The CIX VFR Club	Flight Training Notes	Exercise 5
For Simulation Purposes only. Not to be used for real World flight	TAXYING	Issue 1.1 09/03/21

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, which has tricycle undercarriage. Some details will be different for other aircraft, especially tailwheel aircraft, and parts of this tutorial may not be relevant to such aircraft.

You should read Exercise 4c before continuing with this tutorial.

2 DESCRIPTION

An aircraft is controlled and manoeuvred on the ground using power, rudder and brakes either one control at a time, or in combination. The rudder pedals are linked to the nosewheel on aircraft with tricycle undercarriage, and ground steering is by means of the rudder pedals.

Aircraft should always be taxied slowly. Aircraft with tricycle undercarriage in which the pilot has a good view ahead may be taxied in a straight line or turned as required. Tailwheel aircraft should never be taxied in a straight line unless the pilot can see directly ahead. Normally with tail-wheel undercarriage the pilot cannot see directly ahead and must therefore turn the aircraft from side to side to maintain a satisfactory lookout. Speed should always be kept low to give the pilot adequate time to see, think and manoeuvre the aircraft. During taxying the flaps must be raised to avoid damage by flying stones, etc.

3 USE OF POWER

The amount of power required depends on the ground surface. For example, on grass more power is required to move the aircraft than on asphalt or concrete. When moving off from a standstill in order to overcome the inertia of the aircraft, considerable power may be required to overcome the inertia of the aircraft. Immediately the aircraft is moving, power must be reduced to keep the aircraft under control and prevent a runaway.

The student should aim to select a power setting that will keep the aircraft moving at a constant safe speed; normally a fast walking pace. Under certain circumstances it may be necessary to increase the amount of power, for example when making tight turns or, in tailwheel aircraft, whilst taxying in a strong crosswind, to maintain direction by providing slipstream to assist rudder effectiveness. Differential braking may also help maintain directional control.

4 TURNING

4.1 Aircraft with Tricycle Undercarriage and Nosewheel Steering

Aircraft with "tricycle" undercarriage have two main wheels under the wings, and a single steerable wheel beneath the front of the fuselage. In aircraft with tricycle undercarriage, the centre of gravity lies between the mainwheels and the nosewheel, which is an inherently stable configuration. This makes turning a relatively simple manoeuvre. The aircraft have independent brakes on the mainwheels, operated typically by toe-extensions to the rudder pedals, or by other controls. The rudder pedals are connected to the nosewheel by strong elastic bungee cords, so that the connection is firm and positive but not rigid.

The aircraft is turned by use of the rudder pedals steering the nosewheel, or by braking on the wheel on the inside of the turn (differential braking) or both. Some aircraft (e.g. the Cessna 152 & 172), have a steerable nosewheel up to a certain angle of turn, after which differential braking is used to tighten the turn.

Differential braking forces the nosewheel to turn beyond the limits of the rudder pedal control, stretching the bungee cords. Normally differential braking requires additional thrust to overcome the friction caused by braking and care should be taken not to lock one wheel (particularly when moving forward from rest) since turns on a locked wheel cause stresses on the undercarriage, distortion of the tyre and possibly tyre creep.

4.2 Aircraft with Tricycle Undercarriage and a Castoring Nosewheel

Aircraft such as the Grumman AA5A Cheetah have a castoring nosewheel which operates in a similar manner to the wheels of a supermarket trolley (although with less of a mind of its own). It turns in response to sideways forces on it imposed by the turning moment from differential braking of the mainwheels. It follows that steering such aircraft is solely by differential braking, a technique less difficult than it perhaps sounds. Again, additional thrust may be required to overcome the friction caused by braking and care must be taken not to lock one wheel.

4.3 Tailwheel Aircraft

In tailwheel aircraft, the centre of gravity lies behind the mainwheels, which is inherently ***un***stable. The tailwheel may be fully steering or fully castoring, and may also be capable of being locked in the ahead position. In all cases, if the aircraft is turned too quickly, the turning moment can be sufficient to overcome the very light tailwheel ground adhesion and force the aircraft to rotate horizontally about the mainwheels, perhaps ending up facing in the opposite direction to that intended. This is known as a "Ground Loop". If

this occurs at any significant speed it usually results in considerable damage to the aircraft.

Strangely, in Microsoft Flight Simulator X, some light aircraft with tricycle undercarriage exhibit this effect, wrongly, and ground handling is notoriously tricky at any speed in FSX. Conversely, the default tailwheel aircraft in FSX are usually quite benign on the ground. A good example of this is the De Havilland Chipmunk, which in FSX is quite docile, but in real life is very easy to ground loop.

Tailwheel aircraft may be turned by steering the tailwheel with the rudder pedals, or by use of differential braking, or assisted by increasing power to add a turning force from slipstream on the rudder, or a combination of all three.

To avoid a ground loop, care should be taken not to make sudden changes of direction except at very low speed since the turn may result in the tail swinging sideways which can be difficult or even impossible to control. Turns may also be effected by using the brakes.

On aircraft with tailskids instead of a tailwheel, such as the De Havilland Tiger Moth, fairly coarse use of rudder, accompanied by a burst of power is often needed to produce a turn, particularly in a crosswind. Because of the Coriolis effect which tends to yaw an aircraft when propeller rpm is changed, pilots can make use of this when turning. For example, it is easier to turn a Tiger Moth, which has no brakes, to the right than to the left, because a sudden increase in propeller rpm tends to make the aircraft turn right. This Coriolis effect is modelled in Flight Simulator X, and can affect tailwheel aircraft turning characteristics in this way.

5 USE OF BRAKES

5.1 General

The brakes should be applied gently and the amount of braking should be progressively reduced as the aircraft slows down. Prolonged braking should be avoided, especially when the differential braking is required to maintain direction in a strong crosswind. The effect of prolonged braking is to heat up the brake drums with adverse effect on the tyre and tube, resulting in reduced tyre life and brake effectiveness (brake fade). Disc brakes are less prone to brake fade, although this effect is not modelled in FS.

When moving off chocks, the brakes should be tested after moving a few yards.

5.2 Tailwheel Aircraft

The brakes should always be used carefully since harsh braking can cause the aircraft to nose over, damaging the propeller.

6 USE OF FLYING CONTROLS

Normally the flying controls are held in a neutral position during taxying with certain exceptions.

6.1 Surface Conditions

When taxying on grass or rough ground, particularly when transitioning from grass to asphalt or vice versa, the yoke or joystick is held fully back to maximise ground clearance for the propeller and to lighten the load on the nosewheel as the slipstream effect on the elevators forces the tail lower.

When crossing a boundary such as grass to asphalt, or a shallow depression, always cross at an angle so that both mainwheels cross at different times, reducing the shock on the undercarriage and reducing the risk of the nose bouncing up and down excessively with the attendant risk of a propeller strike.

Not relevant in Flight Simulator, but when crossing rough ground or traversing disused runways, keep the power low to minimise or avoid small stones striking the propeller or fuselage.

6.2 Effect of Wind

When taxying into wind the yoke is held neutral or back

When taxying with a tailwind, the yoke is held forward to prevent the wind lifting the tail. When taxying with a crosswind the yoke is turned towards the wind to prevent the into wind wing being lifted by the wind.

Because of the large tail surface, aircraft tend to turn into wind if there is a strong crosswind. With tailwheel aircraft, the yoke must be held back to maximise the tailwheel force on the ground and with nosewheel aircraft, the yoke is held forward to increase ground friction on the nosewheel. Differential braking may nevertheless be necessary.

In some aircraft in Flight Simulator, e.g. the John Woodside Tiger Moth, wind effects can be quite marked and the use of controls to neutralise wind effects is very important.

7 TAXYING RULES

1) Regardless of any ATC instruction, it is the duty of the pilot alone to avoid a collision with another aircraft, vehicle or object.
2) Aircraft on the ground must give way to aircraft landing or taking off, and to any vehicle towing an aircraft.
3) When two aircraft approaching each other head on or nearly so, each should turn right.

4) When two aircraft are converging, the aircraft which has the other aircraft on its right should give way. It should also avoid crossing ahead of the other aircraft unless passing well clear.
5) If overtaking another taxying aircraft, pilots must overtake on the left and pass well clear.
6) If in any doubt - STOP. The pilot is solely responsible for his aircraft when taxying, even when being guided by a marshaller.

Pilots must keep a good lookout for other aircraft and ground obstacles while taxying.

8 MARSHALLING

Although a marshaller may be seen in some add-on scenery for Flight Simulator, they are best ignored!

9 CHECKS WHILE TAXYING

As well as testing the brakes on moving off, as mentioned above, the following instruments should be checked during taxi for take off:

1) Check the rudder for full and free movement
2) Check the turn indicator is operating whilst turning, and in the correct sense. In initiate small turns to right or left on a straight taxiway if there are no suitable turns in the required direction en route to the active runway.
3) Check the parking brake is off. (In FS, setting the parking brake is 100% effective, so you cannot move unless the parking brake is off. This makes this check redundant in practice, although it is good airmanship to practice the check anyway.

ENDS