The CIX VFR Club	Flight Training Notes	Exercise 10b
For Simulation Purposes only. Not to be used for real World flight	STALLING	Issue 1.1 02/08/12

1 INTRODUCTION

This series of tutorials for the CIX VFR Club are based on real world flight training. Each document focuses on a small part only of the necessary skills required to fly a light aircraft, and by echoing real world training, you will be a better Flight Simulator pilot and get more enjoyment out of the hobby as a result.

These tutorials are written specifically for the Flight Simulator Default Cessna 172. Some details will be different for other aircraft.

Note: The stall behaviour in Flight Simulator is unrealistic in most aircraft. Do use Flight Simulator as a means of practicing stall recovery for real world flying.

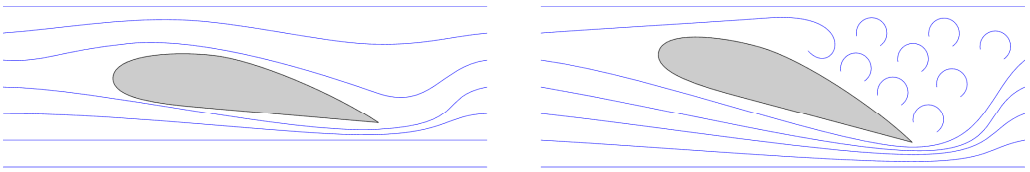
2 OBJECT

The aim of this exercise is to make the pilot aware of:

1. How and why an aircraft stalls,
2. The problems associated with stalls,
3. How to initiate a stall in various configurations
4. Recovery from a stall

3 DEFINITION

A simple definition, for Flight Simulator purposes, is that an aircraft wing stalls when the smooth (laminar) airflow over the top of the wing profile which produces the lift by "sticking" to the surface (Fig.A) becomes "unstuck" and separates from the wing surface, breaking up into turbulent "vortices"(Fig, B). The vortices left behind the wing absorb a lot of the flight energy available, and the aeroplane experiences this as a large increase in drag.



A B

Microsoft Flight Simulator aircraft do not generally stall in the same manner as their real world counterparts, due to the different wing geometry (see section 4 below) and simplified aerodynamic equations used to simulate the forces of flight. As a generality though, reduce airspeed to the "book" stall speed and your MSFS aircraft will stop flying. It will descend rapidly, usually accompanied by a sharp pitching nose down. If held in the stall, i.e.

recovery is not attempted, it may commence a rapid spiral dive or flip inverted.

An important point about stalling is that it depends, not on airspeed as you might imagine, but on the angle of attack of the airflow. (See Exercise 3 section 3.1). In level flight, the angle of attack for most light aircraft is between 1 and 3 degrees. If the angle of attack increases to around 10 degrees, the airflow over the upper surface of the wing becomes turbulent, and the wing stalls.

One effect of this is that if the wing suddenly changes direction such as in a very sharp turn, it can stall, even though the indicated airspeed is above the "book" stalling speed. If just one wing stalls in this and similar manoeuvres, then the aircraft may enter a spin. Spinning is always bad news unless commanded by the pilot deliberately, and with the corollary that he knows how to get out of it!

4 PILOT PREPARATION

One of the most important essentials for flight is adequate preparation. Plan the flight carefully and make sure that you have all the charts, addon software, radio frequencies, pencils and paper that you need, even for a simulated flight, before starting to taxi.

For this exercise the pilot needs a joystick with rudder control (usually twist grip), or yoke and pedals. Using keyboard controls for is not practicable because of the speed of control inputs required.

5 EXECUTING STALLS

There are four significant types of stall:-

- Flaps up (Clean) stall without power
- Clean stall with power
- Power off stall with flaps
- Power on stall with flaps

5.1 Flaps up (Clean) stall without power

5.1.1 Entry to the Stall

Keep the aircraft wings level and in the aircraft in balance with rudder (keep the ball centred). Do not try and carry out stalls with autorudder set in FS. It is totally unrealistic. Close the throttle (prevent yaw with a little left rudder (Cessna 172)). Maintain height by easing back on the joystick or yoke to maintain height, keeping the ailerons neutral (wings level).

Observe:

- Falling airspeed

- Sloppy controls
- High nose attitude
- Stall warner sounding.

5.1.2 Developed Stall

Continue to move the joystick back until it is fully back. Keep the wings level, but also keep the aileron movements small.

Observe:

- Low airspeed
- High rate of descent.
- Nose suddenly pitches down.

With the control column fully back, you will not be able to raise the nose. In Flight Simulator, the aircraft may nod up and down repeatedly as it gains airspeed a little and the nose comes up, only to stall again. Sometimes the aircraft will roll inverted.

5.1.3 Recovery

If the aircraft is still erect,

- Move the stick forward to neutral,
- Observe rapidly rising airspeed as the aircraft dives,
- At 60 knots move the stick back gently until the aircraft is level in pitch,
- Apply cruise power.

If the aircraft is inverted,

- Move the stick forward to neutral,
- Observe rapidly rising airspeed as the aircraft dives
- Roll the aircraft erect with ailerons while still diving.
- At 60 knots move the stick back gently until the aircraft is level in pitch
- Apply cruise power.

5.2 Clean Stall with Power

5.2.1 Entry to the Stall

Start the manoeuvre from normal cruising flight with power at 2350rpm. Keep the aircraft wings level and in the aircraft in balance with rudder (keep the ball centred). Do not try and carry out the manoeuvre with autorudder set. Ease back on the joystick or yoke as if commencing a climb, keeping the ailerons neutral (wings level).

Observe:

- Initial increase in altitude
- Falling airspeed
- Sloppy controls
- High nose attitude
- Stall warner sounding.

5.2.2 Developed Stall

Continue to move the joystick back until it is fully back. Keep the wings level, but also keep the aileron movements small.

Observe:

- The onset of the stall is delayed
- Low airspeed
- High rate of descent.
- Nose violently pitches down.

With the control column fully back, you will not be able to raise the nose. In Flight Simulator, the aircraft will frequently roll inverted from a power-on stall.

5.2.3 Recovery

If the aircraft is still erect,

- Fully close the throttle
- Move the stick forward to neutral,
- Observe rapidly rising airspeed as the aircraft dives
- At 60 knots move the stick back gently until the aircraft is level in pitch
- Apply cruise power.

If the aircraft is inverted,

- Fully close the throttle
- Move the stick forward to neutral,
- Observe rapidly rising airspeed as the aircraft dives
- Roll the aircraft erect with ailerons while still diving.
- At 60 knots move the stick back gently until the aircraft is level in pitch
- Apply cruise power.

5.3 Power Off Stall With Flaps

5.3.1 Entry to the Stall

The use of flaps reduces the stall speed in the Cessna 172 by about 11 knots to 48 knots. Commence the manoeuvre by reducing airspeed to 70 knots and lowering two stages of flap. Set power at 2100 rpm and trim. The aircraft should fly approximately level. Keep the aircraft wings level and in the aircraft in balance with rudder (keep the ball centred). Do not try and carry out the manoeuvre with autorudder set. Slowly reduce power to idle and ease back on the joystick or yoke as if commencing a climb, keeping the ailerons neutral (wings level).

Observe:

- Rapidly falling airspeed
- Very high nose attitude
- Stall warner sounding
- Rapid onset of the stall.

5.3.2 Developed Stall

The stall will be sudden and the aircraft is likely to roll inverted.

Observe:

- The onset of the stall is rapid
- Very low airspeed, almost off the scale of the airspeed indicator
- High rate of descent.
- Nose violently pitches down.

5.3.3 Recovery

If the aircraft is still erect,

- Fully close the throttle
- Move the stick forward to neutral,
- Observe rapidly rising airspeed as the aircraft dives
- At 60 knots move the stick back gently until the aircraft is level in pitch
- Apply cruise power.

If the aircraft is inverted,

- Fully close the throttle
- Move the stick forward to neutral,
- Observe rapidly rising airspeed as the aircraft dives
- Roll the aircraft erect with ailerons while still diving.

- At 60 knots move the stick back gently until the aircraft is level in pitch
- Apply cruise power.

5.4 Power On Stall With Flaps

5.4.1 Entry to the Stall

The use of flaps reduces the stall speed in the Cessna 172 by about 11 knots to 48 knots. Commence the manoeuvre by reducing airspeed to 70 knots and lowering two stages of flap. Set power at 2200 rpm and trim. The aircraft may climb slowly. Keep the aircraft wings level and in the aircraft in balance with rudder (keep the ball centred). Do not try and carry out the manoeuvre with autorudder set. Slowly ease back on the joystick or yoke, keeping the ailerons neutral (wings level).

Observe:

- Steadily falling airspeed to the airspeed indicator minimum
- Very high nose attitude
- Stall warner sounding
- Full aft elevator

5.4.2 Developed Stall

In the default Cessna 172, the elevator will be fully aft and the stall may not develop properly. At around 45 knots indicated the aircraft will start to descend rapidly, and although an extreme nose-high attitude remains, pitch oscillation may ensue. If the controls are held in this manner for more than a few seconds, the aircraft is likely to roll inverted. Recovery is as in section 5.3.3 above.

This is not realistic behaviour. Although a power on stall with flaps may be demonstrated during training, the student is not required to learn the