

The CIX VFR Club	Flight Training Notes	Exercise 10a
For Simulation Purposes only. Not to be used for real World flight	SLOW FLIGHT	Issue 1.0 02/02/12

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.

2 OBJECT

The objective of manoeuvring during slow flight is to develop the pilot's sense of the feel of the aircraft, the ability to use the controls correctly, and to improve proficiency in performing manoeuvres that require a slow airspeed such as during takeoff, climbing, descent, approaches to land and go-arounds.

3 DEFINITION

Slow flight can be defined as flight at any airspeed that is less than normal cruise airspeed. Extending the definition, it means flying the aircraft at the slowest possible airspeed while still able to maintain full directional and altitude control of the aircraft. This airspeed is usually about 5 knots above the aircraft's known stall speed.

4 PILOT PREPARATION

One of the most important essentials for flight is adequate preparation. Planning the flight carefully and making sure that you have all the charts, radio frequencies, pencils and paper that you need, even for a simulated flight, is covered in Exercise 17. Know off by heart the aircraft's performance figures: Clean Stall Speed V_S , Stall speed with flaps extended, V_{S2} Never Exceed Speed V_{NE} , normal cruise power setting etc.

5 AIRCRAFT BEHAVIOUR

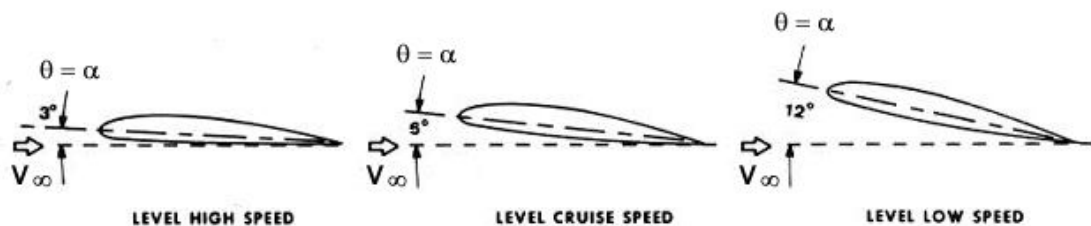
The Cessna 172 cruises at approximately 100 knots, normal climbout is flown at 70 knots and the approach to landing is flown at 70 knots. Rather like riding a bicycle, where you have to make extreme handlebar movements to stay upright at slow speed, the slower you fly the more extreme the joystick or yoke inputs become in order to maintain control.

The lift generated by a wing is proportional to the square of the airspeed and the angle of attack. Sort of:

$$L \propto V^2 \times \alpha$$

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The equation is complex, so let's leave it at that! What it means is that as the airspeed V is reduced, the angle of attack α on the wings has to be increased in order to maintain the lift L required to balance the aircraft's weight. This means that as the aircraft is slowed, its longitudinal (pitch) angle θ has to increase, and the aircraft will assume a considerable nose-high attitude in level flight.



Angle of attack (α) increases as pitch up angle (θ) increases in level flight.

In the slow flight condition, the wings are near the stall, and a slight imbalance in airflow over the wings can induce a stall in one wing and not the other, leading to a spin. So it becomes very important to keep the wings level and the balance ball centred in slow flight. That is in the real world. Microsoft Flight Simulator treats both wings as one, so the condition of one wing stalling before the other cannot occur. Keeping the wings level remains important, with small aileron inputs, but keeping the ball centred becomes less important, although as a conscientious virtual pilot, you will do so anyway!

The high pitch angle results in a greater cross-sectional area of the aircraft being presented to the airflow, which results therefore in higher drag. To maintain level flight at slow airspeeds will therefore require an increase in thrust, a higher power setting, than might be expected for the slow airspeed. The illustration below shows a power setting of 2150rpm for an airspeed of just 53 knots.

6 FLYING THE MANOEUVRE

6.1 Establishing Slow Flight

From a safe altitude of 3,000 feet above the ground (AGL) or a little more, establish a straight and level cruise attitude. Note your heading. Before beginning slow flight you should clear the flight area for any other flying traffic if you are connected to an on line service such as VATSIM. First establish that your heading is suitable; that you are not going to be flying into any controlled airspace or high terrain. Then make a medium bank turn 90 degrees in one direction, then 90 degrees back to your heading.

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Slow Flight in the FSX Cessna 172

Once you have cleared the area for other traffic, you are ready to begin the manoeuvre. Note the altitude and the heading of the aircraft, as you will strive to maintain both during slow flight.

Begin reducing power to around 1500rpm. Simultaneously, begin applying backpressure on the yoke (or stick) to maintain altitude. The airspeed begins to slow, and then will stabilise at about 60 knots. However, you're looking for 53 knots. Raise the nose just a fraction of an inch on the horizon and again let the airspeed stabilize. Once you've reached 53 knots, note and maintain that attitude.

You must try and maintain a constant altitude throughout the manoeuvre. Remember that: -

Attitude Controls Airspeed, Power Controls Altitude

A quick glance at the altimeter may indicate that your altitude is decreasing. If so, smoothly add power, increasing the RPM by approximately 200. Do not fixate your vision on the altimeter. Rather, look out over the nose allowing airspeed and altitude to stabilize for a few seconds. Then quickly glance at the altimeter again. If you are still losing altitude, add another 100 RPM and repeat the process until both airspeed and altitude have stabilized.

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Once both have stabilized you'll be holding quite a bit of back pressure on the yoke. Apply nose up trim until you see the nose begin to rise, then ease off back pressure a little. Continue to trim nose up in this way, repeating until the spring pressure on your yoke or joystick is neutralised, indicating that the aircraft is correctly trimmed, and the aircraft is maintaining both attitude and altitude.

You are now flying in a slow flight configuration. However, you'll note that the aircraft has turned about 30 degrees to the left (or right in British built aircraft) of your assigned heading while you were busy adjusting attitude, power, trim, etc. When the aircraft is in a nose high attitude and you are carrying any amount of power, engine torque and propeller "P" factor enter into the equation trying to turn the aircraft. To hold a constant heading while performing slow flight you must therefore also apply slight but constant rudder to offset the torque and "P" factor.

It may take a while to achieve slow flight at first as you "feel your way" avoiding sudden control movements and the risk of a stall, but after several tries you'll be able to simultaneously raise the nose, adjust the back pressure and trim, and adjust your power to quickly establish and maintain an assigned constant altitude, airspeed and heading.

That describes the step-by-step procedure for transitioning from cruise flight to slow flight. Now take a detailed look at making the transition from slow flight back to cruise flight.

6.2 Returning to Normal Cruise Flight

You should to make the transition back to cruise flight without changing altitude or heading. The very first step is to begin applying power until you're back at the approximate normal cruise power setting. As the power is applied the nose will have a tendency to pitch further upward but you must prevent this by forward pressure on the yoke to prevent the aircraft from climbing and possibly stalling. Slowly lower the nose back to the straight and level attitude and observe the airspeed begin to build. Relax the pressure on the rudder.

After positioning the nose to the straight and level flight attitude, fine tune the power setting, and trim for cruise. Again, with practice the procedure will become much easier.

6.3 Turning in Slow Flight

Making turns while in the slow flight configuration requires a bit of finesse because the secondary effects of the controls will be more apparent now than in normal cruise (See Exercise 4b for details of that subject). While maintaining a steady 53 knots, gently turn the yoke to the left and adjust the rudder pressure you are holding to centre the balance ball. Establish a

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bank angle of about 10 degrees and return the yoke to the centred or neutral position. The aircraft will now be in a shallow banked turn to the left and the altimeter will be indicating a slight descent.

You have lost a slight amount of lift due to the bank angle of the wings, so you need to compensate by applying slight backpressure on the yoke, increasing the angle of attack, and thus the lift. However, as you increase lift the airspeed shows a slight decrease. So you adjust for your airspeed by making a very small power increase, approximately 50-100 RPM. In practice, making the power adjustment alone will raise the nose sufficiently. Do not trim, as this is a transitional manoeuvre only. Now you're comfortably established in a slow flight at constant altitude and airspeed.

When you are about 5 degrees from your next intended heading, stop the turn and return to wings level straight flight at 53 knots by turning the yoke slightly to the right. Also apply slight right rudder pressure to centre the ball. Approaching the wings level position, return the yoke to the centre or neutral position and relax the pressure you are holding on the rudder.

Once back in the nose high wings level position you will need to readjust the power to prevent the aircraft from climbing. Again add very slight rudder pressure to prevent torque and "P" factor from pushing the aircraft off your intended heading. Slow flight right turns are carried out in a similar manner.

Note how slow and sluggish the control inputs are compared to flying at a normal cruise speed. Slow flight is valuable in Flight Simulator, as it demonstrates very well the flight handling characteristics of an aircraft. Every different make and model of aircraft that you will fly in Flight Simulator will have a different feel when flown in the slow flight configuration. Practicing slow flight in each aircraft is not only fun, but will increase your confidence greatly when flying on line.