Theory Brief 5: Stalling

Aim:

"To be able to recognise the onset of the stall, so that a stall may be avoided in potentially dangerous situations."

Objectives:

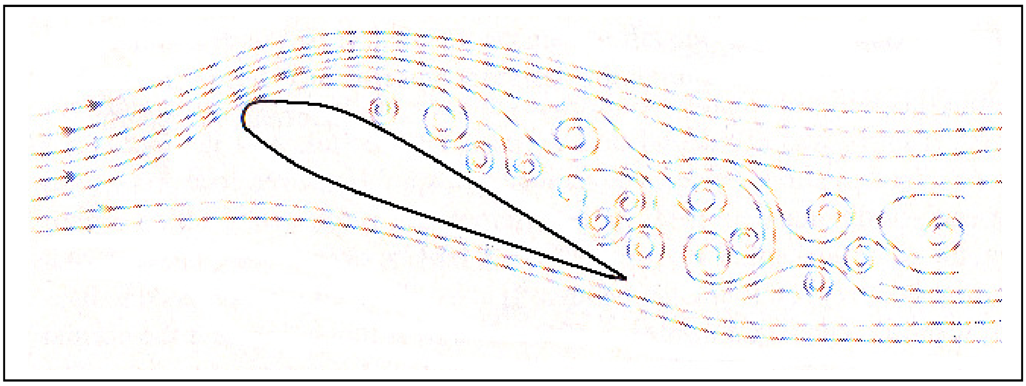
1. Recover from the stall and stall onset (insipient stall) with minimal height loss.
2. To be able to recover from a stall in the climb. (Simulated engine failure after take-off).

Definition of the Stall:

An aerofoil is said to have stalled when it reaches an angle of attack at which the airflow separates over the upper surface, dramatically reducing lift and usually inducing a nose down pitching moment.

This occurs after the aerofoil has reached its critical angle - the angle at which the amount of lift that can be created by the aerofoil has reached a maximum.

The effect of separation is to increase the pressure on top of the aerofoil, and so reduce the pressure differential the wing still receives some lift from the dynamic pressure under the wing, but it is insufficient to support the weight of the aircraft



When the term stalling speed is applied to an aeroplane, this is taken to mean the IAS at which an aircraft stalls when it landing gear and flaps are retracted (not applicable to Thruster), the throttle closed, and IAS reduced in straight and level flight and the aircraft is at Maximum All Up Weight (MAUW). However, since the stall is merely a function of angle of attack, the aircraft can be stalled at any speed and in any attitude. When propellor driven aircraft are under power, the propellor slipstream washing over the wing will delay the onset of the stall, below the 'clean' stalling speed.

Indications of the Approaching Stall

- The IAS has dropped to a speed close to that specified in the aircraft Handling Notes. (Vs)
- Nose high attitude. (Applying back pressure on control stick)
- The reduction in aerodynamic pressure causes the controls to feel 'sloppy'.
- Stall warning device activates. (Horn)
- Air noise reduces.
- Airframe buffeting commences.

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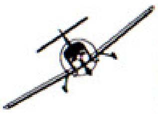
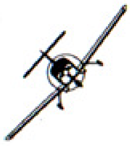
Variations in Stalling Speed

For a given aeroplane, there is a specific angle of attack which corresponds to a given IAS in straight and level flight, and these relationships only change if the weight (or apparent weight) changes. This value is known as Vs

In the turn, the apparent weight of an aeroplane increases, dependant on the angle of bank, so there is a direct correlation between angle of bank and stalling speed. The higher the angle of bank, the higher the stalling speed.

$$\text{Turn stall speed} = V_S \times \sqrt{Load\ Factor}$$

Load Factors During Banking

Angle of bank	 34°	 48°
Factor by which stalling speed is increased	1.1	1.2
Factor by which lift is increased	1.2	1.5

Recovery Technique

Because the aerofoil is at or near the critical angle, use of ailerons will increase the angle of attack on one half of the wing. This would have the effect of stalling that half of the wing further, resulting in high drag and onset of a spin. (This is not a permitted manoeuvre in RAAus aircraft)

To negate this effect, simultaneously:

1. Ailerons must be centred to neutral,
2. Any turning effect is countered with opposite rudder,
3. Reduce back pressure on the control column to reduce the angle of attack.
4. Apply power. Once flying speed has been achieved, rearward pressure of the controls will arrest any descent and allow the establishment to straight and level flight.

These inputs will combine to a rapid increase of IAS, but a rapid loss of height will also occur. This could prove fatal if the aircraft is already close to the ground. (eg: in the circuit)

Remember - Heavy rearward pressure of the controls may well lead to an angle of attack exceeding the stalling angle. An aircraft with stalled wings will never recover from its descent.

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Safety (Airmanship)

Prior to commencing stalling exercises, we must ensure we have:

H – Height,	Set a minimum safe recovery **height** which we will not descend below during the stalling exercises. 2000' AGL for simple stalls. (NB:3000' AGL for advanced stalls later in the training)
A- Area,	The **Area** you are intending to do stalls over is suitable. Not built up, no obstructions etc
S- Select,	**Select** a suitable emergency landing field in the event of an engine failure considering wind, obstacles etc
S - Security,	**Secure** Harnesses and hatches, no loose objects, aircraft equipment secure.
E – Engine,	Check **Engine** Temperatures are in the green and Electric Fuel Pump "ON".
L- Lookout,	Conduct a **lookout** clearing turn by:

1. Turning 90° from heading Left or Right or;
2. Turning 180°

Whilst turning maintain a full lookout in all directions (left , forward, right, up and especially below) for any other aircraft that may be affected by our activities.

ACRONYM – HASSEL Height, Area, Select, Security, Engine, Lookout.

Air Exercises

1. Stall - straight ahead, no power. Confirm stalling speed as per manual (Vs = 45Kts)
2. Stall - straight ahead, (2000 RPM), delayed onset of stall, increased buffeting effect. (Clean)
3. Stall - straight ahead, (2000 RPM), delayed onset of stall, increased buffeting effect. (1st stage flap)
4. Insipient Stall - Apply power to prevent the stall, achieving minimum height loss.
5. Stall in the descent configuration. (Stall in circuit simulation)

<u>The above exercises will be completed to achieve:</u>

Recovery to straight and level (requires power for transition to straight and level).

Recovery to minimise height loss (early application of power to reduce height loss).

Basic Aeronautical Knowledge

The wing has a twist built into it so that the angle of attack is lower at the wing tip, and higher at the wing root. This means the stall develops at the wing root and progressively moves to the wing tip, ensuring the ailerons are effective for as long as possible. This design feature is called wing tip washout.