12
APPROACH AND LANDING

AIM

To teach the student to land safely under various wind and runway conditions.

INSTRUCTIONAL GUIDE

Before the first solo flight the student must be able to make competent engine assisted approaches and landings and be able to go around again safely. Glide approaches and landings must also have been practiced sufficiently for the student to be able to attempt a landing in the event of engine failure and still land if the aeroplane is slightly high on final. The remaining sequences of the Air Exercise should be covered after the first solo.

Many students have difficulty in mastering the approach and landing. This is a matter of judgment and there is no simple way of teaching judgment to those to whom it does not come easily. Proficiency is attained mainly through practice and although the instructor's advice and guidance is of great help in the early stages any attempt to analyze the student's difficulties too specifically should be delayed until he or she has had a fair amount of practice. Until this practice is gained the errors are likely to be of a random nature while the student is becoming accustomed to the appearance and feeling of a good landing. After the student has grasped the basic requirements any errors will normally form a consistent pattern which can be recognized, analysed and corrected.

It is important that the instructor demonstrates quite frequently the type of approach and landing being taught.

Many instructors are reluctant to do this as they feel that they are depriving the student of one more approach and landing. This is not true. Only by seeing and retaining a mental picture of this exercise can the student learn to land the aeroplane.

The completion of the touchdown should be judged by the change in attitude of the aeroplane rather than by movements of the control column. The attitude should be changed by reference to the landing horizon (edge of airfield) and the front of the aeroplane. The idea may be helped if the instructor places the aeroplane in the approximate position on the airfield where it will be touching down, then shows the student the sight picture that will be seen during the landing. In the case of most nose wheel type aeroplanes the attitude in which it rests on the ground has to be modified slightly and this can be done by visualizing the attitude resulting from the main wheels being on the ground and the nose wheel a few inches above the ground.

During the float or hold off period the instructor should watch the student's eyes to see where he or she is really looking. Students normally tend to look too close. Advise them to look ahead and slightly to the left at a point about 50 to 100 meters away. The student's gaze should not be rigid, this point being the centre of what he can see. If the student looks too far ahead objects will hardly appear to move, if too close they will appear to move too fast and become blurred. Both these conditions make judgment very difficult.

Remember that students will rarely make a good landing unless they make a good approach. Good approaches rarely follow bad circuits. It therefore follows that the instructor should not allow the student to attempt landings until he or she can fly a reasonably accurate circuit and approach.

To do so will, in most cases, only discourage the student when the almost inevitable bad landing follows. It is well to remember that the aim in teaching consistent square circuits is to develop judgment as rapidly as possible by repetition.

PRE-FLIGHT BRIEFING CONSIDERATIONS

THE CIRCUIT

The so called square circuit is used for training purposes and the student must be given a clear briefing on this exercise. The student should be presented with a diagram of the standard circuit pattern and the following points must be emphasized:

After lift off ensure the aeroplane tracks on the extended centre line of the runway

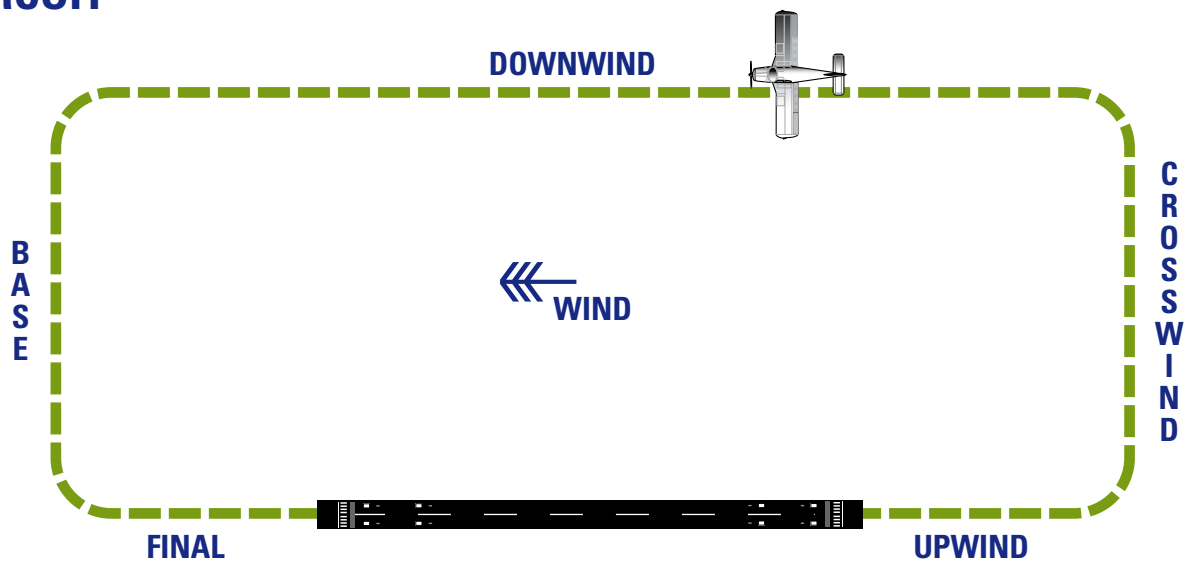
Commence turn onto cross wind at 500FT AGL, or slightly higher in a low powered aeroplanes and allow for drift

- Turn onto the down wind leg in accordance with company policy.
- *Check heading, height, distance out and RPM
- Complete pre landing checks
- *Turn onto base, reduce power, select flap, trim and allow for drift
- Commence turn onto final at about 500FT and select landing flap when rolled out on final

*Explain and demonstrate to the student the correct distance out on down wind' and the base turn position for normal, flapless and glide approaches.

The method of re-entering the circuit should be emphasized though the student will in fact have had practical demonstrations of this during previous exercises. The method used will depend on whether or not aerodrome control, including the use of radio procedures, is in operation.

CIRCUIT



APPROACH INTO WIND

The approach and landing is normally carried out into wind for the following reasons:

(i) It gives the shortest run and lowest ground speed during the subsequent landing

(ii) There is no tendency to drift

(iii) It gives the best directional control during the landing

(iv) The angle of descent is steeper, thus improving the view of the landing path.

The student should also be briefed on the effect of wind gradient. The effect of a sharp wind gradient on an aeroplane approaching to land is a sudden reduction in IAS. This in turn may cause rapid sink followed by a heavy landing or even failure to reach the runway before striking the ground.

The use of flaps during an approach will give the pilot:

(i) A steeper path of descent at a given speed and power setting

(ii) A lower stalling speed, thus permitting an approach at a lower airspeed.

The amount of flap used will depend on the type of aeroplane and the wind conditions prevailing. In strong crosswinds it is generally preferable to use only partial flap in most training aeroplanes. The student must be briefed on this point so that there is in no doubt as to the amount of flap to use.

ENGINE ASSISTED APPROACH

This should be taught as the normal procedure to make an approach to land.

The use of power on the approach enables the rate of descent to be adjusted safely over a very wide range. However, the instructor must not allow the student to carry out very low flat approaches using high power. Other reasons for power assisted approaches are:

(i) By using selected power settings it is possible to regulate the angle of descent despite varying wind strengths

(ii) The change of attitude when rounding out is small compared with that for a glide approach

(iii) The use of power may reduce the stalling speed and thus a lower approach speed can be used

APPLICATION IN FLIGHT

Brief the student on the method of carrying out a powered approach.

Ensure the student is aware of:

(i) The position in the circuit from which to commence the approach

(ii) The approach speeds to be used

(iii) The flap setting to be used

(iv) The selected approach speed is normally controlled with the elevator and the rate of descent and thus the approach gradient is controlled with the throttle. There is another school of thought who believes it best to teach attitude to control aiming point and power to control IAS. However, the method to be employed, which may be variations of the above, is the decision of the CFI responsible for the operation.

There are a number of views on how to achiever a satisfactory landing, including a mathematical model. However, as stated earlier the teaching technique to be employed is the responsibility of the CFI

GLIDE APPROACH

The main features of the glide approach are:

(i) As there is no power with which to adjust the rate of descent a high standard of accuracy is required to judge the position on the base leg at which to close the throttle. Development of this aspect of judgment is important for the later emergency exercise simulating complete loss of engine power

(ii) The rate of descent is high and the angle of descent may be steep

(iii) A considerable change of attitude is made during the round out. The round out must therefore be started earlier than for an engine assisted approach

APPLICATION IN FLIGHT

Brief the student on the method of carrying out the glide approach. Ensure that he is aware of:

(i) The position in the circuit from which to commence the approach

(ii) The approach speeds to be used

(iii) The flap setting to be used

(iv) The necessity to maintain the correct speed with the elevator. Brief that should there be any doubt about reaching the runway power should be used early. If the student is overshooting badly the approach should be abandoned.

LANDING

The student should be in no doubt as to the type of landing he or she is to perform.

NORMAL LANDING

The aeroplane is landed on the main wheels with the nose wheel held off the ground. However, the nose wheel is usually held only a small distance off the ground in an attitude which is very little different from that of a normal engine assisted approach. Consequently only a small change of attitude is required when rounding out.

FLAPLESS LANDING

This type of landing may be used in gusty or strong cross wind conditions or in the event of mechanical failure of the flaps.

The descent path may be flatter, making judgment more difficult and an engine assisted approach should be made. An additional advantage in using power is that the lowest safe speed during the flapless approach is obtained with power on. Ensure that the student is aware of this recommended speed. Due to the absence of drag there may be a longer float period.

EFFECT OF CROSS WIND

The initial part of the approach is similar to that of a normal into wind approach and landing, except that the turn on to the final leg has to be started earlier or later than usual, depending on the cross wind direction. There are two recognized methods of making the final approach. They are:

(i) To counteract the drift by sideslipping the aeroplane into wind (banking into wind) sufficiently to keep the resultant path of descent in line with the intended landing path

(ii) To counteract the drift by heading slightly into wind keeping the wings level, so that the aeroplane tracks along the intended landing path

The second is the most suitable method for most modern aeroplanes. This method has therefore received greatest emphasis in this manual. The student must have one of these methods carefully explained to him and should become competent at employing this one type before being introduced to the alternative method.

Regardless of the method employed the student must carry out engine assisted approaches under cross wind conditions.

During the final stages of the approach there is normally less drift as the wind speed decreases near the ground. However, this is sometimes offset by the reducing airspeed during hold off. The temptation to align the aeroplane with the intended landing path too soon must be resisted.

Consideration must be given to the amount of flap used in cross wind conditions. In some light aeroplanes it may be best to use no flap at all in a strong cross wind, or the normal landing setting in a light cross wind. Some aeroplane manufacturers give specific advice on the use of flap in these conditions. Instructors must be aware of this and teach their students accordingly.

The student should be briefed to expect that as the speed of the aeroplane decreases during the landing run, the tendency for it to weathercock into wind will increase. Normal steering methods should be employed to keep straight, but students should be made aware of the need to use coarse opposite rudder, with brake if necessary.

SHORT FIELD LANDING*

* 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 landing technique is applicable.

The short field landing technique is of great value when the pilot is forced to use a landing area of marginal length or when the pilot is either unfamiliar with or unsure of the condition of the landing surface.

Note: Remind the student that the recommended speed may be lower than for the normal engine assisted approach, and aim to attain this speed as the aeroplane crosses the airfield boundary at the minimum height consistent with obstacle clearance.

As with a normal engine assisted approach the airspeed is normally controlled with the elevators and the rate of descent with the throttle. Because of the low speed the aeroplane will touch down without float, or with minimum float, when the throttle is closed. It may be necessary to increase power momentarily to arrest the rate of descent and to prevent the aeroplane landing heavily. This applies particularly when a strong wind gradient is experienced. Full flap should normally be used.

The already short landing run may be further shortened by the judicious use of brakes.

MISS LANDING AND GO AROUND PROCEDURE

In the early stages the student must be briefed that he or she must not try to convert a bad landing into a good one but must, without hesitation, go around again. Similarly the student must be briefed to go around again if the aeroplane is held off too high.

The following points must be emphasized:

(i) The application of full throttle or normal take-off power, as applicable

(ii) The speed for the climb out whilst still in the landing configuration

(iii) The method of raising flap

(iv) That large changes of trim may be experienced during this procedure.

As the student progresses he or she must be briefed on and have demonstrated the method of converting a poor but not dangerous landing into a good arrival. This involves the use of power to prevent any high rates of descent and, in the case of single engine propeller aeroplanes, to increase the effectiveness of the elevator and rudder. The student must be warned that the only way to recover from an extreme attitude or abnormally low airspeed is to apply the full go around procedure.

AIRMANSHIP

The following points of airmanship must be stressed both before flight and during the air exercise:

(i) The often large number of aeroplanes in the circuit demands a particularly careful lookout

(ii) Turns in the circuit must be limited to medium angles of bank except in emergency

(iii) All checks must be carried out thoroughly

(iv) After landing, the aeroplane must be taxied according to the local regulations but in all instances must give way to other aeroplanes taking off and landing.

AIR EXERCISE

(a) Engine assisted approach

(b) Glide approach

(c) Normal landing

(d) Flapless landing

(e) Cross wind landing

(f) Short field landing

(g) Go around procedure.

ENGINE ASSISTED APPROACH

This demonstration commences on the down wind leg. Show how to judge the distance from, and how to remain parallel to, the landing path. Carry out the down wind checks. Show the position at which to turn on to base leg.

On base allow for drift. At the appropriate point reduce power and settle at the correct speed for the turn in. Select flaps as required and re-check the landing drills. Turn on to the final leg then set the airspeed as recommended for the final approach. Control the airspeed with the elevator and the rate of descent with the throttle, showing how to adjust the approach path to achieve the required touchdown point. Demonstrate how to carry out the type of landing applicable. Ideally the power should be reduced smoothly whilst the aeroplane is being placed in the landing attitude so that the throttle is closed completely just as the wheels touch the ground.

GLIDE APPROACH

As with the engine assisted approach, commence instruction for this exercise whilst on the down wind leg. Carry out appropriate checks, then turn on to base leg and re-check all landing drills. When within guaranteed gliding distance of the intended landing point, close the throttle, settle at the required gliding speed, set flap and trim.

Demonstrate that by turning either towards or away from the airfield, correction can be made for undershooting or overshooting. When nearly opposite the landing path turn on to the final leg. During basic training a straight descent should then be made from a height of not less than about 400FT.

Keep the flaps at a setting less than the normal landing setting until it becomes obvious that there is surplus height to be lost, and then set them as required. Maintain the correct speed with the elevators.

Demonstrate where to commence the round out, pointing out that the change of attitude is much greater than when carrying out an engine assisted approach.

Make the type of landing applicable to the aeroplane type.

NORMAL LANDING

Approach and round out the aeroplane in the normal manner. Keep the aeroplane flying just above the ground by progressively moving the control column back until the main wheels touch down. At this point continue to move the control column back to prevent the aeroplane pitching forward suddenly. The nose wheel should then be kept off the ground if possible whilst the speed decreases, but it should be lowered to the ground before elevator control is lost. Brakes should not be applied until the nose wheel is firmly on the ground.

FLAPLESS LANDING

After completing the pre-landing checks continue down wind. Turn on to base leg then commence the approach which should invariably be engine assisted.

Maintain the recommended speed which is normally higher than when flaps are used. Point out that there is usually a smaller round out angle and the possibility of a longer float which occurs before the aeroplane touches down. Use the brakes normally and, when the aeroplane has stopped, draw attention to the much longer distance covered.

CROSS WIND LANDING

Demonstrate how the down wind leg is flown allowing for drift in order to track parallel to the landing path.

When turning on to the final leg show how to allow for the different radius of turn due to the cross wind, by turning either early or late according to the direction from which the wind is coming.

During the final approach head the aeroplane sufficiently into wind so that the path of flight is along the intended landing path. Place the aeroplane into the landing attitude, still with this correction for drift applied, then just before touchdown apply rudder smoothly to yaw the aeroplane so that it heads along the landing path. Use the ailerons to keep the aeroplane level whilst applying this rudder.

Another technique is to fly 'wing down into wind' on final, effectively controlling direction with bank angle, touching down on the into-wind wheel first.

A combination of both the above techniques are commonly used.

After landing, the nose wheel should be placed firmly on the ground in order to improve directional control through the nose wheel steering. In all aeroplanes make careful use of the rudder and brakes to prevent the aeroplane from swinging into wind i.e. weather cocking.

SHORT FIELD LANDING

Carry out a normal circuit and after the turn on to final approach lower additional flap as required. Remind the student that full flap should normally be used for this type of approach. Progressively decrease the airspeed, aiming to cross the boundary at the correct airspeed for this type of approach*. Point out that there is very little round out owing to the aeroplane's attitude. Demonstrate that when the aeroplane is near the ground the rate of descent is checked with the elevator, assisted by an increase in power, if necessary. When the aeroplane is at the correct hold off height, close the throttle and land. Point out the absence of significant float.

*In the early stages of training the approach speed should be stable from early final as some students cannot cope with reducing speed approaches i.e. changing approach profiles.

Lower the nose wheel or ensure that the tail wheel is on the ground as applicable and apply brake.

GO AROUND PROCEDURE

This procedure must be demonstrated both in the air before touchdown and after a bad touchdown resulting in a bounce.

When demonstrating the exercise whilst still in the air first apply take-off power. Trim, then hold the aeroplane level until the recommended climbing speed with flaps down is obtained, and then raise the flaps to their optimum setting. At a safe height and speed raise the flaps fully and resume a normal climb.

Demonstrate that after a bad landing or if the aeroplane is held off much too high the procedure is to go around again. In this case care must be taken not to fly back into the ground in a nose down attitude. Unless the POH sates otherwise a positive rate of climb or at least level flight must be established before flaps are raised to their optimum setting as quickly as possible on most aeroplanes.

As the student progresses demonstrate that a poor but not dangerous landing may be converted into a good arrival by judicious use of power. However, caution must be exercised when using this technique on relatively short runways as the landing roll can be significantly increased.

COMMON FAULTS

Causes of bad landings include:

- Failure to round out sufficiently. This may be due to the approach being too steep or the student may be getting tense when the ground appears to rush up at him or her
- Beginning to hold off then ceasing to do so. Make sure that the student is looking well forward of the aeroplane and realizes that a backward progressive movement of the control column is necessary right up to the point of touchdown
- Holding off too high consistently. This can often be overcome by demonstration i.e. flying low over the runway at hold off height
- General difficulty with all stages of landing up to the point of touchdown. This may be due to faulty approaches at incorrect speeds and poor use of power. An inadequate view due to the seat position being too low can also cause this
- In giving too much attention to the actual landing after an engine assisted approach the student often fails to close the throttle in the final stages. This delays the touchdown
- Having touched down successfully a student often has difficulty in controlling direction during the landing run. This may be due to relaxing concentration after touchdown or conversely being too tense and over controlling. Another cause may be that the student has been given too many touch and go landings and lacks practice in controlling the landing run
- Student lining up the cowling parallel to the edge of the runway and touching down with self induced drift
- Student inadvertently applying left aileron when moving the control column aft (poor ergonomics)
- Student moving head during round out (trying to look over the nose) and ‘losing’ the required sight picture
- Allowing the aeroplane to touch down at too high a speed, often caused by ‘relaxing’ during the hold off.

GENERAL FAULT

Many students do not understand the relationship between power/attitude and IAS on base and final. This often results in making large power changes late rather than timely minor power adjustments.