Spin Avoidance and Recovery

The majority of unintentional spins occur at altitudes too low for recovery. They generally have only one outcome…

This TSB explains the conditions that will encourage an aircraft to spin, and what you can do about them. But nothing can help you if you enter a spin at low altitude.

The best line of defence is to avoid the spin in the first place.

This TSB discusses unintentional spins.

It is not a substitute for intentional spin training. Under no circumstances should pilots deliberately enter a stall in the turn, an incipient spin or a fully developed spin unless they have received appropriate training from a qualified instructor in a suitable aircraft type, and at a safe height in a suitable location.

There is no universal spin-recovery technique that will work for all aircraft. Therefore, you must consult the Pilot Operating Handbook/Flight Manual for the aircraft you fly.

What is a spin?

When an aircraft spins, a stall occurs together with yaw, and self-perpetuating rotating forces develop. These forces keep the aircraft in the spin until positive and correct control inputs from the pilot stop them.

In a fully developed spin, the aircraft follows a spiral flight path about an axis going straight down, pitching up as well as rolling and yawing towards the spin axis. Descent rates during a stable spin in light aircraft are typically about 5.000 to 8.000 feet per minute.

All aircraft will spin, but not all aircraft can be recovered from a spin. Your aircraft's particular spin characteristics are listed in the Pilot Operating Handbook / Flight Manual.

The aircraft may be approved for spins, but only under certain weight and balance, and centre of gravity restrictions.

Anatomy of a Spin

A spin will not exist without both stall and yaw.

Stall

The stall angle of attack is the critical angle which, when exceeded, will cause the normally streamlined flow of air that follows the curvature of the upper wing surface to separate from the wing and leave as turbulent air flow. At the stall angle of attack, lift reduces rapidly.

Pilots use a quoted indicated airspeed (for straight and level flight at a given weight and configuration) to correspond to this stall angle for each aircraft. But in reality this speed varies depending on the weight the wing has to support. Airspeed is only an indirect measure of an approaching stall.

The quoted stall speed really reflects the 1G straight-and-level speed at a nominal aircraft weight. Increase aircraft weight, and the stall speed will increase. Enter a turn, and the stall speed will increase.

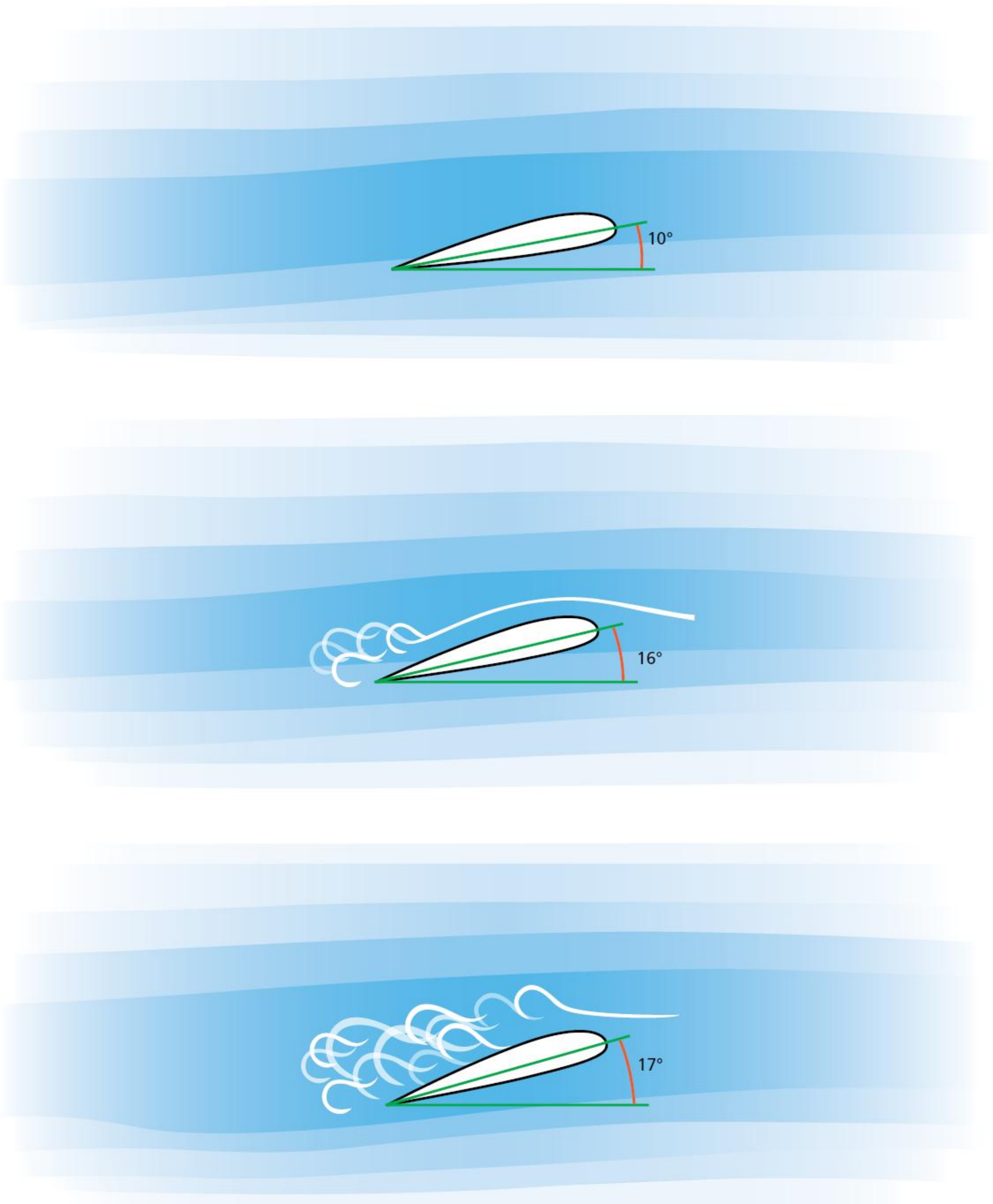
"Airspeed is only an indirect measure of an approaching stall"

A 60 degree banked steep turn at a constant altitude produces a 2G loading in all aeroplanes. The stall speed will increase with the square root of that loading – e.g.$\sqrt{2}$ is 1.4 and thus a basic stall speed of 40 knots becomes a little more than 56 knots (40 x 1.4) in a 60 degree (2G) steep turn.

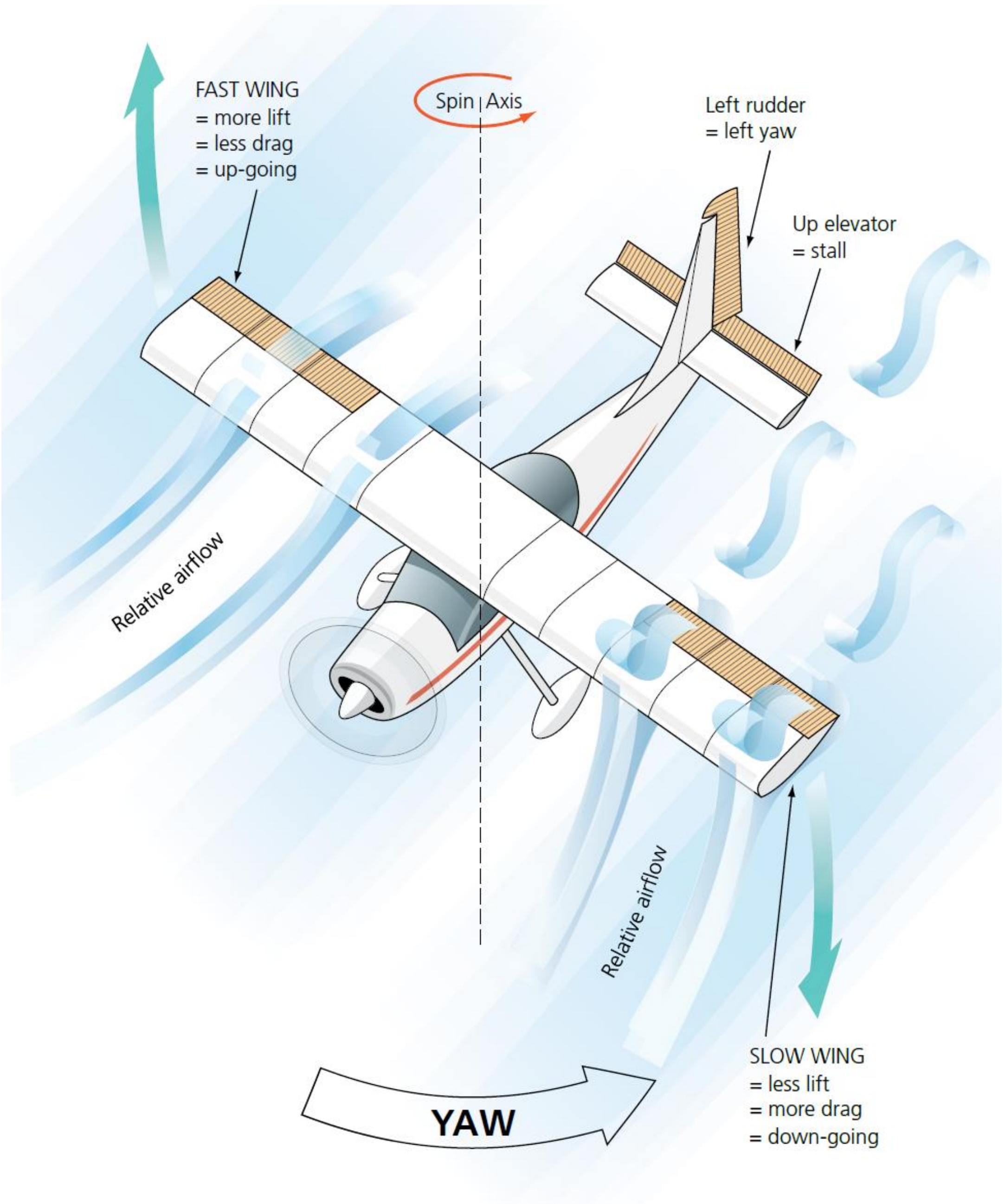
When evaluating how close an aircraft is to the stall, pilots should think angle of attack rather than airspeed. The elevator position (how far back the stick or control column is held), is actually a better indication of how close to the stall the aircraft is.

"Think angle of attack, rather than airspeed"

In a balanced, wings-level stall with the ball in the middle, both wings will remain at the same angle of attack. At the stall, aerodynamic forces may try to pitch the nose forward, but there should be no overall rolling or yawing.



When the stall AoA is reached, the normally streamlined flow of air over the wing becomes turbulent, reducing lift



Stall and yaw combine to produce a new axis, the spin axis

Three Stages of Spin

Incipient Stage

This is the transitional stage, during which the aircraft progresses from a fully developed stall into autorotation.

This progression may be very rapid and is sometimes described as a flick. It may last only two turns, during which time the rotation tends to accelerate towards the rate found in the developed stage. The final balancing of aerodynamic and inertial forces has yet to occur.

The incipient stage is generally driven by pilot inputs. As a very general rule, if pro-spin control inputs are removed in the incipient stage (the elevator is moved forward to unstall the wings, or the out of balance yaw is removed), then the aircraft will not continue to enter a stable spin.

In some aircraft, recovery may not be possible if the spin is allowed to progress to the developed stage. Therefore, recovery must be initiated at the first sign of a spin.

Developed Stage

In the developed stage, a state of equilibrium is reached, characterised by a low and constant airspeed. Rates of descent will be as high as 5.000 to 8.000 feet per minute.

At this stage the spin will be self-perpetuating. If the pilot does nothing about it, the spin is likely to continue until the aircraft hits the ground. Positive anti-spin control inputs will be required to recover from the fully developed spin.

Recovery Stage

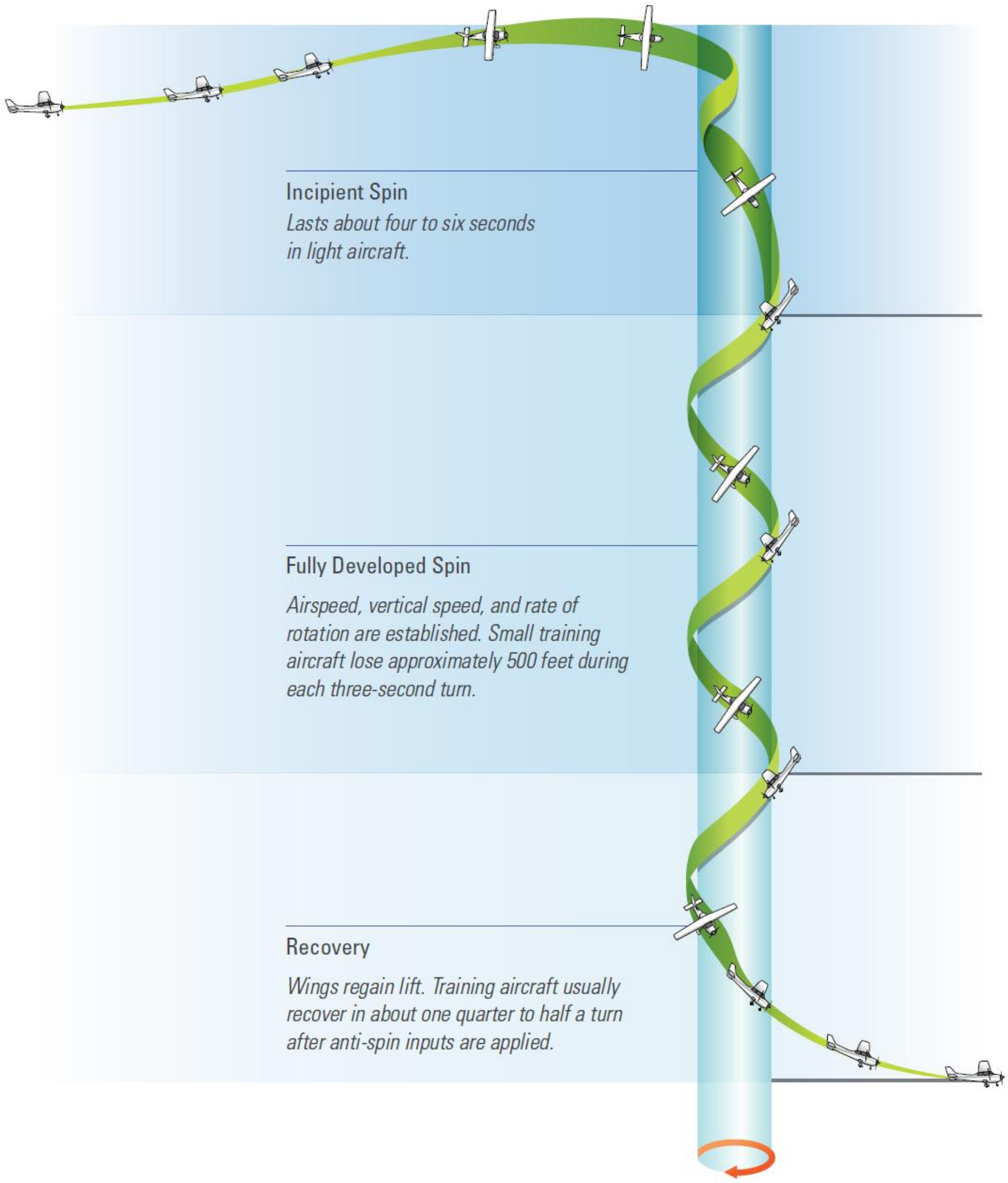
Spinning ceases only if and when opposing forces and moments overcome auto-rotation.

Since yaw coupled with roll powers the spin, the pilot must forcibly uncouple them by applying full opposite rudder. After a brief pause, this is followed by forward movement on the stick or control column.

During the recovery phase, the nose attitude typically steepens and the rate of rotation may momentarily accelerate as well, giving the impression that the spin is actually getting worse. It is not, and the anti-spin control inputs must be maintained until the spin stops.

Spin recovery is not instantaneous. It may take up to several turns for the anti-spin control inputs to finally overcome pro-spin forces. The longer an aircraft is in a spin, the more turns it may take to recover.

Spins are recoverable only when the cumulative effects of the interacting variables favour recovery and there is enough altitude.



Pipistrel Explorer Spin Maneuvers

SPIN ENTRY (Ref. POH #4.16)		
1	Airbrakes / flaps/trim	Airbrakes retracted, flaps 0, trim for 67 KIAS
2	Throttle Lever	Idle
3	Control Stick	Roll input neutral, pull to reach stall
At the moment the stall occurs:		
4	Flight Controls	Hold stick full aft, apply full rudder in the desired spin direction
While spinning:		
5	Flight Controls	Hold controls steady (full aft, roll input neutral)

SPIN RECOVERY (Ref. POH #4.16)		
1	Throttle Lever	Idle
2	Roll Input	Neutral
3	Rudder	Full opposite deflection
As the rotation is about to stop, or fully stopped:		
4	Rudder	Neutral
5	Control stick	Release control force towards neutral elevator position, roll input neutral
6	Horizontal Flight	Resume (do not exceed g-load / speed limitations)

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