Basic
Straight and Level

SKYCADEMY

The Basic straight and level lesson teaches the student pilot how to identify and set a constant heading and attitude, building on the skills learned in ‘Effects of Controls’ to adjust and trim the aircraft for a standard directional flight configuration.

Aircraft
The Straight and Level lesson is conducted in the Pipistrel Alpha Electro 2 seat Sports aircraft

Human factors
Physical requirements - Must be able to fit comfortably in the aircraft seat and safety harness.
Maximum passenger weight allowable - approx. 100KG

Requirements
The candidate must be a temporary or subscribing member of Recreational Aviation Australia.

Duration
Intend to arrive 45 minutes early for a detailed briefing and aircraft pre-flight checks. After a 20-minute technique and fundamentals briefing, you will complete a 30-40minute skills development mission with your instructor. The airborne sequence of this lesson will be conducted twice (Basic and Advanced) to achieve proficiency in all areas.

Mission Briefing

We must be able to fly the aeroplane in a straight line, on a constant heading and at a constant altitude. Maintaining a constant *altitude* requires a constant *attitude* and a constant heading requires the aeroplane to have wings level and be in balance.
This is the first exercise in coordination and it's very important that you understand, and can then demonstrate, how the Effect of Controls are used to achieve and maintain a constant heading, constant altitude, constant airspeed, and keep the aeroplane in balance.
The lesson will initially cover configuring straight and level flight at a constant airspeed, and then maintaining it.
This is followed by regaining straight and level after a disturbance, and finally configuring for straight and level at different airspeeds and power settings.

It's critical that you understand that straight and level flight is achieved by referencing the aeroplane's nose attitude directly in front of the pilot with the horizon (where the sky meets the sea, or an imagined line superimposed over terrain or weather), and then checked by reference to the aeroplane's instruments (see Figure 1, below).

Figure 1. The horizon is where the sky meets the sea - this needs to be imagined and superimposed over terrain or weather where the sea isn't visible.

Objectives

To establish and maintain straight and level flight, at a constant airspeed, constant altitude, in a constant direction, and in balance.

Principles of flight

In VFR flight, flying straight and level should only be accomplished with reference to the horizon. Define the horizon and identify where the horizon sits if it's not visible, for example with hills or weather in the way.

The four forces

The four forces acting on the aeroplane should be explained.

Weight
Weight acts straight down through the centre of gravity.

Lift
Lift is produced by the wings and acts upwards through the centre of pressure.

Thrust
Thrust is provided by the engine through the propeller.

Drag
Drag is the force that resists movement of an aircraft through the air.

Equilibrium requires a constant airspeed and constant direction (the combination of these is velocity). A constant direction is maintained by the wings being level and the aeroplane in balance. Equilibrium is achieved when lift = weight and thrust = drag.

The arrangement of these forces forms couples.
Lift acts through its centre of pressure and is slightly behind the centre of gravity, where weight acts (small moment arm), creating a nose-down pitching couple.
For the Pipistrel Electro, the lift-to-drag ratio is 15:1.
a picture is worth a thousand words (see Figure 2).

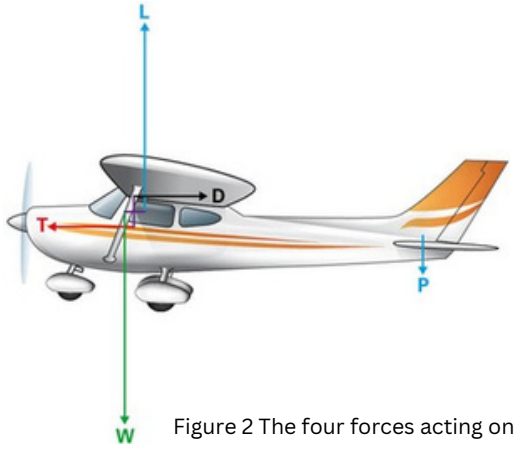


Figure 2 The four forces acting on an aeroplane

The Pipistrel Electro maintains a thrust line well below the level of the mean drag line.
This provides a large moment arm to compensate for the smaller forces of thrust and drag, and creates a nose-up couple that balances the nose-down couple of lift and weight.
In the previous lesson Effect of controls, you saw the pitch change when power was increased and decreased. The arrangement of these couples is the reason for the pitch changes. A decrease in power will pitch the nose down into a descent, without pilot input, and an increase in power will pitch the nose up.
In practice, getting the thrust and drag lines separated far enough to balance the lift/weight couple is not possible. Therefore, the tailplane is set at an angle of attack that will provide a down force on the tailplane in level flight, which combined with the large moment arm, balances the forces.
Any further imbalance between the couples, as a result of weight or airspeed changes, for example, are compensated for by the elevator and if necessary, are trimmed accordingly.

Lift is generated by air flowing over surface of the wing (see Figure 3).

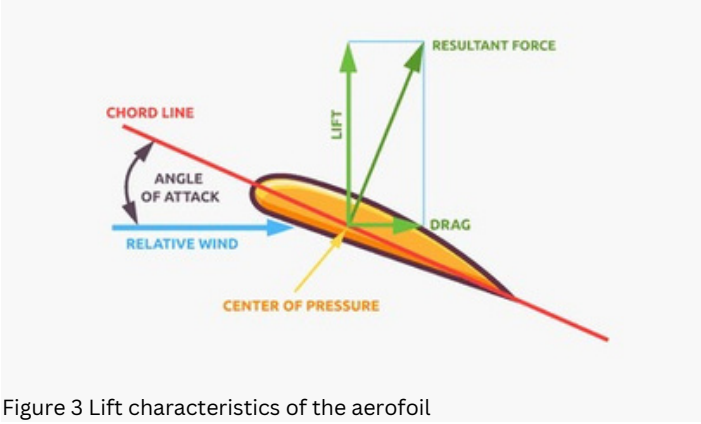


Figure 3 Lift characteristics of the aerofoil

To maintain or change lift, the pilot can control two elements, airspeed and angle of attack, so in essence:

LIFT = angle of attack x airspeed

Angle of attack is the angle between the relative airflow (Relative wind) and the chord line of the aeroplane's wing.

The most efficient angle of attack is approximately 4 degrees, but as no angle-of-attack indicator is fitted to the Pipistrel Electro, the airspeed and attitude is used as a guide to monitor the aeroplane's angle of attack.
n order to keep lift constant, any change in the angle of attack must be matched by a change in the airspeed. For example if airspeed increases, less angle of attack is required to maintain a constant lift. A decrease in airspeed will require an increase in the angle of attack to maintain constant lift and consequently altitude.

Performance

Power + Attitude = Performance
Power is set by reference to power level indicator on the EPSI display in kW.
In this case the performance we want is a constant altitude, direction and airspeed – straight and level.

Power + Attitude = Performance

18kW + (to the horizon) = Straight & Level

Establish straight and level

Establishing straight and level flight is achieved by using the mnemonic PAT,
Power, Attitude, Trim.

P - Power
Set the power for selected (normal) straight and level performance.
The power setting required for Straight and Level flight in the Pipisterl Electro will vary considerably depending on your payload. For a light payload (total passenger weight) of 50-100kg, the typical power settings for S&L are around 14-16kW. For higher payload weights closer to MTOW, expect a power setting requirement of up to 22kW.

A - Attitude
The attitude control of the aircraft for straight and level flight is governed by three elements.
Elevator
Set the nose attitude – for level (eg, two fingers between the dash and horizon)
Aileron
Wings are level relative to the horizon
Rudder
In balance

If a constant direction is not being maintained on the reference point either the wings are not level, or the aeroplane is out of balance, or both.
Balance is confirmed with the balance ball indicator. The method used to achieve balance is 'stand on the ball'.

If the ball is out to the left, increased pressure on the left rudder pedal is required. Once the ball has been centred, the Pipistrel Electro airframe will typically maintain balance after a correction.
The aeroplane is kept in balance to not only keep the aeroplane flying straight but also for best efficiency by keeping drag to a minimum and achieving the best airspeed.

T Trim
Take the time to understand this thoroughly. In flight, take a moment to relieve all of the control pressures, trim and balance for straight and level flight and allow your hands to come off the controls for the aeroplane to remain in straight and level flight.

Maintaining straight and level

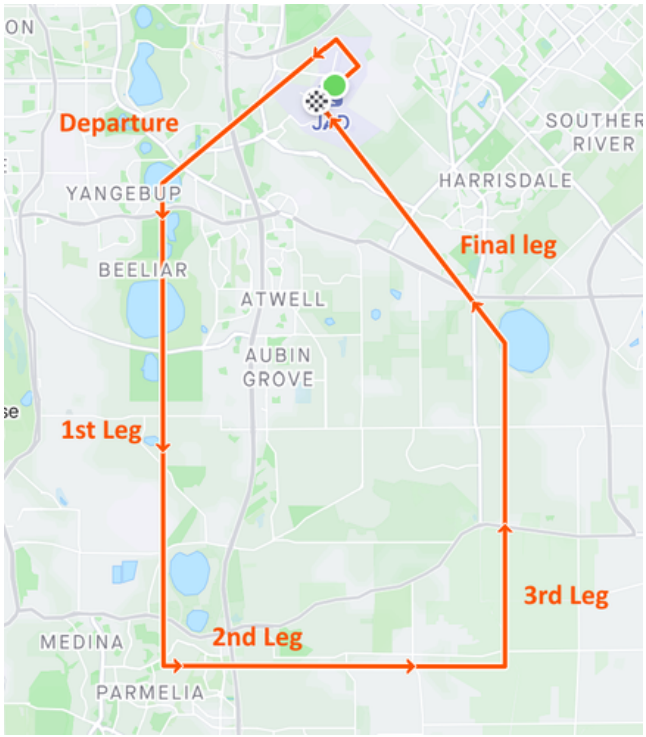
Maintaining straight and level is achieved by using the mnemonic ALAP

A- Altitude
The ceiling for this lesson is a height of 1500ft unless otherwise indicated by your instructor.
To begin the exercise, you will first climb to, and set the aircraft for straight and level flight at the target heigh, and maintain/return to this height during the exercise.

L - Lookout
In a scan loop ahead, look out to the left and scan 20 degrees for 2 seconds from left to right, passing over the nose of the aeroplane to identify any hazards, landmarks or other traffic.

A - Attitude
Ensure the attitude is correct relative to the horizon and, more importantly, constant.

P- Performance
Used to confirm accurate flight – not set it. From right to left the instruments are scanned, and this brings the scan back to the left side of the aeroplane and the process starts again.
During the instrument scan, only those instruments important to this phase of flight are read. In this case the altimeter will probably be scanned on every sweep, with battery level and temperature scanned every 5th sweep.



Standard straight and level lesson track for YPJT Jandakot Airport

Airborne Sequence

On the ground
Complete the preflight inspection

- Make sure the controls are properly adjusted.
- Talk through the start-up checks
- Load mission map to the Garmin Aera 660
- Revise taxiing.

Complete remaining checks and run up

The exercise

Follow through with the instructor on takeoff, and once safely airborne, assume control, identifying the climb attitude (which will be taught next lesson) and reference point to hold with the assistance of the instructor.

Departure
Follow the mission track to a height of 1500ft and once clear of the control area (if applicable) establish the aeroplane in straight and level flight at 70KIAS. Identify the horizon position relative to the dash and note the attitude when level.

1st Leg
The Instructor will demonstrate an attitude that is too high and an attitude that is too low.
Configure the aeroplane, using PAT, in straight and level flight at normal cruising power. Once you have recognised the attitude, and noted that the wings are level and the aeroplane is in balance, the instructor will hand over control.

2nd Leg
The instructor will talk through establishing straight and level using P.A.T. and maintaining straight and level using ALAP.
The instructor will make minor deviations away from straight and level and talk you through regaining it. Identify the effect of a marked imbalance. You should be able to 'feel' that the aeroplane is out of balance.

3rd Leg
The instructor will create, and you will identify, a slight imbalance. This is much harder to 'feel' or detect, and that is why regular reference of the balance ball is used to correct slight imbalances.

Final Leg
On the return to the aerodrome, identify the local landmarks, and if available (non-controlled airspace) take note of the attitude and speed used on the approach configuration.

Debrief and review your progress with the instructor, taking notes on areas of aptitude and areas of improvement in your skills development.

Mission Time blocking

Pre Flight Inspection	**5 Min**
Control set and completion of startup checks	**3 Min**
Total Apron time (approx.)	**8 Min**
ENGAGE FLIGHT SWITCH	
Complete Taxi to run up point	**3-7 Min**
Complete Run up and safety brief	**3 Min**
Taxi to Holding point	**2-4 Min**
Log Book time (On Ground) -	**8-14 Min**

Airborne sequence

Take off and clear the traffic pattern/control area, Climb to 1500 ft @70KIAS Non controlled/ Controlled	**3 Min/ 5-7 Min**
1st leg Attitude demonstration @70KIAS	**4 Min**
2nd leg P.A.T. Demonstration @70KIAS	**5 Min**
3rd leg Minor Deviations from S&L @70KIAS	**5 Min**
Return to Aerodrome	**3-7 Min**
Log Book time In Air	**28 Min**
Taxi to charge location and shutdown procedure	**3-7 Min**
Total Log Book time for each Straight and Level training Mission	**39-49 Min**