



05 STRAIGHT AND LEVEL FLIGHT

AIM

To teach the student how to fly the aeroplane in straight and level flight at varying airspeeds.

INSTRUCTIONAL GUIDE

Figure 5-1 provides a basis for the briefing. Before the flight ensure that the student has received a briefing and has grasped the fundamentals of this exercise. Ensure that the student is aware of the way in which to move the controls to maintain and regain this condition of flight. Also stress again the importance that you will place on trimming during the exercise.

Choose smooth flying conditions for this exercise and if there is significant wind at the operating altitude conduct the exercise into wind or down wind. Additionally, there needs to be an easily definable horizon.

During the flight stress the attitude of the aeroplane with reference to the natural horizon. Show the student how to pick some reference point on which to keep straight and assist in the initial stages to decide when the wings are, in fact, level. Show the student how to detect out-of-balance flight and how to correct this. Demonstrate to the student that if his wings are level and the balance ball is, say, over to the left, a slight pressure on the left rudder will correct the unbalanced state. Later on when power changes are being made, ensure that the student corrects for the resultant yaw and pitch changes.

Instruct the student to keep a good lookout and point out prominent landmarks in the ongoing process of orientation training.

As the student becomes more proficient draw attention to the flight instruments. Show how their indications are directly related to the attitude of the aeroplane in relation to the horizon. Do this in all exercises from now on. Remember to impress on the student the need for a good lookout. Do not let the student get a 'head in the cockpit' complex.

Ensure the student is correctly trimming the aircraft by occasionally asking for 'hands off flight.' If rudder trim is fitted a similar exercise can be conducted for checking on balance.

PRE-FLIGHT BRIEFING CONSIDERATIONS

Figure 5-1: Lift formula

$$L = C_L \frac{1}{2} \rho V^2 S$$

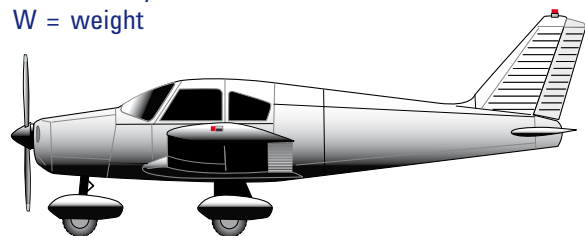
During straight & level flight

$$W = L = C_L \frac{1}{2} \rho V^2 S$$

$$= C_L \frac{1}{2} \rho V^2 S$$

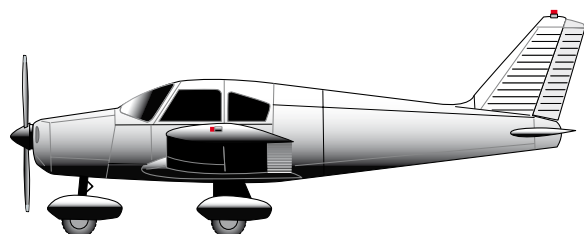
Pilot has no control over circled items (ignoring use of flap)

C_L = coefficient of lift
 ρ = air density
 S = plan area of wing
 V = velocity
 W = weight



Straight & level at low speed

$$C_L \uparrow \quad V^2 \downarrow$$



Straight & level at high speed

$$C_L \downarrow \quad V^2 \uparrow$$



FORCES ACTING ON THE AEROPLANE

Explain that there are four forces acting on the aeroplane in balanced straight and level flight, namely, Lift - Thrust

-Weight and Drag.

LIFT

Explain how lift is derived from an aerofoil, emphasizing the factors which can be controlled by the pilot, i.e., airspeed and angle of attack.

POWER

Tell the student the recommended power setting to be used for normal cruise flight. Explain that the amount of power available is the governing factor for both the maximum and minimum speeds at which the aeroplane may be flown in level flight.

STABILITY

Explain how the aeroplane is made stable in all three planes i.e.

Longitudinal - tail plane

Lateral - dihedral (or high wing low centre of gravity)

Directional - keel surface

TRIMMING

Explain again the operation and use of all trimming devices. Stress again that the correct technique is to hold the selected attitude and then trim to relieve the control load.

USE OF CONTROLS IN STRAIGHT AND LEVEL FLIGHT

Explain to the student how to judge the correct attitude in respect of the nose and wing tips position relative to the horizon. Explain the use of the elevators and how the wings must be kept level with ailerons and the rudder used to keep the aeroplane balanced.

INSTRUMENTS

Briefly explain the instrument indications relating these indications to aeroplane attitude with respect to the natural horizon.

APPLICATION IN FLIGHT

Brief the student on the particular phases of straight and level flight you intend to teach during the particular lesson. Ensure that the student is aware of the sequence of events to achieve these particular conditions. This is normally to set the selected power, assume the correct attitude, trim, then readjust as necessary. Explain that this sequence may vary, e.g. from the climb to straight and level flight, the attitude is first selected then power, then trim.

AIRMANSHIP

Stress that a good lookout must be maintained at all times. Keep a check on the aeroplane's position throughout the flight.

AIR EXERCISE

(a) Attitude, balance, trim

(b) Straight and level flight at various power settings
- instruments

ATTITUDE, BALANCE, TRIM

Firstly demonstrate straight and level flight with the aeroplane in a normal cruise configuration. Point out the attitude (i.e. sight picture) in relation to the horizon. Show how to maintain this attitude with the elevator control. Ensure that the student is aware of the trimming procedure and that he or she is able to trim the aeroplane to fly 'hands off'.

Next, point out the position of the wing tips in relation to the horizon but then explain it is far easier to gain the required sight picture by having part of the aeroplane structure parallel to the natural horizon. Show how to maintain this position with the ailerons. Help the student choose a point on which to keep straight. Demonstrate that if the wings are kept level, small movements of the rudder will keep the aeroplane straight. Point out the balance of the aeroplane. If the aeroplane is fitted with a rudder trim, ensure that the student uses this in the correct sense.



At this point in the lesson it is invariably beneficial to demonstrate to the student grossly exaggerated crossed controls (not followed by student practice). Note the IAS prior to crossing the controls and maintain a constant altitude. Explain to the student that the net flight path of the aeroplane is straight but the wings are certainly not level. Also point out the reduced IAS (i.e. inefficient form of flight) and the manoeuvre is uncomfortable. Then reduce the bank angle considerably and explain that whilst this may not feel uncomfortable to a student it certainly is uncomfortable for an experienced pilot.

Next allow the student to use all controls and impress that in smooth air the movements of the control surfaces are so small that it is more a question of applying pressures rather than moving the controls.

The student is likely to have deviated from the nominated height and direction during the above practice. In this early stage of training it is often helpful to make height corrections first and then direction corrections until more proficiency is gained. The instructor can then demonstrate how to make the corrections

As the student becomes more proficient take control and alter the attitude, trim and power setting, then tell the student to regain straight and level flight.

Frequently the following exercise, similar to the above, is helpful. Tell the student that you want a new height (higher or lower by up to 200 FT) and a new direction (up to 20 degrees off the current heading).

Allow ample student practice of the above exercise(s) prior to continuing the lesson.

Now demonstrate the effect of power changes on pitch and yaw. In some low powered training aeroplanes this demonstration can be less than convincing! Start from straight and level at a low power setting and in a trimmed condition rapidly apply full power. Induce the pitch and roll if necessary as you take your hands and feet off the controls. Set the aeroplane up as previously advised and close the throttle quickly and induce the effects if necessary.

STRAIGHT AND LEVEL FLIGHT AT VARIOUS POWER SETTINGS – INSTRUMENTS

Commence this demonstration from straight and level flight at normal cruising power. Point out the airspeed, attitude and height. Impress upon the student that this height is to be maintained exactly. Now show how to increase power to maximum continuous. Point out

that the aeroplane increases speed and tends to climb. Show that this tendency to climb must be countered by lowering the nose position in relation to the horizon. Re-trim the aeroplane. Impress upon the student the different sight picture from straight and level at normal cruise power. Ensure that the student corrects for yaw when altering power settings.

Point out that the indications of the instruments are now different from the normal cruise straight and level indications. Relate these readings directly to the aeroplane's different attitude, especially the lower nose position.

Now fly straight and level and show the power reduction for normal cruise. When settled demonstrate the effect of reducing power. Ensure that the power selected is still sufficient to maintain height. Point out that the aeroplane will yaw as power is decreased, keep straight with rudder. Show that it will lose height unless the attitude is changed to give a higher nose position. Point out the decreased airspeed and the need to re-trim.

Bring the student's attention to the flight instruments showing that their indications are once again related directly to the aeroplane's new attitude, especially the high nose position.

Demonstrate that when the power is reduced below a certain amount the aeroplane is unable to maintain height.

COMMON FAULTS

Many students tend to fly in a continual state of out-of-balance flight. This is almost invariably due to the wings not being level. The result is that the student uses rudder thus crossing the controls in attempting to keep straight.

Students often require much prompting before they will satisfactorily eliminate yaw whilst changing power.

Do not allow the student to change attitude by using the trimming controls.

Some instructors rush this exercise, which can result in students having difficulties for the remainder of their training and beyond.