The CIX VFR Club	Flight Training Notes	Exercise **8**
For Simulation Purposes only. Not to be used for real World flight	**DESCENDING**	Issue 1.1 31/07/12

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.

You should read Exercise 7 before continuing with this tutorial.

2 OBJECT

The aim of this exercise is to lose height at a constant Rate of Descent whilst holding both course and airspeed steady, and to

3 DESCRIPTION

The prime object of flying is to make the number of landings equal the number of take-offs! While you happily flying along enjoying the view, at some stage you have to come down. The Law of Gravity, if nothing else, determines that. Therefore the descent is a fairly important phase of flight.

There are two ways to descend: -

- The Glide Descent
- The Powered Descent

Because gravity works for you in the descent, engine power required is less than for level flight. Part of the aircraft weight acts along the thrust line, and thus replaces some of the thrust. It is similar to a car going downhill. Each method has its own particular advantages and applications.

In Straight and Level Flight the function of the throttle is to keep the aircraft moving forward. If the throttle is closed completely, the plane is left without any thrust with which to overcome drag and a force must be provided from another source in order to keep the aeroplane moving forward. It is the weight component which takes over this function. In the extreme case of a vertical dive, the weight becomes opposed by drag and there is virtually no lift from the wings. In this configuration the aircraft descends at its maximum theoretical rate.

In a 45° dive, although the rate of descent will be less than before, the aeroplane will still move forward under the influence of its own weight, or using the analogy with cars described above, will still coast downhill.

The rate of descent would still be high in a 45° dive. On the other hand, if the pilot tries to fly level with power at idle, the aircraft will slow to the point where it does not have enough speed to generate enough lift and it will inevitably descend, and the harder the pilot continues to try and stay at his chosen altitude, the faster the aircraft descends ever more rapidly. If it runs out of lift altogether and stalls, it descends very rapidly!

3.1 The Best Glide Speed

There is a point in between these two extremes, at which the aeroplane will have the flattest path of descent in relation to the ground. This occurs when the weight opposes the most amount of lift for the least amount of drag. In more technical terms, the best glide ratio will occur at the angle of attack which provides the maximum lift/drag ratio. For any aircraft type, this is a designed airspeed which is also measured among in the many practical flight tests before the aircraft is put on the market by the manufacture. For the Cessna 172, for example, best glide speed is 65 knots. Any attempt to glide at a higher or lower airspeed will always result in a steeper "glide path" (the descent in relation to the ground).

Too high a glide speed results in a steeper glide path than the best glidepath for the reasons given above, and similarly any attempt to stretch the glide by holding up the nose (for example trying to maintain height perhaps to reach the runway which is just ahead) will result in a loss of speed, which will cause the aeroplane to sink more than the optimum angle of glide. This can be misleading to the pilot, because whilst the aeroplane seems to be in a level attitude, it is actually descending, perhaps quite rapidly.

4 TYPES OF DESCENT

4.1 The Glide Descent

The pilot closes the throttle completely, and raises or lowers the nose with elevators until the aircraft is flying at its best glide speed. Once thios is achieved, the aircraft will fly at its best glide ratio. For many light aircraft, the glide ratio is about 9 to 1. In other words it will fly 9000 feet forward (about 1¾ miles) for every 1000 feet of height lost.

Some engines, particularly those of American origin, suffer carburettor icing (ice build-up in the carburettor air intake) in certain weather conditions which can cause loss of power or even cause the engine to stop. A carburettor heat control is therefore fitted to warm the air before it reaches the carburettor, to prevent ice formation.

The engine is most prone to carburettor icing at low r.p.m., such as in a glide. When gliding therefore, if a carburettor heat control is fitted, it should be used in accordance with the instructions laid down in the engine operating notes. In Flight Simulator, the default Cessna 172 does not have a carburettor heat contol, because the engine is fuel-injected and does not have a carburettor.

In addition, during a prolonged gliding descent of perhaps a minute or longer, the throttle should be half opened every 500 feet to prevent the engine from over cooling and causing unacceptable wear in the cylinders and possible insipient stress fractures.

4.2 The Powered Descent

There are times when it is necessary to control the rate of descent within fine limits, e.g. instrument flying. The glide is unsuitable under these conditions and the powered descent must be used for the purpose.

For a powered descent, a speed above the best glide speed is normally used, so that with the engine throttled back, there is a higher rate of descent than at best angle of glide. The nose will be pitched lower than at the best glide speed. Power is added in sufficient amounts to achieve the desired rate of descent, which will be indicated on the VSI. This instrument was described in the chapter on climbing.

If the descent is too fast, more power is added and if a quicker descent is required power is reduced or the throttle closed completely. When you add power, the nose tends to rise, and vice versa, so during these throttle adjustments pitch must be adjusted with elevators to maintain a constant airspeed.

Put simply, the rate of descent is controlled by the throttle and the airspeed is controlled with attitude. It seems an odd rule, so it is worth repeating, because it is not perhaps instinctive.

Control rate of descent with power

Control airspeed with pitch attitude

The powered descent is practically always used on large aircraft although they are as capable of gliding as well as smaller aircraft and sometimes better. What is more, large jet aircraft have a very large excess power available – they can climb almost as well on one engine as two – and because of this, the above rule does not apply – but we don't need to worry about that here.

During the Approach to Land, a shallow glide path is undesirable for several reasons. Obstacle clearance is poor when crossing the aerodrome boundary prior to landing and forward vision is poor because of the flat attitude of the aeroplane. Biplanes suffer from high drag because of their "unclean" design but this has at least one benefit. The high drag means that the glidepath is steeper at a given airspeed than that of a more streamlined aircraft, so that vision difficulties on the approach to land are not an issue.

5 FLAPS

More streamlined aeroplanes need a means of increasing drag and avoiding the undesirable effect of a flatter approach and wing flaps are fitted in an effort to achieve this.

There are many designs of flap, but essentially they are extensions to the wing which, when not deployed, doi not interrupt the smooth airflow over the wing for maximum cruising efficiency, but when deployed, change the airflow. They are normally fitted inboard of the ailerons, but in some aircraft the ailerons and flaps are combined in "flaperons" mostly microlight and home-built types.

The function of flaps is: -

a) to increase drag, thus giving a steeper approach without increasing the airspeed, and
b) to increase lift particularly at low speed.

In most aircraft, lowering flap moves the centre of lift rearwards, so the nose tends to drop because the centre of gravity opposing the lift is further forward. This helps improve the pilot's vision for the approach and landing.

Flaps are usually placed inboard of the ailerons. The first stage of flaps is usually 10° , with typical increments of 10° to a maximum of 30° or 40°. The earlier Cessna 172s had a maximum flap setting of 40° but many pilots believe that this adds too much drag, and makes climbing away in the event of an aborted landing, somewhat of a struggle. The Cessna 172SP in FS9 and FSX, has a maximum flap angle of 30°.

The first15°-20 ° of flap deployment gives the largest lift increase. Subsequent deflection increases drag significantly but not lift. One important consequence of this behaviour is that before raising flaps in flight, the aircraft must be at sufficient height that any sink caused by removal of the extra lift does not result in the aircraft becoming dangerously low. The normal recommended height above ground for raising the final stage of flaps is 300 feet. In any event, raising flaps should be done gradually.

One vital thing to remember about raising flaps is that If flaps are being used to control a glide approach, and that approach is misjudged and it looks as if the aircraft is going to land short, raising the flaps to try and regain a shallow glidepath, will inevitable result in the aircraft descending even more rapidly, and definitely landing short! It is even possible that even applying full power as the flaps are raised is insufficient to prevent an unrecoverable sink.

The rule is

Once flaps have been lowered during an approach, NEVER raise them again until the aircraft has landed.

Flaps are designed to be used in the lower speed range of the aircraft, and are usually designed such that they must not be deployed if the airspeed is above a certain maximum. In modern aircraft, the flap deployment speed range is marked on the Airspeed Indicator with a white arc. For the Cessna 172, the white arc range is 0 to 80 knots, and "flap limiting speed" is 80 knots.

6 EFFECT OF WIND

The wind direction and speed influences the glide path. A headwind will steepen the glidepath (relative to the ground) because although the descent rate and airspeed will be unchanged, the ground speed will be reduced. Descending with a tailwind will increase groundspeed and result in a shallow glide path

7 FLIGHT PRACTICE

7.1 Outside Checks

a) Altitude - sufficient to begin a safe descent

b) Location: not over another aeroplane

c) Not in an aerodrome ATZ (controlled airspace) without permission

7.2 Cockpit checks

d) Trim for straight and level flight.

e) Engine set at cruising r.p.m.

f) Carburettor heat control to warm.

7.3 The Glide Descent Without Flaps

This configuration is not commonly used, but is the essential configuration when the engine has failed (yes, it can happen in Flight Simulator) as it produces the lowest rate of descent, thus giving the pilot more time to plan his emergency landing. It is also the initial approach to land configuration if the flaps have failed. See figure 1.

The procedure is as follow: -

a) From cruising power close the throttle fully. At tbe same time keep straight. Prevent the' nose from dropping below the horizon with elevators.

b) As the airspeed decays to near the best gliding speed, allow the nose to drop gently to settle the aeroplane in the gliding attitude. This is a gentle action not unlike “lowering a baby into its cot” Note the attitude of the nose in relation to the horizon.

c) Re-trim so that the aircraft flies in this attitude “hands off.

d) Make any necessary small airspeed adjustments by slight backward or forward movement of the yoke or joystick and again re-trim. The aeroplane should now be descending at a steady rate, with a steady airspeed and in a straight line.

e) Note the instrument indications. (See Figure 2 below

f) Open the throttle at approximately 500-ft intervals in order to warm the engine.

7.4 Resuming Straight and Level Flight

a) At the target altitude open the throttle to cruise power and adopt the straight and level attitude (check the position of the horizon in the windshield).

b) Re-trim.

c) Allow the airspeed to settle and check the r.p.m. Re-trim if necessary.

d) Move the carburettor heat control (if fitted) to “cold” if necessary.

7.5 The Glide Descent With Flaps

This is the landing configuration used for short airstrips where a minimum approach speed is required. It was the preferred landing configuration for many years, but has been superceded in many cases by the powered descent which shortens the approach time in a world with little time to spare. Note the difference in pitch attitude (look at the artificial horizon instrument) between a 20º flap setting and a 30º flap setting (figures 2 & 3), and compare them with the glide attitude without flaps (Figure 1).

a) From cruising power close the throttle fully. At tbe same time keep straight. Prevent the' nose from dropping below the horizon with elevators.

b) When the airspeed has decayed to below the flap limiting speed, lower the first stage of flap. and allow the aeroplane take up the flaps down gliding attitude which will be steeper than before.

c) Apply carburettor heat (if fitted).

d) Retrim at the correct airspeed and the glidepath is now steeper. Note that the artificial horizon now indicate the steeper nose down attitude. The airspeed is lower than before although the nose points at a steeper angle to the ground, and the forward visibility is much improved.

7.6 Resuming Straight and Level Flight

a) At the target altitude open the throttle to cruise power and adopt the straight and level attitude (check the position of the horizon in the windshield).

b) Close the carburettor heat control.

c) Before the aeroplane accelerates beyond the flap limiting speed, raising flaps gradually and retrim. If preferred you can read trim in between each stage of raising the flaps, as holding the level nose attitude until the aircraft accelerates, can sometimes be hard work.

d) When the airspeed is certain to the cruising speed checks the r.p.m. and if necessary re-trim again.

7.7 The Cruise Descent

A cruise descent is a descent with power. The essential feature of the cruise descent is that airspeed is maintained at cruising airspeed, so that no loss of flight performance occurs and en route timings can be maintained. In most light aircraft, reducing power to around 2000 rpm, with no other action, will result in a descent at cruising airspeed. In flight simulator, this behaviour is exhibited by the Cessna 172 perfectly. See Figure 4 below. Note that the airspeed is still 100 knots, but the aircraft is descending because of the reduced power.

One of the most important characteristics of flight is that the "power plus attitude equals performance" rule always applies. In this case, we can be assured that by reducing the power to 2000 rpm in still air conditions, the aircraft will descend at the same rate every time that power setting is selected. The exact power setting will vary from aircraft type to aircraft type and even from aircraft aircraft because of small differences in construction.

7.8 The Powered Descent with Flaps

A powered descent, using flaps as required, is nowadays the preferred procedure for the approach to land. See Figure 5 below. Note the high power setting to overcome the high drag created by the flaps.

a) From cruising power close the throttle fully. At tbe same time keep straight. Prevent the' nose from dropping below the horizon with elevators.

b) When the airspeed has decayed to below the flap limiting speed, lower the first stage of flap. and allow the aeroplane take up the flaps down gliding attitude which will be steeper than before.

c) Increase engine r.p.m. to approximately 1800, and note that the rate of descent is less than in the glide descent. Continue to control the rate of descent to that required by increasing all decreasing engine power as necessary. Apply carburettor heat (if fitted) whenever the tachometer remains below 2000 r.p.m.

d) Because of the increased slipstream both rudder and elevators are more effective than in the glide.

e) Retrim at the correct airspeed.

f) Practice the powered descent using different stages of flap, and notice that the more flap that is deployed, the steeper the those down attitude, and the more power that is applied the less is the rate of descent, and vice versa.

The approach to land is covered in much more detail in Exercise 13.

Fig. 1 The Glide Descent Without Flaps

Fig. 2 Glide Descent with Flaps at 20°.

Fig. 3 Glide Descent with Full Flap

Fig. 4 The Cruise Descent

Fig. 5 Powered Descent with Full Flap at Approach Speed

All the screenshots above were taken from Flight Simulator X in the default Cessna 172.