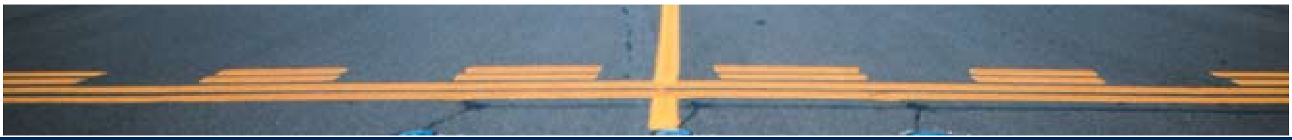


11
TAKE-OFF

AIM

To teach the student how to conduct take-offs under various wind conditions and runway types.

INSTRUCTIONAL GUIDE

Things happen quickly during a take-off, the instructor therefore has to speak sparingly. It is essential that the instructor fully explains what is required before undertaking the air exercise.

Often the students's greatest difficulty is keeping straight from the commencement of the take-off run.until the rudder becomes effective. See that the student releases the brakes properly, straightens the nose wheel before opening the throttle smoothly to take-off power.

If the difficulty in keeping straight persists, the instructor should give the student only the rudder to operate then open the throttle very gradually so lengthening the take-off run. The instructor should then allow the student to operate the rudder and throttle together, then if necessary the control column only, and finally all the controls.

Insist that the student carries out all checks and vital actions conscientiously and ensure that such checks never become a mere formality.

The position in which to hold in order to carry out engine checks and vital actions may vary with local requirements.

If the taxiway layout permits the normal procedure is to stop the aeroplane facing the circuit, thus, in the case of a left hand circuit the intended take-off path will be on the right. This gives the pilot a view of the take-off path, the whole circuit and the approach path. It also shows other pilots that the aeroplane standing in such a position is not yet ready to take-off. In strong winds it is advisable to stop with the aeroplane facing into wind.

When engine failure after take-off is demonstrated the instructor should ensure that the terrain ahead and the conditions and method employed are such that the demonstration will inspire confidence and not the reverse.

PRE-FLIGHT BRIEFING CONSIDERATIONS

TAKE-OFF INTO WIND

It is usual to take-off into the wind for the following reasons:

(i) It gives the shortest run and lowest ground speed at the moment of take-off

(ii) There is no tendency to drift and so strain the undercarriage

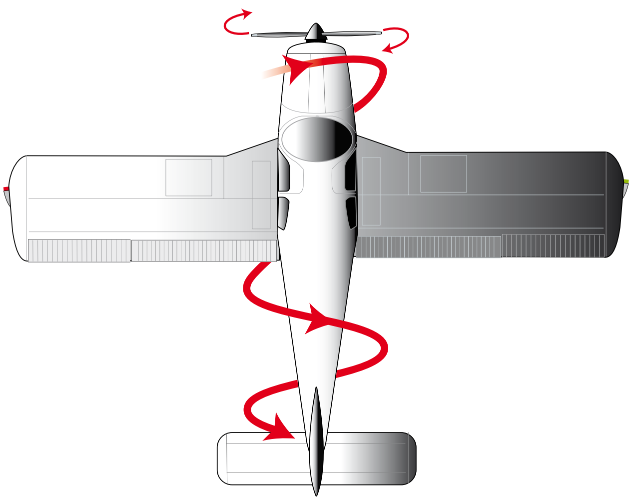
(iii) It gives the best directional control, especially at the beginning of the run

(iv) It gives better obstacle clearance owing to both the shorter run and the steeper angle of climb

(v) It normally provides the best possible landing area in the event of engine failure immediately after take-off

Explain the reasons for the tendency to yaw during take-off. Two of the causes, slipstream effect (Figure 11-1) and torque reaction (Figure 11-2), affect most aeroplanes. The other two causes, gyroscopic action and asymmetric propeller thrust, affect only those aeroplanes which are fitted with a tail wheel undercarriage.

Figure 11-1: Airflow from propeller corkscrews – impacting on the left hand side of the fin and rudder.



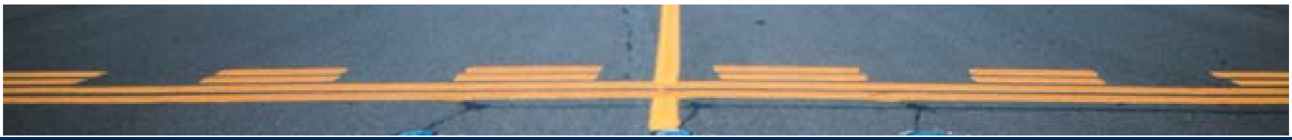
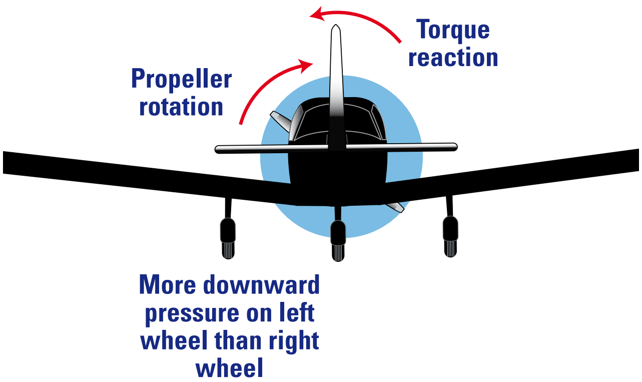


Figure 11-2: Torque reaction is in the opposite direction to propeller rotation.



Explain the factors which affect the length of a take-off run:

(i) **Weight** The greater the load carried by a given aeroplane the longer will be the run required. This is due to the higher speed required to give sufficient lift and the slower acceleration at high weight.

(ii) **Wind Strength** The stronger the headwind component the shorter the take-off run.

(iii) **Surface** If the surface is rough or soft it will have a greater retarding effect than a smooth hard surface.

(iv) **Temperature** An increase in temperature gives lower air density and and may reduce engine efficiency.

(v) **AirfieldHeight** The considerations are the same as for an increase in temperature.

(vi) **flaps** Lowering the flaps enables the wing to produce sufficient lift for take-off at a lower speed, a shorter run is therefore achieved. A flap setting greater than the optimum should not be used as the added drag may have a detrimental effect. The use of flap is particularly applicable to the short field take-off.

APPLICATION IN FLIGHT

Brief the student on the sequence of actions leading up to the take-off, the method of taking off, and actions during and method of carrying out the climb out. Ensure the student is aware of:

(i) The method of determining wind direction and the runway in use

(ii) The position in which to hold whilst carrying out checks immediately prior to take-off

(iii) The drill of vital actions applicable to the type of aeroplane

(iv) The use of controls during take-off, especially in keeping straight

(v) The actions to be carried out after take-off and during climb out

ENGINE FAILURE AFTER TAKE-OFF

Brief the student on the actions to be taken in the event of an engine failure after take-off. The following points must be covered:

(a) maintain control of the aeroplane

(b) the speed of action

(c) the gliding speed

(d) the choice of landing area

(e) the height available

(f) the use of flap; and

(g) the position of fuel cock, ignition switches, master switch and hatches.

Choice of landing area and height available must be considered together. The amount of turn should be restricted to the minimum dictated by obstacles ahead. It must be stressed that the rate of descent and stalling speed will increase in any turn.

Figure 11-3 shows the usual areas to select for a landing. In any case the intention should be to have the wiings level by no lower than about 200FT AGL.

The instructor should also take this opportunity to discuss symptoms and available options for a partial power loss. This is potentially a more complex problem than a simple complete power loss, particularly if the power loss is intermittent. As a minimum, the instructor should discuss the option of closing the throttle to convert the emergency to a complete loss of power and should emphasise the need to resist the desire to turn the aeroplane steeply near the ground in an attempt to return to the airfield. This should be reinforced at regular intervals during the students training.

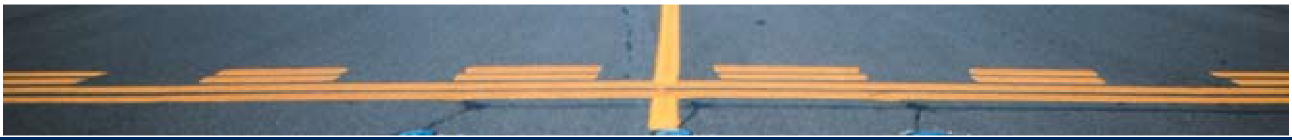
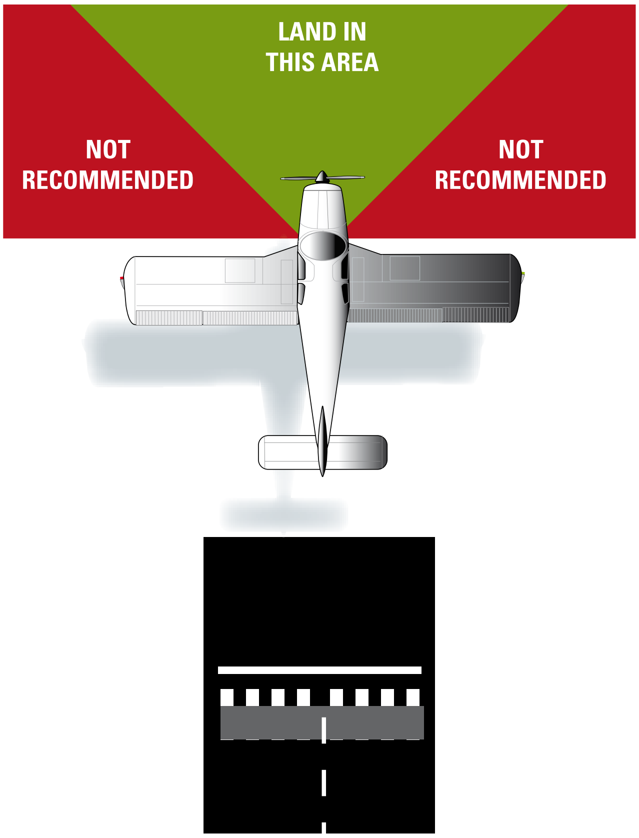


Figure 11-3: Landing area selection following an engine failure after take-off.



AIRMANSHIP

Impress upon the student the need to keep in mind the wind speed and direction, take-off and circuit direction. When holding prior to take-off the student must choose a position in relation to other aeroplanes so that slipstream is not a hindrance and there is no danger of running into them. Stress the importance of the vital actions and a good lookout to ensure that all is clear. It is important that when cleared for take-off this should be done with a minimum of delay.

CROSS WIND TAKE-OFF

Explain that a cross wind take-off may be necessary when the best take-off run is at an angle to the wind. More particularly runway directions dictate that many take-offs must be made out of wind.

Explain that when an aeroplane runs along the ground out of wind the following factors must be taken into consideration:

(i) The wind on the keel surface tends to turn the aeroplane into wind

(ii) The aeroplane tends to drift and so imposes a side strain on the undercarriage

(iii) The wind tends to lift the wing on the windward side.

Explain how to assess the value of the cross wind component. This can be done using simple trigonometry or with the aid of a navigation computer. A simple 'rule of thumb' method is to assess the number of degrees out of wind then use the following figures. If the take-off path is 20 degrees out of wind the cross wind component measured at right angles to the take-off path is approximately one-third of the wind strength. Other figures are:

30°—half wind strength.

45°—almost three-quarters wind strength.

60°—almost nine-tenths wind strength.

Ensure that the student is aware of the maximum cross wind component for the type of aeroplane or the maximum component to which student pilots are allowed to operate, if this is applicable.

APPLICATION IN FLIGHT

The briefing should take a form similar to that for a normal into wind take-off except that the student must be made aware of the need to prevent the weathercock tendency. Emphasize the necessity to hold the aeroplane on the ground until a higher than normal take-off speed has been attained and then lift off cleanly. Demonstrate how to correct for drift after take-off.

ENGINE FAILURE AFTER TAKE-OFF

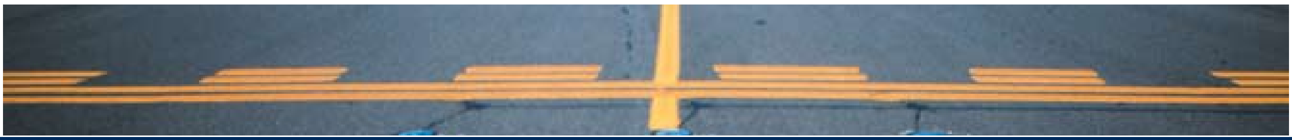
The same considerations as for an into wind take-off apply, except that it may be advantageous to make a turn into wind providing sufficient height is available.

AIRMANSHIP

The same considerations apply as with an into wind take-off with perhaps even more emphasis on lookout.

SHORT FIELD TAKE-OFF*

* This expression is a misnomer as the performance charts indicate if the runway is suitable for your intended operation. However, if a runway is only just suitable for your intended operation, then a short field take-off technique is applicable.



Explain that the short field take-off technique is useful when taking off from a field of marginal length. It is also of value when using soft or rough surfaces.

As the student progresses explain the use of take-off performance charts.

APPLICATION IN FLIGHT

Brief the student on the technique for the particular aeroplane with particular reference to the use of power, flaps and elevators. The student must also be aware of the lift-off speed and actions on the subsequent climb out.

A maximum angle climb is normally entered after take-off and held until the actual or assumed obstructions are cleared.

ENGINE FAILURE AFTER TAKE-OFF

The same considerations apply as for a normal into wind take-off except that it is even more essential to assume the gliding attitude very quickly owing to the lower climbing speed.

AIRMANSHIP

All the available take-off length should be utilized.

The use of high power whilst the aeroplane is stationary should be avoided when loose stones, gravel, etc., are present. This particularly applies to aeroplanes fitted with nose wheels, as considerable propeller damage may result.

AIR EXERCISE

(a) Take-off into wind

(b) Cross wind take-off

(c) Short field take-off

TAKE-OFF INTO WIND

Point out the take-off and circuit direction, the taxi path to the holding point and position in which to hold to carry out the necessary checks and vital actions prior to takeoff. Make this procedure the student's responsibility as soon as possible.

Complete the checks according to the check list, ensure that all is clear and obtain a take-off clearance if necessary.

Line up without delay, ensuring that the nose wheel is straight. Point out a reference point on which to keep straight - remember the offset seating effect if applicable - then smoothly apply take-off power, keeping straight with rudder. During the ground roll it is essential to check that the airspeed is showing an increase, the RPM is as expected and the engine oil pressure (and fuel pressure if applicable) is normal. As the aeroplane gathers speed ease it into the flying attitude. In nose wheel aeroplanes this means raising the nose until either the weight is off the nose wheel or the nose wheel is just clear of the ground.

Maintain this attitude by a progressive backward movement of the control column and when flying speed has been obtained the aeroplane will become airborne.

After becoming airborne gradually assume the climbing attitude and at a safe height complete any after take-off checks and carry out a normal climb.

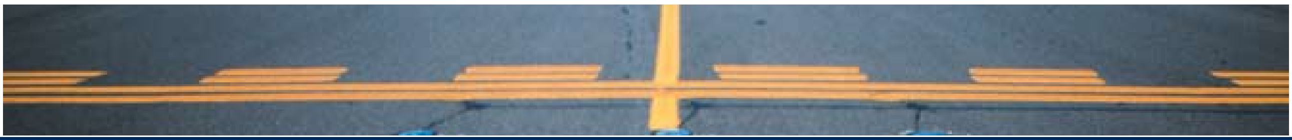
If flaps are used for take-off, point out the dangers of raising them too early.

Demonstrate simulated engine failure after take-off from about 500 feet. Point out that it is essential to assume the gliding attitude and speed very quickly. Choose a landing area ahead keeping alteration of heading to a minimum – see Figure 11-3. Change fuel tanks quickly if possible. Use flaps or sideslip as necessary. If changing fuel tanks has had no effect, turn off the fuel, ignition and master switch before impact. In most aeroplanes it may be advisable to unlock doors or hatches if time permits.

CROSS WIND TAKE-OFF

Demonstrate that the take-off technique to be used in a cross wind is very similar to that used for a normal take-off. However, it may be necessary to make more positive use of the rudder to prevent the aeroplane yawing into wind. In addition the aeroplane is held firmly on the ground by a forward movement of the control column until flying speed has been attained, then it is flown off cleanly and positively by a backward movement of the control column. Once well clear of the ground turn into the wind to counteract drift so that the track is a continuation of the take-off path. Climb in the usual way. On most aeroplanes it is recommended to have 'the ailerons into wind' during the take-off run. With this technique the pilot must be prepared for the ailerons to suddenly take effect.

Demonstrate that should engine failure occur after take-off the actions are the same as for the into wind case except that it may be advantageous to turn into wind if height permits.



SHORT FIELD TAKE-OFF

When completing the vital actions before take-off lower the flaps to the optimum lift setting.

Line up on the selected take-off path making use of all the available space.

Apply the brakes and open the throttle to the maximum power setting at which the brakes will hold, then release the brakes and continue to open the throttle to full power if not already applied.

Gain the flying attitude as soon as the elevators are effective then ease back on the control column so that the aeroplane becomes airborne as early as possible.

Point out the short take-off run to the student.

When airborne establish a climb using take-off power and the speed which gives the maximum angle of climb.

When the obstacles (actual or simulated) are cleared resume a normal climb, raising flaps when it is safe to do so.

When practicing this exercise on a surface where loose stones and gravel are present, point out that the take-off run is only slightly increased if power is applied whilst rolling forward slowly rather than while stationary against the brakes, when serious damage may result from stones being thrown up into the propeller.

Demonstrate that should engine failure occur during the maximum angle climb a very positive forward movement of the control column is essential if control of the aeroplane is to be maintained.

COMMON FAULTS

Over controlling and lack of co-ordination are usually caused by muscular tenseness (demonstrated by too firm a grip on the control column) brought about by the high degree of concentration required in the initial attempts. Encourage the student to relax as much as possible and that will only be achieved if the instructor appears to be relaxed.

Difficulties in this sequence (and the following sequence) may be the result of rushing the earlier sequences and introducing circuit training too early.