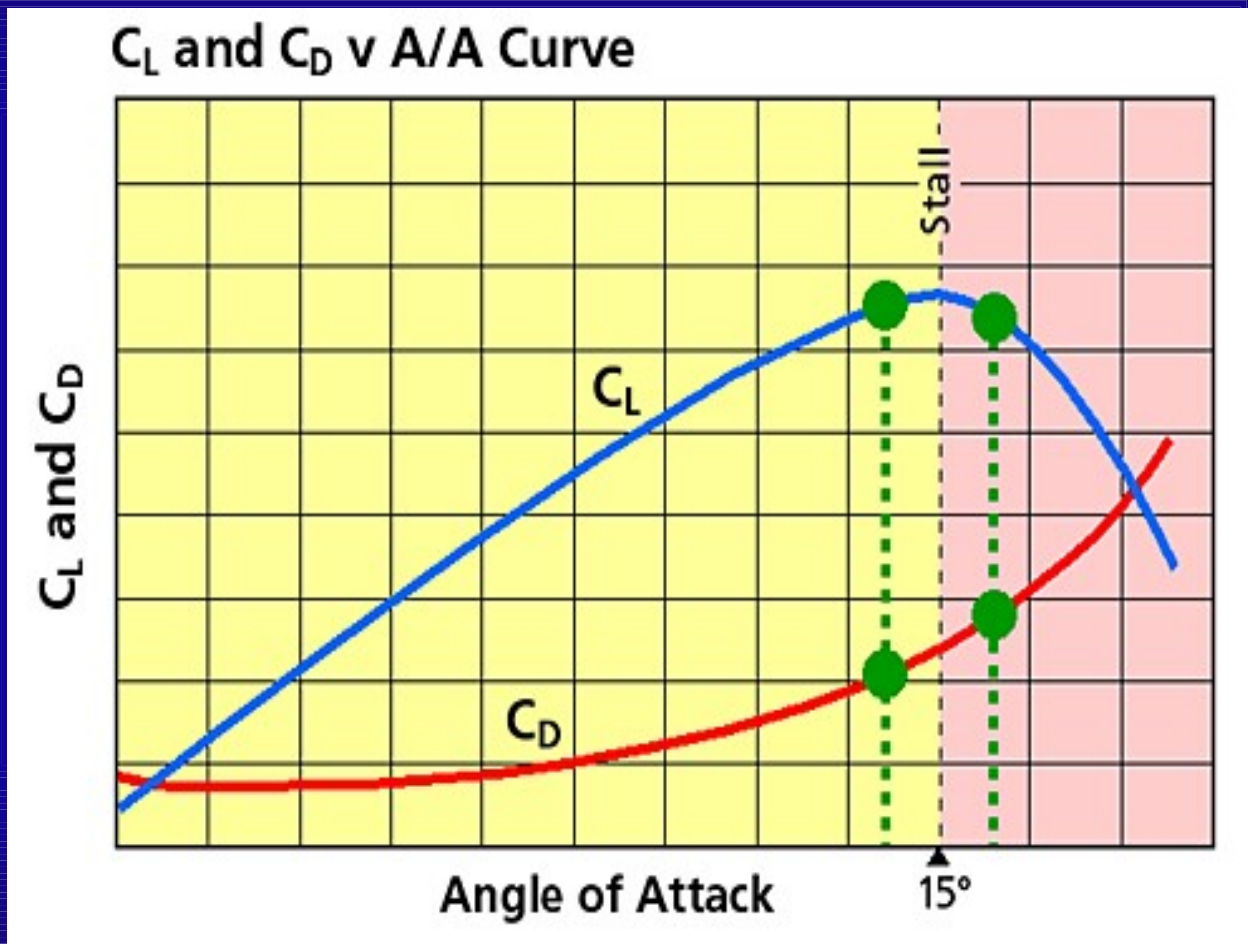


	<i>Spin</i>	<i>Spiral Dive</i>
IAS	$<V_s$	High & increasing
Stalled	Yes	No
Fwd stick on recovery	Yes	No
R of Descent	High	Higher
G	Low	High
Noise	Low	High

An Aircraft Established in a Spin



C_L / C_D vs. Angle Of Attack



Engine Handling

- ◆ Power (RPM) Smooth movements (red line)
- ◆ Mixture Full Rich
- ◆ Carburettor Heat Normal use
- ◆ T's and P's Monitor green range

Human Factors / Airmanship

- ◆ **I'MSAFE / LOOKOUT / HASELL/ HELL**
- ◆ Flaps up
- ◆ Limit number of turns in spin (ref AFM)
- ◆ Recover above 3000ft AGL

Air Exercise

Entry – specific to type (ref AFM)

Typical Entry

- ◆ HASELL Flap UP
- ◆ Pick ref point and height
- ◆ Carb heat **HOT**
- ◆ Reduce power Idle
- ◆ Straight on reference point in balance
- ◆ Maintain height – increase back pressure
- ◆ Airspeed reducing 70kts Carb heat COLD
- ◆ Airspeed through 60kts apply full rudder in desired direction of spin
- ◆ Immediately apply stick full back and hold

Air Exercise

During The Spin

- ◆ Stick full back
- ◆ Full rudder
- ◆ Ailerons neutral (ref AFM)
- ◆ Note: high rate of yaw, roll, pitch and descent, low airspeed

Air Exercise

Recovery

POWER.....Confirm Throttle closed

DIRECTION.....Confirm Spin Direction

RUDDER.....Full opposite rudder to direction of rotation

PAUSE

STICK.....Brisk forward until rotation stops

- ◆ Centralise the controls when the spinning stops
- ◆ Level wings and ease out of the dive to the climbing attitude

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Questions?