



04 OPERATION OF CONTROLS

AIM

To teach the student the effect on the aeroplane of movement of the flying controls and the correct method of handling the aeroplane's ancillary controls.

INSTRUCTIONAL GUIDE

The instructor must ensure that the student clearly understands the principles of this exercise. Whilst the fundamentals can be covered in one lesson it is usually necessary to devote further time to cover the full scope of the exercise.

During the flight spare no effort to get the student off to a good start. See that the student is comfortable. Students must have the same seating position for subsequent flights so that the sight picture is not altered. Make sure that the controls are held correctly and that full travel of the controls is possible. Make sure that the student knows what you mean when you refer to the horizon and aeroplane attitude. Other words such as 'elevator', 'rudder', 'flap' and 'trim' may cause confusion for some students as they have a different understanding of the words from non-aeronautical use.

Demonstrate each segment and then allow, whenever appropriate, the student to repeat the particular segment. This should apply to all your instruction. When handing over to students ensure that they are aware of the correct way of handing over and taking over control. Use the term 'handing over' or 'taking over' as applicable. Do not hesitate to hand over one control only e.g. 'Handing over elevator control only' or 'Handing over aileron control only.'

Often it is helpful to have the student 'follow through' (hands and feet lightly on the controls but not making any input) in order that the student gets a feel for what is occurring. This technique may be appropriate for take-offs and landings before formal instruction has been given in the sequence.

When appropriate allow the student to fly the aircraft even if a particular sequence has not been formally taught e.g. climbing out to the training area or descending back to the circuit.

Always keep a good lookout for other traffic, making it obvious to the student that you are doing so, because students tend to model their instructors.

PRE-FLIGHT BRIEFING CONSIDERATIONS

PLANES OF MOVEMENT

Pitching-rolling-yawing. Relate these to the three axes (See Note 1). Emphasize how movement in these planes should be considered relative to the aeroplane itself and not the horizon.

Note 1: If the student is 'straight off the street' (i.e. recent post air experience flight only), an explanation of the three axes and movement about them may confuse the student. Figure 4-1 is helpful when explaining the primary and secondary effects of controls.

CONTROL SURFACES

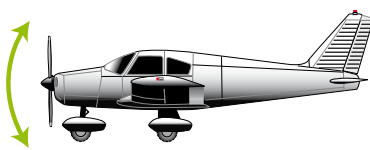
Elevator-aileron-rudder. Explain the movement of these controls and how they are operated by the pilot.



Figure 4-1: Use of controls—primary and secondary effects

Control	Primary effect	Secondary effect
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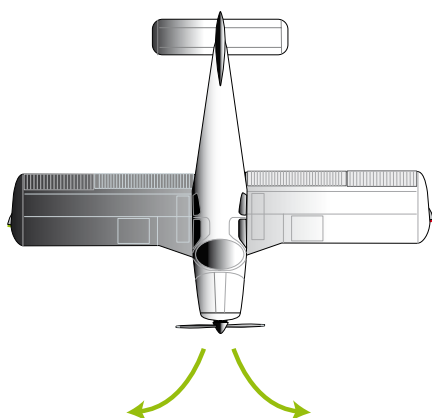
Elevator	Pitch	Nil
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Aileron	Roll	Yaw
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Rudder	Yaw	Roll
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PRIMARY EFFECT OF FLYING CONTROLS

Explain the primary effects of individual movement of elevator, ailerons and rudder.

SECONDARY EFFECTS OF CONTROLS

Explain how an aeroplane which is banked will yaw and conversely how a yaw will cause an aeroplane to bank. Fully explain the attitudes which will result from continued application of ailerons and rudder separately.

EFFECT OF SPEED

Explain the effect of speed and ensure that the student is aware that the effectiveness of all three primary controls is affected by airspeed.

EFFECT OF SLIPSTREAM

Explain that the elevator and rudder only are affected.

TRIMMING CONTROLS

Explain the operation of the trimming devices fitted to the particular aeroplane and their correct method of use. Emphasize that attitude must be kept constant with the primary control whilst trimming the aeroplane.

ANCILLARY CONTROLS

Explain the use of the controls as applicable to the particular type of aeroplane. These controls may include throttle, mixture, carburettor heat, fuel system, engine cooling and flaps.

AIRMANSHIP

Emphasize:

- the need for a good lookout and how to report other traffic
- Hand over take over drills and follow through drills
- Orientation and area boundaries
- Actions in the event of impending air sickness



AIR EXERCISE

- (a) Primary effects of flying controls
- (b) Secondary effects of flying controls
- (c) Effect of airspeed
- (d) Effect of slipstream
- (e) Effect of trim
- (f) Engine controls
- (g) Effect of flaps

For this lesson to be effective there needs to be an easily definable horizon and little, if any, turbulence.

PRIMARY EFFECTS OF FLYING CONTROLS

With the aeroplane trimmed to fly straight and level in a normal cruising configuration demonstrate as follows:

Elevator Show the effect of fore and aft movement of the control column. This is best done by raising the nose and explaining (for a given head position) you see more sky and less ground. Hold the new attitude for several seconds and return the nose attitude to the original position.

This should be followed by student practice having control of the elevator only. The exercise is repeated in the nose low case i.e. the student can see more ground and less sky. Allow the student to control the aeroplane in the pitching plane for sufficient time to learn the feel of the control so that the student can without undue difficulty, place the nose of the aeroplane in a nominated attitude and change from one attitude to another.

Ailerons In straight and level flight draw the student's attention to the position of the wing tips in relation to the horizon.

Ensure the student's feet are not on the rudder pedals during the demonstrations and practices. The instructor prevents secondary effects (yaw).

Lower a wing slightly and explain the new sight picture prior to leveling the wing followed by student practice. Demonstrating lowering and raising the other wing prior to student practice is at the discretion of the instructor, based on the student's earlier performance. The same guidelines apply to how many practices you allow the student to have.

Rudder Ensure the student's hand is not on the control column during the demonstrations and practices. The instructor prevents secondary effects (roll).

Point out the position of the nose or reference point of the aeroplane in relation to a point on the horizon. Apply rudder in one direction and point out that the nose of the aeroplane yaws away from the reference point. Then release the rudder pressure, pointing out that the aeroplane will stop yawing. The same guidelines as shown above apply to a demonstration in the opposite direction and the amount of student practice.

Student practice with all three controls Commencing from straight and level flight the student should then be given the opportunity to gently practice using all three controls with the instructor performing only a monitoring role.

Reacting of control input relative to aeroplane

Demonstrate the primary effects in banked attitudes by banking the aeroplane and move the control column forwards and backwards. Point out that relative to the aeroplane the same pitching movements are produced. When in a banked attitude vary the bank angle to show that while doing this the wing tip movements are still relative to each. Apply rudder in both directions and show that relative to the aeroplane the same yawing movements are produced.



SECONDARY EFFECT OF FLYING CONTROLS

Elevator Demonstrate by raising and lowering the nose to a greater divergence from level flight than in the initial demonstration.

Ailerons Advise the student that your feet are on the floor and not on the rudder pedals, Apply aileron, point out that the aeroplane commences to roll, then because of the resulting slip, the nose yaws towards the lower wing tip. Continue the application of aileron until a definite yaw and lowering of the nose position is noticed by the student. Do not continue the demonstration to the extent that a steep spiral dive might cause some discomfort or anxiety to the student. After recovery to level flight allow the student to experiment with the manoeuvre (initiation and recovery) in both directions.*

Rudder Advise the student that your hand is deliberately not on the control column. Apply rudder, point out that the aeroplane commences to yaw and because of the yaw, commences to roll in the same direction. The nose will continue yawing towards the lower wing tip below the horizon and because of this the aeroplane will continue to roll. Do not continue the demonstration to the extent that the resultant steep spiral dive might cause some discomfort or anxiety to the student. After recovery to level flight allow the student to experiment with the manoeuvre (initiation and recovery) in both directions.*

*The instructor should advise the student when to commence the recovery.

EFFECT OF AIRSPEED

Place the aeroplane in a slight descent at an IAS just below the top of the green arc on the ASI and ensure the aeroplane is correctly trimmed. Hand the aeroplane over to the student and allow him or her to gently experiment by moving all flight controls individually then collectively.

Repeat the exercise at an IAS about 15 knots above the stall speed.

Following the high and low speed exercise quiz the student on the feel of the controls in both speed ranges.

EFFECT OF SLIPSTREAM

Set the aeroplane up in a normal climb with high power. Hand the aeroplane over to the student in a trimmed condition and ask him or her to feel the effect of each control individually.

Resume control and without unsettling the student with the relatively large pitch change commence a glide at the same speed that was used for the climb. Hand the aeroplane over to the student in a trimmed condition and ask him or her to feel the effect of each control individually.

Following the climb and descent exercise quiz the student on the feel of the controls in both parts of the exercise.

EFFECT OF TRIM

Place the aeroplane in straight and level flight, correctly trimmed. Point out the attitude of the aeroplane and tell the student to keep the aeroplane in exactly that attitude even though he or she is about to feel very heavy loads on the controls. When the student has settled down and is holding the attitude reasonably well, move the elevator trim and point out the increasing load on the control column. Have the student move the trim to relieve this load. Repeat the exercise moving the trim in the other direction.

Repeat the demonstration for the rudder and aileron trims if applicable. Allow the student to experiment with the trims until the student is reasonably confident in their use.

Ensure that the student appreciates the sense of trim control movements and that the aeroplane will remain in the selected attitude when accurately trimmed. Ensure too, that the student understands that changes of trim may occur with changes of power, airspeed, flight configuration and loading.

Note: Many students are beginning to tire by this stage of the exercise and it may be prudent to terminate the flight at this point and continue the exercise later.



ENGINE CONTROLS

Throttle Point out the red line on the tachometer and reaffirm that that RPM must never be exceeded and if it is exceeded it must be reported.

Give the student control of the 'throttle only' and have the student set various RPM.

Demonstrate that the RPM of a fixed pitch propeller varies with IAS. Set a mid range RPM and vary the airspeed to show RPM changes.

Mixture control Indicate that in the early part of the training the mixture will usually be set at full rich. However, a demonstration of leaning the mixture is usually worthwhile.

Carburetor heat control Demonstrate use of the control, when it should be used and allow the student to practice.

Engine cooling devices If fitted, explain and demonstrate use.

Engine control friction Demonstrate use and allow student practice.

Fuel system If applicable demonstrate use of the auxiliary fuel pump, changing fuel tanks and instrument indications.

EFFECT OF FLAPS

Point out to the student the maximum speed for lowering flaps. Fly just below this speed and lower the flaps partially. Point out the effect on trim, nose position and speed. Repeat the demonstration using full flaps. Raise the flaps in stages, re-trimming as necessary. Next fly at a low airspeed with flaps fully lowered. Raise all the flaps as rapidly as possible, pointing out the resulting sink and change of trim. Stress that this is the reason why with most aeroplanes the flaps must be raised in stages.

COMMON FAULTS

The most common faults are that the student:

- Is too tense and does not hold the controls correctly. Several attempts are often necessary to convince the student that a light touch is essential
- Fails to lookout prior to manoeuvring – constant reminders may be necessary and the instructor must be exemplary in this matter

A common instructional fault is that this sequence is too often rushed through with insufficient time allowed for the student to appreciate the feel of the aeroplane. At the completion of this exercise a student should be able to place the aeroplane in any desired attitude in the pitching plane, while maintaining a constant heading with wings level. If the student cannot do so then more time should be taken before proceeding to the next sequence.