CIVIL AVIATION AUTHORITY
OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

# Circuit Training

The order for the following ten lessons will be dictated by; the conditions on the day, the student's ability to learn the new material, and their progress in mastering the skills.

All of the circuit lessons must be completed before the student can achieve their first milestone – first solo.

In order for the student to be sent solo in the training area they must have shown their competency in all of the manoeuvres, particularly the solo circuit consolidation training.

Please refer to your CFI for the order your organisation uses.

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# Contents

# Circuit Introduction

The circuit is an orderly pattern used to position the aeroplane for landing and minimise the risk of collision with other aircraft.

Airfields attract aircraft, therefore rules and procedures are required to maintain an orderly sequence or flow of traffic. Knowing that all aircraft should be following these published procedures makes it easier to identify which runway should be used, where other aircraft are (or can be expected to be), and who has the right of way (or priority) in the sequence to takeoff or land.

**Having the right of way does not absolve the pilot-in-command from avoiding a collision.**

The standard circuit pattern or procedure, and the rules to be employed around specific aerodromes are published in *AIP New Zealand*. The rules governing circuit procedures are contained in Part 91, Subpart C.

The skills the student has acquired leading up to this lesson combine so that there is only one new skill to be learnt now – landing the aeroplane.

This briefing is based on the normal lefthand circuit, assuming nil wind or at least wind straight down the runway, with variations to this gradually introduced. Aim to introduce this lesson under ideal conditions. Obviously this will not always be possible and the briefing will need to be modified for the actual conditions on the day. In addition, discuss with your supervisor or CFI the acceptable weather conditions for this lesson.

## Objectives

To takeoff and follow published procedures that conform to the aerodrome traffic circuit, avoiding conflict with other aircraft.

To carry out an approach and landing using the most suitable runway.

## Considerations

### Takeoff

Even though the student will probably have completed a number of takeoffs already, this is an important review of what they may know already, but also introduces some new considerations.

#### *Slipstream*

In aeroplanes where the propeller rotates clockwise, when viewed from the cabin, the effect of slipstream is to apply a force on the port side of the vertical tail fin, and this will tend to yaw the aeroplane to the left at high power settings. This effect is greatest during the takeoff roll as a result of the high power and low airspeed.

#### *Torque*

The effect of torque, the force that tries to rotate the aeroplane rather than the propeller, is to cause increased downward pressure to be applied to the left main wheel. This results in increased resistance on this wheel, yawing the aeroplane to the left.

There are two more effects, but these apply more significantly to tailwheel aeroplanes.

### *Asymmetric Blade Effect*

Asymmetric blade effect is the result of the down-going blade of the propeller meeting the relative airflow at a higher angle of attack than the up-going blade. This effect is noticeable with tailwheel aeroplanes; it will only affect tricycle types in the rotate or climb. It results in the thrust force being slightly offset to the right (in clockwise rotating engines, as viewed by the pilot) and thus a tendency to yaw to the left.

### *Gyroscopic Effect*

The gyroscopic effect occurs when the tail is raised to the level attitude. This causes a force to be applied to the propeller disc, the effect of which will be to produce a turning moment, which acts at 90 degrees in the direction of propeller rotation. Gyroscopic effect has no practical application to tricycle types.

## *Keeping Straight*

Emphasise that rudder should be used as required to keep the aeroplane straight during the takeoff roll by reference to a feature at the far end of the runway, and if available, the runway centreline. Whenever power is changed the aeroplane will yaw, and must be corrected with rudder.

## *Crosswind*

The tendency for the aeroplane to weathercock (point nose into wind) during the ground roll or while taxiing, as a result of a crosswind pushing on the empennage is explained, and the need to keep straight on the reference point is restated. In the air, allowance for drift is necessary to track towards any reference point.

## *Headwind*

The presence of a headwind reduces the length of the ground roll and in an extreme example, if the aeroplane was parked facing into the wind, and the wind was blowing at ________ knots, the aeroplane would be about to get airborne, and they sometimes do in strong winds if not tied down well.

There will be no drift experienced if the wind is directly ahead of the aeroplane, and there is no crosswind component.

## *Tailwind*

A takeoff with the wind would require the aeroplane to be accelerated to the wind speed just to bring the airflow over the wing to a standstill, a further ________ knots would be required to get airborne, greatly increasing the takeoff distance required, for example, just 5 knots of tailwind increases takeoff distance by 30 percent.

Taking off with a tailwind results in a shallow angle of climb, reducing obstacle clearance.

## *Climb Angle*

If the wind was blowing at 70 knots and the aeroplane was in a 70-knot climb, to a ground observer the aeroplane would appear to rise like an elevator, as the distance travelled forward over the ground would be zero. Therefore, the angle of climb is increased (ie, is steeper) into wind, improving obstacle clearance.

## *Takeoff into Wind*

For the above reasons, all takeoffs are into wind, to minimise the ground roll and takeoff distance, and to improve the climb angle.

**Ground roll =**
brake release
to liftoff.

**Takeoff distance =**
distance taken
to achieve height
of 50 feet.

both are
affected

## *Power*

Use full power to minimise the takeoff roll and ensure climb performance.

## *Flap*

Flap increases lift and drag. Because of the drag increase, most light aeroplane Flight Manuals do not recommend the use of flap for a normal takeoff, although this will depend upon the runway surface.

### *Surface and Slope*
Discuss factors that are applicable to the runway being used.

## Landing

### *Wind*
Landing into wind reduces the groundspeed, requiring less stopping distance and therefore a shorter landing distance and ground roll.

**Ground roll =** wheels-on-the-ground distance.

**Takeoff distance =** from 50 feet above threshold to full stop.

both are affected

Once again if the headwind is 70 knots the aeroplane would not need to move forward at all to descend at 70 knots. Therefore, a headwind steepens the approach and improves obstacle clearance.

### *Flap*
Flap increases lift and drag. The increased lift lowers the stall speed and permits a lower and safer landing speed, which will also reduce the ground roll. The increased drag allows a lower nose attitude for the same airspeed, and it increases the rate of descent, steepening the approach which provides improved forward visibility and obstacle clearance.

### *Power*
Power controls the height or rate of descent. As discussed in the *Climbing and Descending* lesson, increasing or decreasing the power alters the rate of descent.

The increased rate of descent as a result of using flap is countered by the use of power to control the rate of descent. In addition, the use of power provides a slipstream effect that makes the rudder and, more significantly, the elevator more effective. Therefore, in a modern light aeroplane the normal approach is a powered approach using full flap. The various reasons for limiting flap during the approach will be discussed under the non-normal circuits.

### *Brakes*
Brakes will need to be used to either slow the aeroplane or bring it to a stop. If carrying out a touch and go, brakes will not be used.

It is very important that you discuss the need for the student to keep their feet off the toe brakes to avoid inadvertent use of the brakes during takeoff or landing.

### *Runway Length*
The student should be left in no doubt that sufficient runway length for takeoff and landing must be available before starting the takeoff or approach.

At this point you can tell the student that you have carried out the necessary calculations. However, before the third or fourth (refer CFI) revision exercise of circuits, a formal briefing or discussion of the Group Rating System and its application must be given. Before the fifth or sixth (refer CFI) revision of circuits, the calculation of takeoff distance by reference to the Flight Manual must be carried out.

> The effects of density altitude, weight, surface and slope are discussed during circuit revision when discussing calculation of required takeoff and landing distances. Therefore, they need not be formally introduced in this briefing, unless any are pertinent to your normal circuit (refer CFI). The effect of these factors will be revised (not taught) during the briefing Short Field Takeoffs and Landings.

### *Windshear*
The effects of windshear may be discussed in this briefing (refer CFI) or incorporated in the second lesson on circuits.

# Airmanship
Throughout circuit training you should place more and more emphasis on the student's command decision making.

## Checklists
Checklists, as well as the use of a kneepad to record ATIS (Automatic Terminal Information

Service) information, fuel endurance and clearances, will assist in the retention and processing of information.

It is well known that humans are limited in their ability to recall information accurately from memory. The use of written checklists for normal and emergency operations is reasonably common in general aviation. However, basic flight training still tends to use mnemonics exclusively for all operations. What is learnt first is generally accepted as being the correct method, therefore, the use of checklists should be encouraged during basic training.

There are two ways to use a checklist. It can be a list of things to do, as used with complex aeroplanes or systems, or a list to check off things that have been done, as used with simple aeroplanes or systems. General aviation basic training tends to use mnemonics to complete the checks, while confirming that checks have been completed by using a written checklist.

Correct use of the aeroplane radio and checklists will influence situational awareness.

### Right-of-Way Rules

As there will be several preflight briefings during circuit revision, the right-of-way rules can be spread over these briefings.

The suggested rules for discussion in this briefing are:

- aircraft taking off and landing have right of way over all other traffic,
- aircraft landing have right of way over aircraft taking off,
- aircraft established in the circuit have right of way over joining traffic,
- the good aviation practice considerations of avoiding overtaking or cutting in, and
- the application of the right of way rules while taxiing.

The rules or good aviation practice considerations most pertinent to your operation should be considered first, for example, circuit direction and altitude.

## Aeroplane Management

The importance of normal instrument readings is revised.

**SADIE** checks are introduced.

***S*** ***S****uction*
gauge is operating in the green range.

***A*** ***A****mps or* ***A****lternator*
is functioning correctly.

***D*** ***D****irectional Indicator (DI)*
has been synchronised to the compass and is functioning correctly.

***I*** ***I****ce*
existence of carburettor ice has been checked for and the carburettor heat applied if required.

***E*** ***E****ngine*
temperatures and pressures are in the green range.

### Human Factors

Good communication (radio, ATIS), preflight/in-flight planning and regular practise will minimise disorientation. In addition the student should be asked to describe the wind direction and strength to help orientate them.

Visual landing cues should be introduced in this lesson, and the various aspects of visual limitations previously discussed should be revised.

During circuit training there is a possibility the student may reach a learning plateau, where progress may appear to be minimal, discuss this with your student if it happens to them.

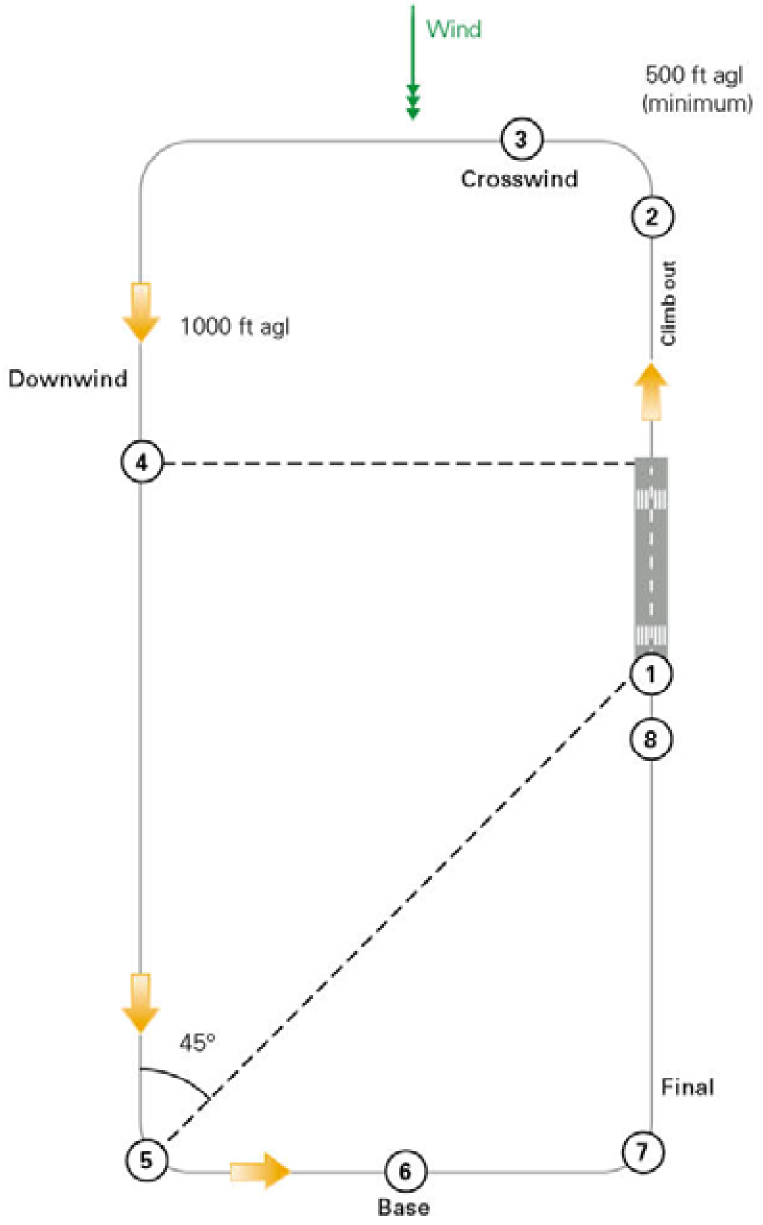
> On the downwind leg, although the physical eye height of students will vary, the effect on the judgement of spacing will be negligible. However, your perspective from the righthand seat may be noticeably different and must be compensated for, as it is what the student sees that is important.

## Air Exercise

One method, you may like to use, is to draw the circuit pattern and number and identify the various points around the circuit at which the listed actions are carried out.

Since each lesson leading up to the circuit involved one or more legs of the circuit, this lesson is primarily revision and application, with emphasis on the new material – the landing.

**Figure 1**



## ① Takeoff

Only the main points are revised, for example, reference points, keeping straight and rotate speed if applicable, as the student will probably be doing the takeoff by now.

Two reference points should be chosen on lining up (backed up by the DI), one at the far end of the runway on which to keep straight during the takeoff roll, and one higher up to keep straight on during the climb.

This second reference point may need to be modified, if a crosswind is present, to prevent drift and provide a straight track over the ground along the extended centreline.

On lining up, the aeroplane should be allowed to roll forward a short distance on the centreline to ensure the nosewheel is straight and aligned with the centreline.

Once on the runway the aeroplane is held on the foot brakes (if required), never on the park brake. When taxiing, forgetting to release the park brake is easily and rapidly identified, however, with the application of full power for takeoff, the poor acceleration may not be recognised early enough.

> In aeroplanes fitted with only a hand-operated brake, if the brake is applied once on the runway, the hand applying it should not be removed until the brake is released.

Early in the takeoff roll, with full power applied, temperatures, pressures, rpm and airspeed should be checked for normal readings.

During the normal takeoff, the aeroplane is seldom actually rotated. Common practice is to use elevator backpressure to take the weight off the nosewheel as the aeroplane accelerates. The aim is to reduce the loads on the nosewheel (the undercarriage weak link) and reduce friction. As the aeroplane continues to accelerate it will fly off in a slightly nose-high attitude and rapidly accelerate to the nominated climb speed.

'Rotate' generally refers to rotating the aeroplane about its main wheel axles into a nose-high attitude to increase the angle of attack and lift the aeroplane off the ground. Commonly this is done at a speed just above the stall speed (about 5 to 10 knots). The aim of this procedure is to minimise the retarding effects of the ground roll, and is often used on soft surfaces or on runways of minimum length. There may, however, be an appreciable delay in accelerating to climb speed.

Maintain the appropriate pitch attitude until reaching the nominated climb speed, and then hold the climb attitude and trim.

## ② Climb Out

Each leg of the circuit is named and explained. The first leg – climb out – is the leg on which separation from other aircraft in the circuit is achieved. This is because the aeroplane groundspeed is at a minimum while climbing into wind, and therefore the circuit pattern is minimally distorted. The practice of trying to provide adequate separation from aircraft ahead during the downwind leg, where the groundspeed is at a maximum, should be discouraged as this tends to unnecessarily stretch out a busy circuit. Therefore, although a climbing turn onto crosswind may be started at 500 feet agl, the actual height at which the turn is started will be dictated by traffic ahead.

Where no conflict with traffic ahead is anticipated, the turn should be started at 500 feet agl – this will assist any following aircraft. Ensure an appropriate lookout is conducted, and reference point identified.

During the climb out and at a safe height, not less than 300 feet agl, the after takeoff checks are completed. A check is made (glance back) to confirm whether the chosen high reference point is maintaining the aeroplane along the extended centreline. If not, an adjustment to the chosen reference point is made.

> If flap is used, retraction heights and speeds need to be discussed.
>
> At night runway heading (DI) is maintained to avoid spatial disorientation.

## ③ Crosswind

The crosswind leg is at 90 degrees to the climb out path and in the circuit direction. Before starting the turn, lookout is stressed and a reference point onto which to turn is chosen.

Commonly, this is a point on the horizon off the wingtip. However, since the aim is to track over the ground at right angles to the runway, the reference point will need to be modified to allow for drift.

## ④ Downwind

For many situations the turn onto downwind is made when the aeroplane is at 45 degrees to the upwind threshold, onto a suitable reference point so as to track parallel to the runway, and the aeroplane is levelled at circuit altitude. This may require the aeroplane to be levelled before, during or after the turn onto downwind. Lookout is again stressed, especially for aircraft joining the circuit on the downwind leg.

The downwind radio call is given abeam the upwind end of the runway to positively establish your position in the circuit for other traffic and Air Traffic Control (ATC) if applicable. If the radio call is delayed for any reason until abeam the threshold, or later, the call should be "late downwind."
As a common courtesy, and to promote situational awareness for all traffic in the circuit, the downwind call should include your intentions, for example, full stop or touch and go. If your position in the circuit is advised by ATC, for example, "number three", a visual search must be made to positively identify the positions of the appropriate number of aircraft ahead. This is generally achieved by scanning from the threshold back along the approach path and base leg, counting off aircraft sighted, ahead of you.

### *Checklists*

The attempt to standardise checklists across aeroplane types may result in irrelevant checks becoming so automatic that they are not actually carried out when required. Latent errors do exist within checklists, and it is recommended that the normal checklist be type specific and backed up by a written checklist (refer CFI).

Thus the use of BUMFH is considered irrelevant for fixed-undercarriage types and generally wrong for retractable types. Most aeroplanes with retractable gear require the undercarriage to be extended before the brakes can be checked for pressure. So the mnemonic should be UBMFH when flying aeroplanes with retractable undercarriage.

The prelanding checks are completed.

***U*** ***U**ndercarriage*
Down and locked (If your organisation includes it at this stage for consistency with later training.)

***B*** ***B**rakes*
Pressure checked, and park brake off

***M*** ***M**ixture*
RICH

***F*** ***F**uel*
On the fullest tank, fuel pump ON and pressure checked

***H*** ***H**arnesses and Hatches*
Secure and doors or canopy closed

### *Spacing*

To judge spacing, a feature of the airframe is assessed against the runway; for example, in most low-wing aeroplanes the correct spacing is achieved when the wingtip runs down the centreline, as observed by the student. In the PA 38, which has very long wings, the outboard flow strip is used, and in high wing aeroplanes the spacing is normally one third of the way down the wing strut from the tie-down end. This can be difficult for the student to see, and there may be some value in marking the strut with tape or a felt-tip pen at the approximate position on the strut through which the runway should cut.

The spacing should be assessed and then corrected at the base turn, allowing for any drift. Do not weave downwind in an effort to correct the spacing. The reference point may be altered in order to maintain a parallel track to the runway. In nil wind the DI should show the reciprocal of the runway in use.

## ⑤ Base Turn

The turn onto base starts at approximately 45 degrees to the threshold. Emphasise the lookout and choose a reference point off the wingtip. Carburettor heat is selected ON, power reduced and a level turn started to bring the airspeed into the white arc. Once in the white arc, 10–20 degrees of flap is selected and, as the airspeed approaches the nominated descent speed, the correct descent attitude is selected, held and trimmed.

The power setting chosen at the base turn depends on the assessment of the downwind spacing (close, correct or wide) and the proximity to 45 degrees from the threshold when starting the turn (early, correct, late). Commonly, 1500 rpm is used as a guide, and this is based on the correct spacing downwind and 45 degrees to the threshold. Any other condition will require a higher or lower power setting; for example, close downwind but correct at 45 degrees, try a lower power setting, say 1300 rpm.

The turn is continued onto the reference point with an allowance for drift or until the leading edge of the wing or wing strut is parallel with the runway (allowing for drift).

> Avoid using ground features as turning reference points as this may cause difficulty for the student at an unfamiliar aerodrome.

## ⑥ Base Leg

Once established on base leg additional flap is extended and the attitude adjusted to maintain the nominated approach airspeed.

At the base turn, the student should be encouraged to estimate what power setting they would require, to take them to the threshold in a steady descent without any changes. This does not mean that the power setting should not be altered if required.

Before the descending turn onto final, emphasise the lookout, especially along the approach path to ensure no other aircraft are on long final.

The roll out onto final, or approach leg, must be anticipated so that the wings are level at the same time as the aeroplane is aligned with the centreline. Throughout the turn the angle of bank should be adjusted to achieve this by about 500 feet agl. The nominated approach airspeed should be maintained by adjusting attitude.

During the approach, as with all phases of flight where the intent is to maintain a specific airspeed, it is important to emphasise that the correct attitude, for the desired airspeed, should be selected, held and trimmed.

**Attitude controls the airspeed**

## ⑦ Final

When established on final, full flap is selected at the appropriate time and the airspeed maintained, or allowed to decrease to threshold crossing airspeed through attitude adjustment (refer Flight Manual and CFI).

Because of the possibility of large flap deflections and the aeroplane’s low altitude, extending flap during the turn onto final is avoided.

The approach path is monitored by reference to the correct runway perspective. Throughout the descent the aiming point, commonly the runway numbers or threshold, is monitored and the power adjusted as required to maintain a steady rate of descent to touchdown.

**Power controls the rate of descent**

With the aeroplane trimmed to maintain the required attitude (airspeed), if the aiming point moves up the windscreen, the aeroplane is undershooting – increase power. If the aim point moves down the windscreen, the aeroplane is overshooting – decrease power. If the aeroplane is correctly trimmed the power adjustments will be quite small; these are often described by the term “a trickle of power.”

On short final in anticipation of any requirement for full power, carburettor heat is selected COLD when a landing is assured.

### ⑧ Landing

The landing is one smooth manoeuvre designed to slow the rate of descent to zero and the speed to just above the stall speed, as the wheels touch the ground. This manoeuvre consists of two phases, the round-out and the hold-off, also known as the flare. This is essentially a progressive transition from a descent into a flared landing attitude, similar to a power off stall, with touchdown just before the moment of stall.

The round-out begins at a suitable altitude for the aeroplane's speed. For a normal approach this is described as about 50 feet.

When the landing is assured, often pattered as "crossing the fence", the throttle is closed, and at about 50 feet the nose attitude progressively raised – the round-out. As the airspeed decreases the aeroplane will start to sink. The sink is observed by looking outside at the far end of the runway (or horizon) and this is the point where the second phase of the landing process begins. The most common errors made by students during the round-out is not looking far enough ahead and lowering the nose in an attempt to fly down to the ground.

The hold-off involves a gradual increase in backpressure to control the rate of sink and to achieve the correct attitude so that the touchdown is light and on the main wheels only. During this phase the student's focus is gradually shortened to facilitate depth perception and provide cues about the sink rate until, at touchdown, the point of focus is just ahead and slightly left of the aeroplane's nose.

Following touchdown on the main wheels, the nosewheel should be gently lowered with elevator by relaxing the backpressure and lowering the nose onto the runway.

Keep straight on the runway centreline with rudder by reference to a point at the far end of the runway, and apply brakes as required.

Under ideal conditions, during the student's introduction to the circuit, each circuit is flown to a full stop and the aeroplane taxied to the holding point for another takeoff. Therefore, the considerations of a touch and go and the go around are deferred to the next circuit lesson – *Circuit Considerations*.

Although including the go around in this briefing can generally be deferred, it is not always convenient in a busy circuit to carry out full stop landings. Therefore, a brief discussion on the touch and go procedure may need to be included in this briefing (refer CFI).

Should a go around be required during this introductory exercise, it is recommended that you take control and patter the procedure.

The after landing checks are normally completed clear of the runway.

## Air Exercise

### On the Ground

The student should be capable of taxiing to the appropriate holding point and carrying out at least some of the checks and using the checklist. Complete the takeoff safety (or emergency) brief for the student, inform them that you will cover this in a future lesson, and then you will be asking them to do their own.

### The Exercise

Start by giving a demonstration of an ideal circuit, followed by pattering the student through a circuit.

The student should be able to fly almost all of this exercise, but will probably still need help with the landing. Let them fly as much as possible – they will only learn by doing, and they need to be doing it consistently for themselves before they can go solo.

You will need to talk them through most of this exercise, but as the circuit lessons progress you will find yourself saying less and less.

### After Flight

Reassure the student that even though there seems to be a lot to fit into the circuit there will be plenty of opportunities to get it right, as all of the following lessons to first solo will be in the circuit.

Encourage them to continue learning the ground checks, and to start learning the prelanding checks.

> During circuit revision, your supervisor will regularly fly with your student, to monitor the student's progress and provide feedback on your instruction. This does not prevent you from carrying out a briefing or discussion before the revision flight, on any of the subjects to be covered before first solo.
>
> Throughout circuit revision, formal briefings or guided discussions will be required to ensure that all environmental factors affecting taxiing and the circuit have been learnt by the student before presenting the student to your supervisor for a pre-solo check flight.
>
> Remember to check English language requirements are met well before first solo is considered.

# Circuit Considerations

This briefing deals with those aspects of a normal circuit that were deferred during *Circuit Introduction*, to avoid student overload.

## Objectives

To continue circuit training.

To use the touch and go and go around procedures.

To use the terms and procedures employed when a deviation from the normal circuit is required.

## Considerations

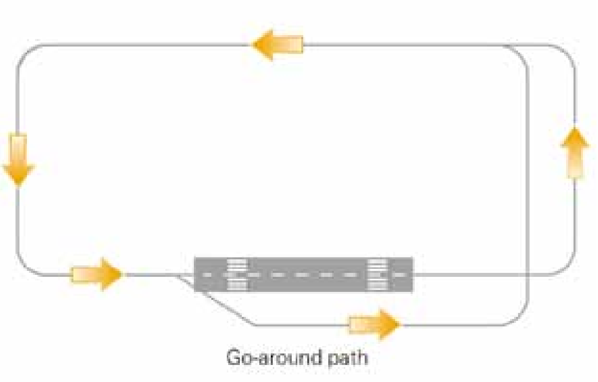
### Touch and Go

The touch and go refers to a normal landing followed by a normal takeoff without stopping or braking. This procedure allows more circuits and landings to be practised, rather than stopping and taxiing back to the holding point – it is most common in a busy circuit.

This procedure is carried out only on runways of more than adequate length, assuming the aeroplane has touched down in approximately the correct place, ie, threshold or numbers area.

## Go Around or Overshoot

Figure 1



At any time after the approach starts the pilot may elect – or be instructed by ATC – to "go around."

The instruction to go around means to discontinue the approach by applying full power (including carburettor heat OFF), climb straight ahead, retract any flap, and follow the circuit pattern to position for another approach and landing.

## Orbit

The orbit is a procedure used by ATC to improve separation from aircraft ahead. An orbit is most commonly carried out on the downwind leg and consists of a 360-degree medium level turn, outside the circuit pattern, which positions the aeroplane back into the downwind leg, at about the same place, approximately one minute later.

As the first half of the turn is completed a conflict with traffic approaching head-on is a real possibility and therefore a good lookout is essential.

An orbit on final or base (with flap extended) should be avoided. The go around procedure is preferred because it is specifically taught before first solo, whereas low-level turns with flap extended are not.

> Where applicable, the CFI should liaise with ATC on the preferred procedure.

## Extend Downwind

Extending downwind is another procedure used by ATC and pilots to improve separation on aircraft in the circuit ahead or joining long final. The aeroplane is flown on the reference point, parallel to the runway, for a suitable distance past the 45-degree base turn point, to achieve separation. The power setting selected at the extended base turn point will need to be higher, and a delay to both flap extension and descent may be required to regain the normal approach profile.

## Repositioning

Repositioning may occur on any leg of the circuit, but it is more commonly at ATC request. This is the preferred method of repositioning where a change in wind direction makes a runway change advisable. Commonly, the aeroplane is flown to the middle of the old downwind leg and then a 180-degree turn made to position the aeroplane on the new downwind leg and the approach begun as normal. For runway direction changes that are not 180 degrees, the heading need only be adjusted to achieve a parallel track to the new runway in use.

Where cross, or multiple, runways exist follow the existing pattern to intercept the new pattern, and if that is not practical pass overhead the aerodrome to rejoin the pattern at the beginning of the downwind leg.

Where this occurs on final, when parallel runways are in use, simply move over to intercept the final approach for the other runway.

## Low Level Circuit

The low-level circuit is carried out at less than 1000 feet agl (or the promulgated circuit height), normally at 500 feet agl. It is most commonly used by instructors, but it may be requested by the pilot or ATC. Only the briefest explanation of this term is included in this briefing for the reasons given in the notes below. How much to include should be referred to the CFI.

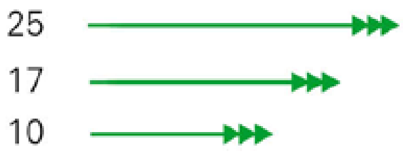
The low-level circuit is generally used by instructors to quickly position the aeroplane for the last part of the approach and landing so that the student can practise more landings. However, its general use is not recommended as all other legs of the circuit are either so rushed that the student has little opportunity to prepare for the landing, or are flown by you, providing the student with little opportunity to practise the other flight phases.

The low-level circuit does not provide an automatic right of way.

The practical application of the low-level circuit will be discussed and practised in precautionary landings. The need to teach low-level circuits before first solo should not arise (refer CFI).

### Wind Gradient

Figure 2



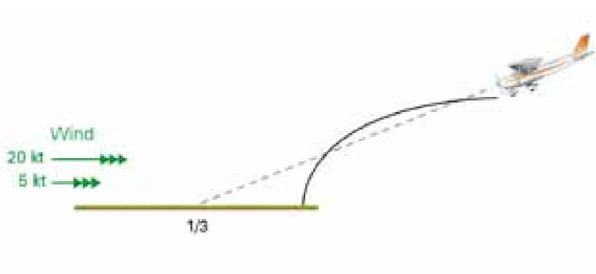
Wind gradient is the gradual decrease of the wind speed near the ground, due to surface friction and the air's viscosity. Discuss the effect it can have on the flare, in particular the inability to touch down at the planned point.

### Windshear

Windshear is a sudden change in wind speed or direction, most common in winds above 10 knots, and it is a hazard at low altitude. Discuss the Terminal Area Forecast (TAF) and/or ATIS contents, especially the relationship between the 2000 foot wind and the surface wind.

A sudden change in wind speed or direction can result in a sudden loss of airspeed and, due to aeroplane inertia, rapid loss of altitude.

Figure 3



The correct response is to apply power to arrest the sink and adjust the attitude to maintain the airspeed.

Where windshear is encountered unexpectedly a go around will probably be appropriate.

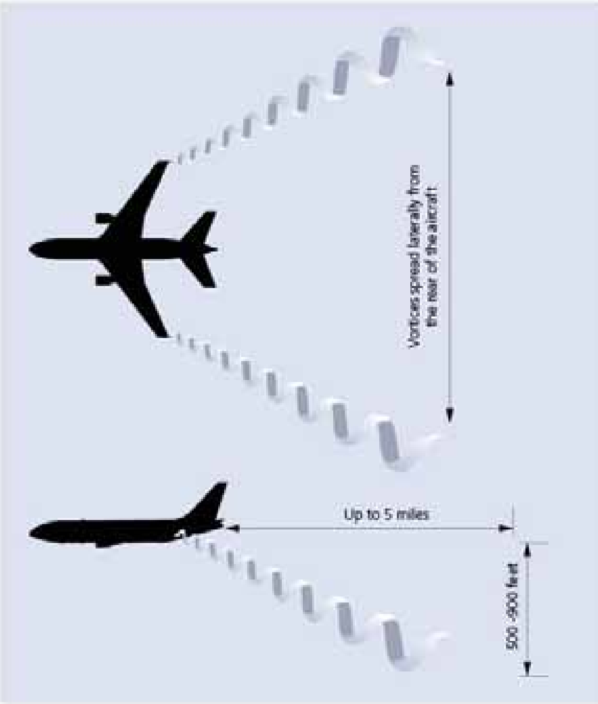
Where conditions of possible windshear (or gusts) are reported or suspected, it is recommended that the approach and threshold speeds are increased. For example, if the approach speed is increased by 5 knots and a sudden change of wind strength results in a decrease of 5 knots in indicated airspeed, the actual approach speed would still be correct.

The decision to continue the approach at an increased approach and threshold speed must take into account available runway length.

### Wake Turbulence

Wake turbulence is a reasonably complex subject and can be dealt with only superficially in this briefing. You may prefer to make this the subject of a separate preflight briefing before the next circuit revision (refer CFI and the *Wake Turbulence* Gap booklet).

Figure 4



Wake turbulence is the disturbed air left behind an aeroplane when its wing is producing lift, and includes propeller slipstream and jet blast. It is encountered when following too closely behind another aircraft, especially a heavier one, and is worst when that aircraft is at high angles of attack and flying slowly – during takeoff or landing.

During the production of lift, air spirals off the wingtips (or blade tips of helicopters) in vortices that increase in size behind the wing, sink, drift downwind, and gradually dissipate.

This turbulence can induce a roll in the following aircraft that control forces cannot counter, and therefore it is extremely dangerous.

Wake turbulence is avoided while taxiing by allowing adequate separation for propeller or jet blast – jet aircraft always have their rotating beacon on when an engine is running.

Before takeoff, allow adequate separation between yourself and heavier aeroplanes ahead (up to 3 minutes in nil wind).

During the approach, avoid getting close behind, downwind or below heavier aeroplanes. For example, if there is a crosswind, fly the final approach slightly upwind of the previous aeroplane or preferably fly above its approach path and descend more steeply.

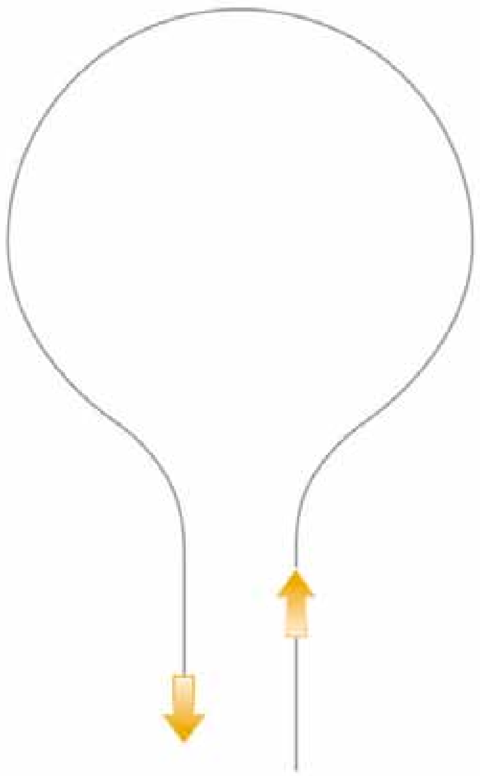
Land past the point of touchdown of the preceding heavier aeroplane – as its nosewheel touches down there is no more lift being produced.

Consider runway length available – an early go around may be more appropriate.

### Dumb-Bell Turn

Fortunately the dumb-bell turn is a fairly rare occurrence. It is used when a change in wind direction makes it advisable to change the landing direction by 180 degrees. On completion of the turn, the aeroplane is repositioned onto final for landing. If a dumb-bell turn is required, the takeoff is continued to a safe height (500 feet agl minimum) and a level turn is started in the opposite direction to the original circuit direction. Then the turn is reversed until an intercept on the final approach path can be made. Clearly, the amount of time available to prepare for the landing will depend on what height and how far out the initial climb is continued to.

Figure 5



No professional instructor would authorise early solo circuit practise when there is any likelihood of these conditions occurring. Likewise, no professional air traffic controller would request a student on first solo to carry out this procedure.

### Glide Approach

Refer to the separate *Glide Approach* lesson.

## Airmanship

Throughout circuit training you should continue to place more and more emphasis on the student's command decision making. The pilot's priority sequence for enhancing decision making whenever a deviation from the expected occurs should be assertively stated.

**Aviate — Navigate — Communicate**

The responsibilities of the pilot-in-command should be discussed with reference to ATC clearances or requests. Every clearance or instruction issued by ATC must be accepted by the pilot-in-command before it is acted upon.

The student should be encouraged to consider the probable outcome of complying with each clearance or instruction, giving due regard to their own capabilities and that of the aeroplane, before accepting the clearance or instruction.

Where the student considers the clearance or instruction to be unacceptable, the student must be encouraged to assert their pilot-in-command responsibility.

The most common mistake in attempting to comply with an ATC request or instruction comes from accepting a clearance to land on an unsuitable runway.

As in all other aspects of aviation, good aviation practice or common sense is a major factor in the acceptance or rejection of ATC clearances or requests. The pilot-in-command has responsibility for the safety of the aeroplane, passengers and crew – but not a right to be obstructive. The clearance, instruction or request should be complied with if, after due consideration, no adverse outcome as a result of complying with the clearance, instruction or request can be foreseen. If the pilot-in-command believes that the safety of the aeroplane may be compromised, then clarification of the clearance, instruction or request should be sought from ATC, an alternative suggested by the pilot-in-command, or the clearance, instruction or request refused.

The student should be fully aware that once a clearance has been accepted, it must be complied with (unless a change to the clearance is negotiated, or the pilot-in-command is reacting to an emergency) and that no matter what the clearance, instruction or request and who issued it, the pilot-in-command is solely responsible for the safety of the aeroplane, passengers and crew.

This may be a good time to remind the student that although you encourage them to make as many command decisions as possible, you are the pilot-in-command. One of the measurements of readiness for solo flight is the student demonstrating pilot-in-command actions.

The requirements for VFR inside a control zone should be revised and the conditions that require a Special VFR (SVFR) clearance introduced.

It is the responsibility of the pilot-in-command to request a SVFR clearance before any of the parameters for maintaining VFR in controlled airspace cannot be complied with. Although it is not anticipated the student would operate in SVFR conditions, some exposure during dual training may provide a controlled experience.

## Aeroplane Management

There are no new aeroplane management considerations for this briefing so revise the **SADIE** checks.

## Human Factors

Improve the student's situational awareness by encouraging them to orient themselves well, telling you which cues they are using for this will help you check that they are using as many as possible.

## Air Exercise

The air exercise discusses the procedures to be used for a touch and go (if applicable) and a go around.

### Touch and Go

The touch and go should be a simple and logical extension of the landing roll.

Once the nosewheel has been lowered to the runway, flap is raised to the normal takeoff position and full power applied for another takeoff. The weight is taken off the nosewheel with elevator, and the aeroplane is allowed to fly off. Keep the aeroplane straight on the centreline at all times.

Reassure the student that you will raise the flap for the student while on the runway – all they need to do is keep straight – and that once the flap is set for takeoff you will say "flap up" and they are then free to apply full power and takeoff. They must not apply power until you have advised them the flap is up.

### Go Around

The go around is initially started at a safe height, once established on final. Ideally, subsequent practise reduces the height at which the go around starts. Circumstances may not permit this gradual introduction to the go around.

Throughout the procedure you should emphasise the correct priority for dealing with the unexpected.

**Aviate — Navigate — Communicate**

The student should be made aware that this is a normal procedure, not an emergency. The student should be encouraged to carry out a go around (and be praised for doing so) at any time throughout the approach to touchdown, if they are not confident about any aspect or parameter of the approach or landing.

Carburettor heat is selected COLD and full power applied. Raise the nose to the level attitude, or slightly above, and reduce the flap setting (as appropriate to the aeroplane type) immediately.

If flap has been extended and the aeroplane trimmed for the descent attitude, there may be a very strong pitch up when power is applied. The student must be made aware of this and be prepared to prevent the nose pitching above the level attitude.

Do not hesitate to raise flap as soon as full power has been applied and the attitude adjusted, it is much better to accelerate over the runway rather than among obstacles in the climb-out area.

As the aeroplane accelerates the attitude is adjusted so that the nose is on the horizon. At a safe height (refer CFI), and safe airspeed (through ________ knots), with a positive rate of climb, the remaining flap is raised gradually and the aeroplane allowed to accelerate to the climb speed. Climb to circuit altitude.

Regardless of when circuit altitude is reached, the aeroplane should be flown upwind along the climb-out path to the normal crosswind turn point. Turning crosswind early will shorten the downwind leg and may rush the student's preparation for the approach. Any decision to turn early must consider other traffic in the circuit and must have ATC approval (if in controlled airspace).

During the go around, flying over the runway would mean flying over any aircraft taking off. The normal procedure, therefore, is to fly just to the right of the runway, so that the pilot has the runway on the left and can observe traffic on the runway or climbing out. This procedure, as with many other general rules in aviation, needs to be tempered with good aviation practice. Where parallel runways are in use, flying to the side of the runway may conflict with traffic landing or taking off on the parallel runway (refer CFI). In this case it may be better to fly along the opposite side, or if it is known that no aircraft are taking off on the runway ahead, to maintain runway heading. If the go around is begun on short final or later, the aeroplane is not flown to one side of the runway during the climb out, because it is known there is no traffic ahead or below that might conflict.

With the aeroplane established in the normal climb and trimmed, it may be necessary to advise ATC that you are "going around."

The other procedures described under considerations (other than low level, which is discussed in the *Precautionary Landing* lesson) are demonstrated and pattered when they occur.

# Airborne Sequence

### On the Ground

The student should be familiar with the checks. They should also be doing most of the radio work on the ground by now.

### The Exercise

This exercise is a repeat of the circuit introduction, except that you will be carrying out touch and go landings. You will need to raise the flap on the runway for the student, until they can manage to coordinate everything themselves.

At an appropriate time, and probably not the first approach and landing, you will introduce the go around, from a sensible height. As the student becomes more practised at the go around, you can gradually lower the altitude at which you give the command.

### After Flight

Keep the student working on their checks. Inform them that you will be expecting them to be doing most of the radio work in the next lesson.

# Engine Failure after Takeoff

Although engine failure in modern aeroplanes is quite rare, the takeoff phase incorporates all the worst aspects of this type of emergency. The aeroplane is usually heavy, slow, low and in a nose-high attitude. These factors combine to provide the least amount of height – and therefore time – available to respond to the emergency. Successfully managing an engine failure after takeoff (EFATO) is dependent entirely upon efficient use of the time available.

The procedure taught in this lesson has been shown to give the best chance of survival in the case of an engine failure after takeoff. Where possible and appropriate during later lessons, the student should complete the manoeuvre to the ground, for example, where there is enough runway ahead to land on. Before doing this, however, consideration must be given to the human factors discussed in this briefing and the limited time available for appropriate actions while all the time remaining in control of the aeroplane.

As with all emergency procedure training, the emergency is simulated in such a way as to ensure there is no danger to the aeroplane or crew.

Considerable time is spent on overlearning a procedure to adopt in case it does happen. The purpose of overlearning is to produce an automatic response that best uses the time available, by overcoming the initial surprise or shock and enhancing the decision-making process.

This briefing discusses engine failure both during and after takeoff.

## Objective

To adopt the recommended procedure in the event of an engine failure at low level (below 1000 feet agl).

## Considerations

### Common Causes and Their Prevention

The modern aeroplane engine is a fairly simple, slow revving (2500 rpm versus average car 4500 rpm) four-stroke engine, and therefore it is very reliable. Its operation requires the mixing of air and fuel and the introduction of a spark. The result is quite predictable. Generally, the reasons aeroplane engines stop can be traced to the lack of one of the following components.

### *Carburettor Ice*

In conditions of high humidity, carburettor ice can form during taxiing and may be hard to detect at low power settings. Being aware of the temperature and moisture content of the air will alert you to the possibility of ice forming, there may be clues in the way the engine is running on the ground.

Selecting carburettor heat HOT is the first action, other than flying the aeroplane, to be taken in the event of any engine failure, and if carburettor icing is the cause of an engine failure it should re-establish smooth engine running. Selecting carburettor heat to HOT also provides an immediate alternate source of air to the carburettor, should the air filter have become blocked during takeoff.

The risk of carburettor ice causing an engine failure is minimised by carrying out the preflight engine run-up. In conditions of suspected carburettor icing, after prolonged idling, it is advisable to cycle the carburettor heat just before takeoff. Be aware of the ground surface when applying carburettor heat. Bypassing the filter can introduce dust and grass seeds into the carburettor, another possible cause of engine failure.

Always ensure that carburettor heat is selected to COLD before opening the throttle for takeoff.

### *Air Blockage*

Another possible cause of the air supply being obstructed is a blockage in the carburettor air filter. In this situation, the carburettor heat, which bypasses the air filter, will provide an alternate source of air to the carburettor. The risk of filter blockage is minimised by carefully examining the air intake during the preflight inspection.

### *Fuel Contamination*

The most probable cause of engine failure is fuel contamination, ie, something in the fuel – most commonly water.

> Most students are surprised to learn that mechanical failure is not the most common cause.

The risk of fuel contamination is minimised by inspecting a fuel sample during the preflight and after-refuelling checks – looking for foreign objects, colour and smell, as well as carrying out the pre-takeoff engine run-up. Be aware that immediately after refuelling some water, if present, will still be in suspension, and a fuel check done too soon after refuelling may not discover this.

Be aware that if the aeroplane is not on level ground, a fuel sample check may not be capturing any water or contamination present.

### *Fuel Starvation*

Fuel starvation occurs when there is fuel on board but it's not getting to the engine.

The most common cause of fuel starvation is the pilot selecting the wrong fuel tank or placing the fuel selector in the OFF position by mistake. Other less common but possible causes are either engine-driven fuel pump failure or blocked fuel lines, injectors or fuel vents.

To help avoid fuel starvation the student must be familiar with the aeroplane's systems and carry out the engine run-up before takeoff.

### *Fuel Exhaustion*

Fuel exhaustion occurs when there is no useable fuel on board, and is less likely to be a factor of EFATO than fuel starvation.

The most common cause of fuel exhaustion is poor in-flight decision making – simply running out of fuel. Another cause is leaving the fuel caps off, this allows fuel to be sucked out by the low-pressure area over the wing surface.

Fuel exhaustion is avoided by careful preflight planning, a thorough preflight inspection and being aware of how much fuel there is on board at all times, use a fuel management procedure such as the *Time in Your Tanks* card.

**Figure 1**

### *Spark*

During takeoff the engine is working at its hardest and, although mechanical failure is still the least likely cause, the risk of mechanical failure is increased.

> Statistically, the first reduction in power after takeoff is the most common time for a mechanical failure to occur. Therefore, if a reduced power setting is to be used for the climb, full power should be maintained to a safe height, and the aeroplane cleaned up and established in the climb before power is reduced.

A thorough preflight inspection and engine run-up should be completed to check for any signs of impending mechanical failure.

## The Aborted Takeoff

Early in the takeoff roll, temperatures, pressures, rpm and airspeed are quickly scanned for normal readings. If anything about the takeoff roll appears abnormal – including the sound – something blocks the runway, or at ATC request, the takeoff should be abandoned, also called 'aborted', by closing the throttle, braking as required, and keeping the aeroplane straight.

## Engine Failure after Takeoff

Remind the student of the concept of Aviate – Navigate – Communicate.

In any emergency situation the first and overriding priority of the pilot is to **fly the aeroplane**. Then if time permits the next two priorities can be attended to, navigate and communicate – in that order. Do not allow your students to feel that the first priority is to communicate, especially if they are trying to respond to requests from air traffic control.

### *Aviate*

Because the aeroplane is slow, low and in a nose-high attitude, an engine failure at low altitude provides little time for decision making. Therefore, the first response must be a positive and automatic movement to lower the nose to maintain best available flying speed and to close the throttle to stop any engine surges affecting the glide. The student must accept that if the engine fails at low level they are committed to a landing.

A pre-takeoff safety brief will help avoid any mindset and improve decision making in the event of an emergency.

### *Navigate*

The second response turning into wind (if applicable or necessary) and choosing a suitable landing site within gliding distance. Without compromising the safe outcome of a simulation, demonstrate good decision-making by talking the student through your decision-making process, this is particularly important when deciding to select flap.

### *Landing Site Considerations*

For a familiar runway, anticipated options should already be available, subject to wind, airspeed, load, and height considerations. The choice of landing sites will be limited by the height and therefore time available, but there is one sure way to improve your options – always use full runway length. Runway behind you is useless. From full length an engine failure at low altitude may present you with the perfect forced landing area – the runway ahead.

The most important consideration when selecting a suitable landing site is to avoid major obstacles – to keep the cabin intact.

Common practice is to limit the choice of landing site to no more than 45 degrees either side of the nose; a simpler and more realistic choice may be to choose anything in the windscreen.

Do not turn back to the runway. A successful turn back to the runway is beyond the capabilities of the student at this stage, but may be discussed in future lessons.

### *Communicate*

This is always last on your list. Make a MAYDAY call to alert others of your situation.

### The Go Around or Overshoot

Once the student has completed the EFATO procedure, you will be asking them to carry out a go around.

In this instance the instruction to go around means to discontinue the glide by applying full power while keeping straight with rudder, raising the nose attitude to the horizon, climbing straight ahead, retracting any flap, and continuing the climb out.

> The early go arounds should be initiated as soon as the student has carried out the immediate actions of lowering the nose and deciding where they will land. Once the student's experience increases they can be initiated at lower levels.

### Takeoff Safety Brief

Because the time available for decision making is short, the anticipated response to an engine failure is briefed before line up.

This type of pre-takeoff preparation is common in multi-engine aeroplanes and, although the choices in a single-engine aeroplane are limited, it is highly recommended. Verbally or mentally preparing a response, through visualisation before an unexpected emergency, has been shown to greatly increase the chances of success.

The takeoff safety brief should include the intentions of the pilot-in-command in the event of an engine failure during the takeoff roll and after takeoff.

The briefing needs to consider the conditions on the day, particularly the direction of the wind in relation to the runway in use. If the wind is not directly down the runway but slightly across, then if an engine failure occurs after takeoff, a gentle turn into wind would result in increased headwind and a shorter landing roll.

The type of terrain off the end of the runway should be visualised and suitable landing areas recalled from memory of earlier flights off this runway.

An example:

> “Engine failure or aborted takeoff before one third of the way along the runway, I will lower the nose, close the throttle and land on the remaining runway. Engine failure after one third of the way along the runway, I will lower the nose, close the throttle, select the best option and execute trouble checks and/or MAYDAY call if time permits.”

## Airmanship

So that there is no confusion between the simulated engine failure and an actual occurrence advise the student that you will close the throttle and use the word "simulating." Any partial power reduction by you during the takeoff is to be considered by the student as a total failure.
You could use the following phrases.

> “I will simulate the engine failure after takeoff by closing the throttle. You are to assume that any power reduction (partial or otherwise) by me during the climb out is a total power failure simulation. During the simulations power will always be available should we need it.”

Any checks that would be carried out in the event of an actual engine failure, which are not actually carried out during the simulated exercise, are known as 'touch checks'. These will be clearly identified in the briefing, and a chance available for the student to familiarise themselves before the flight. A touch check requires the student to state the check verbally and touch the appropriate control, preferably with only one finger, but not perform the required action.

At controlled aerodromes, ATC must be advised of the intention to carry out a simulated engine failure after takeoff and advised when the simulation is complete. Advise the student that you will make these calls.

At uncontrolled aerodromes, a traffic call is made to keep other traffic informed of your movements.

By varying the height at which the simulated engine failure occurs, you are increasing and decreasing the available options for the landing site and the amount of checklist items the student can complete. The student will be making decisions based upon the time they have available, developing their aeronautical decision making skills (ADM).

The student should be advised that this exercise is never to be practised solo.

> EFATO simulations are not to be carried out with passengers on board, nor when following traffic may conflict.

### Trouble Checks

Trouble checks are a way to diagnose (or troubleshoot) the causes of an engine failure and hopefully reinstate engine operation. They cover the most common causes, and give you an increased chance of getting the engine running again.

Critically though, trouble checks are only completed when there is enough time. If there is not enough time – concentrate on flying the aeroplane. It is vital that the aeroplane is consciously flown at all times, and that the pilot is not distracted by carrying out the checks, failing to fly the aeroplane.

The immediate action whenever power is reduced, is to select carburettor heat HOT and carry out the trouble checks. Make sure the student gets into this habit quickly, and it becomes their first action, after aviate and navigate, whenever the throttle is closed.

***F*** ***F**uel*

Selector ON, fuel pump ON (if applicable), change tanks (touch).

Fuel pressure and the contents gauges are checked and compared with the fuel tank selected.

***M*** ***M**ixture*

RICH, carb heat HOT, primer LOCKED.

These are rechecked and the mixture, in the case of partial power, altered (touch) to see if there is any improvement in power or smoothness.

***I*** ***I**gnition*

LEFT, RIGHT or BOTH (touch), check temperatures and pressures

Trying LEFT (touch) and RIGHT (touch) magneto positions for smoother running may keep the engine running. Try to restart the engine with the ignition key if the propeller is not windmilling (touch).

Check the temperatures and pressures for any reading outside the green range.

Further elements of the trouble checks will be introduced in following lessons.

### Shutdown Checks

These are completed if the aeroplane will be landing in order to minimise the risk of fire, but only if there is time available to do them.

***F*** ***F**uel*

OFF.

Pump OFF and tank selector to OFF.

***M*** ***M**ixture*

IDLE CUT-OFF

To stop all fuel from flowing to the engine.

***I*** ***I**gnition*

OFF

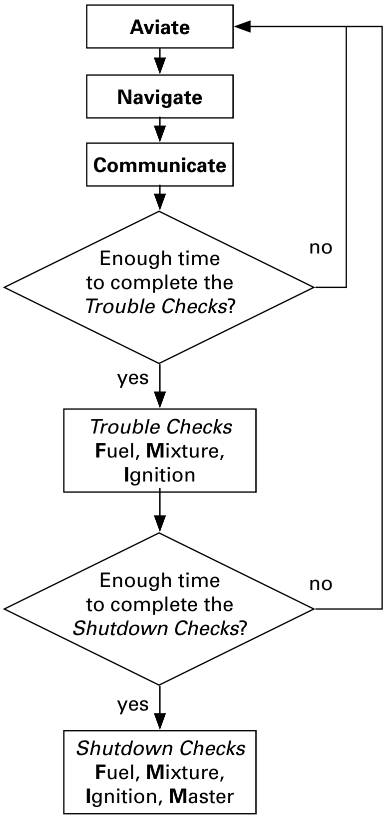
To ensure there is no spark available to ignite any fuel.

***M*** ***M**aster switch*

OFF

After you have made the MAYDAY call and the final flap selection is made, the master switch is turned off to remove power from the aeroplane.

This sequence may be presented in the form of a flow chart.



## Aeroplane Management

Since aeroplane systems management errors are often the root cause of in-flight emergencies, consideration must be given to systems management, regardless of how simple those systems appear. You may like to use a schematic or model to describe the fuel system, as well as providing a handout. The student should operate the fuel cocks, actually turning the fuel off and on, during the preflight inspection.

During the preflight inspection make sure loose articles are secured or removed, there is little point in making the perfect forced landing only to be hit in the head by a heavy article.

As large throttle movements will be made while operating close to the ground, those movements need to be smooth.

Encourage the student to listen to the normal sounds of the aeroplane so that they can be aware of abnormal sounds.

Avoid 'ramming' the throttle to the maximum stops when carrying out a go around.

## Human Factors

Checklists, mnemonics and careful preflight planning allow the student to improve their information processing capabilities.

An engine failure close to the ground can be a stressful experience for the student – even if it is simulated. For the first few engine failures give the student plenty of notice, and as their experience and competence increases, slowly remove the advanced notice.

Continued practise and overlearning the procedure will reduce their stress levels, and their responses will become automatic.

## Air Exercise

Talk through the elements of an appropriate takeoff safety brief. Give the student a written version of your brief.

### Aborted Takeoff

| | |
|---|---|
| **Aviate** | Close the throttle. |
| **Navigate** | Keep straight and use brakes as required – backpressure is used as required to keep the aeroplane weight off the nosewheel. |
| **Communicate** | Advise ATC (if applicable). |

**Keep the cabin intact**. Don't run the aeroplane nose into fence posts, steer between them.

The reason for abandoning the takeoff is simulated by you and the student is talked through the actions. This may be simulated soon after full power is achieved, by advising the student, for example, that oil pressure is (simulated) zero.

Engine failure during takeoff (early in the takeoff roll) is simulated by partially closing the throttle.

### Engine Failure after Takeoff

| | |
|---|---|
| **Aviate** | Fly the aeroplane. **Lower the nose** – close the throttle and achieve best available glide speed.<br>Any nose-low attitude will avoid the stall. Select carburettor heat HOT (as this is a likely cause of rough running) and close the throttle, because a temporary surge in power may divert the student and cause indecision. |
| **Navigate** | Follow the takeoff safety brief and choose a landing site from anything in the windscreen, within easy reach and clear of major obstacles to keep the cabin intact. Use flap as required to reach the landing site. |
| **Communicate** | Transmit MAYDAY **(touch)** if time permits and when full flap has been selected, master OFF **(touch)**.<br>The Mayday transmission from low level may have limited value at an uncontrolled aerodrome, as would the selection of 7700 on the transponder. At a controlled aerodrome, the takeoff is usually monitored by ATC and only an abbreviated call should be required, for example, "MAYDAY – *aeroplane registration* – engine failure." |

The priorities of the pilot-in-command should focus on landing into wind and keeping the cabin intact. However, if time permits the attitude can be adjusted for best glide, carburettor heat applied, and the **Trouble Checks** (FMI) carried out.

***F*** ***F**uel*
Pump ON, pressure checked, change tanks (touch), contents checked.

***M*** ***M**ixture*
RICH, primer LOCKED.

***I*** ***I**gnition*
On LEFT or RIGHT or BOTH (touch).

**If time permits** the **Shutdown Checks** can be completed to minimise fire risk.

***F*** ***F**uel*
OFF (touch)

***M*** ***M**ixture*
IDLE CUT-OFF (touch)

***I*** ***I**gnition*
OFF (touch)

***M*** ***M**aster*
OFF (touch)

Some things are beyond our control, but by paying proper attention to all preflight preparations we can help to avoid an EFATO. Sticking to the priorities of Aviate – Navigate – Communicate greatly increase the chances of survival.

Engine failure after takeoff is simulated by closing the throttle.

## Airborne Sequence

### On the Ground

Sitting in the aeroplane, before start up, demonstrate the touch checks, and have the student complete them for themselves. They should also move the fuel selector, if they haven't had a chance to already.

At the holding point run through your takeoff safety brief, and ask them to do one next time.

## The Exercise

Even though this briefing has concentrated on the EFATO and aborted takeoff, the student is still working on the circuit and landing. Not every takeoff or landing will be an opportunity to practise these actions. Pick appropriate times to carry out these exercises, taking into account student workload and traffic.

Generally you will not carry out a simulated engine failure on takeoff from a touch and go, unless there is sufficient runway available, so ensure you plan when to cover each exercise carefully.

When traffic permits, start with a simulated aborted takeoff. As discussed in the briefing, you will close the throttle and talk the student through the actions you want them to carry out. You may want to use a vector that is not in current use.

At the next good opportunity (having let them carry out at least one normal circuit and landing) simulate the engine failure during takeoff. Early in the takeoff roll, from a full length takeoff, partially close the throttle and talk them though the actions you want them to carry out.

At a suitable time, when traffic permits, simulate the engine failure after takeoff, don't forget to say "simulating." The first simulation should be carried out from a generous height, so that the student has time to take the actions required.

It cannot be stressed enough that you must keep in mind the objective and the safety of the aeroplane while providing the student with the opportunity to practise command decision making. Once the aeroplane nose has been lowered, a decision made as to the landing site, an attempt made to position for a landing, and flap selected or considered, the objective has been achieved, and the instruction to "go around" should be given. Only after these basic actions have become automatic, and where height and time permits, should any attempt to complete checks be encouraged.

As competence is achieved and circumstances permit, EFATO to a landing provides the complete experience and gives the student a true appreciation of the limited time available and the need to prioritise the actions.

## After Flight

Carry out the debrief.

Ask the student to learn their trouble checks and shutdown checks, and to have thought about a takeoff safety briefing before the next lesson.

# Flapless Landings

This briefing and exercise is practised before first solo (refer CFI) to prepare the student against the unlikely event of flap failure during early solo circuit consolidation. Therefore, it must be assumed that flap failure will not have been detected before starting the base turn, where flap is first selected.

What should the student do? Continue with the approach, by switching to a flapless approach or go around, re-circuit and prepare for the approach during the downwind leg? Clearly, if there are no other factors to be considered such as fuel or weather, the go around is the better option.

## Objective

To carry out a flapless approach and landing.

## Principles of Flight and Considerations

In all cases where a systems failure or unexpected deviation in procedures occurs –

**Aviate – Navigate – Communicate**

### Aeroplane System

Although the possibility of failure is rare, the student needs to know how the aeroplane's flap system works and what can be done, not only to deal with any problems arising from its operation, but also how to prevent them occurring.

Describe the aeroplane's flap and electrical systems (even if the aeroplane has manual flap operation) with emphasis on their inter-relationships, through schematics, actual components, models and handouts (refer Flight Manual).

### Detection

The risk of this failure going undetected can be minimised by a thorough preflight inspection, mitigated by sound aeroplane systems knowledge and possibly highlighted before flap selection by carrying out the SADIE checks (A = Amps or Alternator for electrically actuated flaps).

It is probable though that a flap failure will not be detected until flap is selected, usually in the base turn. This is no place to deal with a systems failure, so a go around is carried out. The climb to circuit altitude uses the full length of the climbout leg, giving a long downwind leg to consider options and plan for a flapless approach.

### Causes

The most probable causes of flap failure are mechanical linkage failure (manual or electric flap), electric flap motor failure, or electrical current failure.

Another possible cause, that should never occur, is flap overspeed. If the flap has been extended or left extended at speeds in excess of the manufacturer's recommendation, the flap or linkages may be damaged. If this occurs, flap retraction may not be possible, with a consequent degradation in flight performance. Worse than this, is the possibility that the flap will retract unevenly, causing uncontrollable roll. A third possibility is that loads on the electric flap motor will cause it to burn out with the consequent risk of fire. This damage can go undetected, and may not result in an immediate flap failure, but may occur on later flights.

This malfunction is avoided by never exceeding the $V_{FE}$ speed (Velocity for flap extension – white arc) with flap extended.

**Figure 1**

### Diagnosis

Once the aeroplane is established in level flight at a safe altitude, the possible causes of the systems failure can be considered.

If electrically operated flaps fail, check the master switch is ON, the flap circuit breaker is set (or if popped reset only once), and the alternator or generator output and battery state tested (if applicable). In addition, a visual check of flap position is made to ensure that it is not the flap position indicator that has failed. The visual check can also look for any asymmetric condition.

### Procedure

With flap up, the stalling speed is greater than with flap extended. To retain the same margin of airspeed over the stall speed, the approach and threshold speeds are increased by about the difference in the aeroplane's stall speed clean and the stall speed with full flap – commonly 5 knots for light aeroplanes.

This increase in threshold speed will result in a longer landing distance, and therefore the suitability of the runway should be considered. Neither the group rating system nor the P-Charts allow for a flapless landing.

Without the increased drag provided by flap, the power setting required to control the descent will be lower, the descent angle will be shallower, and forward visibility will be poorer.

## Airmanship

Situational awareness is improved through systems knowledge and routine systems checks.

Revise the SADIE checks, as introduced in the *Circuit Introduction* lesson.

The higher approach speed can affect your judgment of the spacing between you and the aircraft in front.

## Aeroplane Management

As a result of the decreased drag, only small power changes will be required to alter the rate of descent.

# Human Factors

There is a tendency to accelerate as the student unconsciously seeks the lower nose attitude they are familiar with from a normal approach and landing.

The simplicity of the manual flap extension system requires minimal systems knowledge. Electrically operated flap requires more systems knowledge and provides the student with the opportunity to practise problem solving.

# Air Exercise

A flap failure will be simulated at the base turn or when flap is first selected, and a go around carried out for the first occurrence.

For further simulated flapless landings the student should assume that the failure is identified downwind, and there is no need to complete the go around.

### Downwind

The systems checks are carried out (if applicable) as well as the normal radio call and downwind prelanding checks.

The suitability of the runway in use is considered and a decision made on the appropriate approach speed to be used.

> If the runway in use is not suitable and a diversion to another aerodrome is preferred, practise in this procedure should be given before first solo (refer CFI).

Downwind spacing is assessed, and an appropriate power setting at the base turn point is selected. Because of the decreased drag without flap and the desirability of a powered approach, it is common practice to extend the downwind leg and set the same power setting as a normal circuit, so that some power will be used throughout the approach.

An alternative method to stretching the circuit out is to extend downwind only slightly and initially use a much lower power setting. As the aeroplane sinks onto the correct glide slope or approach path, power is slowly increased until the desired rate of descent is achieved. The aim point should not move up or down but remain steady in the windscreen.

### Base

The base turn will have a lower power and higher nose attitude. Ensure the student trims the aeroplane for the descent. Because of the aeroplane's higher inertia, the turn onto final will need to be anticipated earlier than normal.

### The Approach

The approach is flown as normal with the attitude selected to maintain the higher approach or threshold speed and trimmed. Only small adjustments in power should be required to control the rate of descent.

The noticeable differences in this approach are;

- the higher nose attitude required to maintain the desired airspeed, which results in reduced forward visibility (runway may be largely obscured), and
- the effect of power changes on the rate of descent.

As always, if attitude or power is altered some adjustment to the other component will be required to maintain the desired performance.

**Power + Attitude = Performance**

### Landing

Because the aeroplane is already in a higher nose attitude than normal with a lower rate of descent than normal, the round-out is less pronounced and only a slight hold-off is used. The aeroplane is then allowed to sink in a slightly nose-high attitude to prevent the nosewheel taking the landing loads. The nosewheel is then lowered and brakes applied as required, aft elevator is used to keep the weight off the nosewheel.

As the student is familiar with holding off for the normal fully flared landing, resisting an over-flaring action and allowing the aeroplane to sink onto the runway may take some practise.

As with all powered approaches, runway length available and aim point notwithstanding, it is desirable to touch down just inside the threshold. If a prolonged float is permitted to develop, a go around may be appropriate.

# Airborne Sequence

**Before Flight**

By this point the student should be able to do all of the radio work for the flight, with minimal input from you.

As discussed at the end of the last lesson the student will do their own takeoff safety brief.

**The Exercise**

Start with a normal takeoff and simulate flap failure on the base turn of the first circuit, by saying "assume you now have a flap failure."

After the simulation of flap failure, and the repositioning of the aeroplane downwind by the student, the circuit continues normally until the base turn.

Since the flapless landing will usually be a full stop, the next take-off may be a good opportunity to practise an EFATO. Be careful not to fill all of the circuit lessons with emergencies, the student still needs plenty of practise at normal landings.

**After Flight**

Mention in your debrief any go arounds that were carried out, and praise the student for taking the initiative – if that is what they did.

Next lesson will be crosswind circuits, so long as the conditions permit. If not, continue practicing circuits, reminding the student to expect the emergency procedures you have covered in all following lessons.

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# Crosswind Circuit

This briefing primarily deals with the differences between a normal circuit, where the wind is straight down the runway in use, or little wind exists, and a circuit where the wind is at an angle to the runway in use.

The student should already be familiar with compensating for drift on the crosswind and base legs of the circuit. However, when landing in a crosswind, the aeroplane must be aligned with the runway before touchdown. If this is not done, there is a risk of damage to the undercarriage and the aeroplane may run off the runway.

## Objectives

To correctly position the aeroplane controls while taxiing.

To compensate for drift throughout the circuit.

To take off and land in crosswind conditions.

## Considerations

During taxiing and throughout the takeoff and landing, when the wind is at an angle to the runway, the aeroplane will have a tendency to weathercock or swing nose into wind.

Since taxiing in any wind will invariably result in some crosswind being experienced, revise the correct positioning of the aeroplane's controls during taxiing.

**Figure 1a**

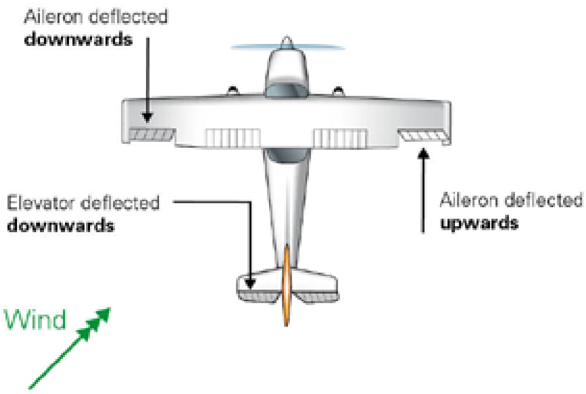
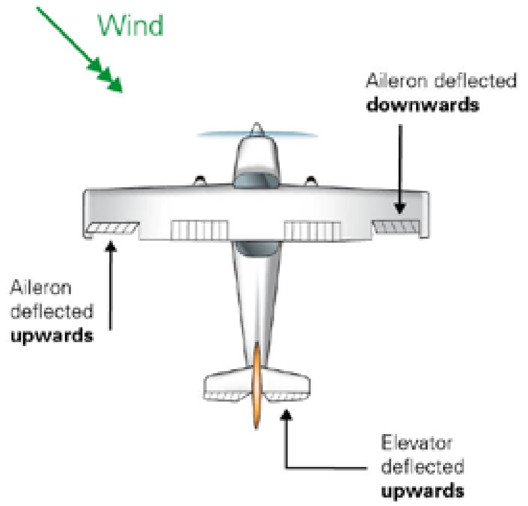


Figure 1b



When climbing out or approaching to land, with the wind at an angle to the runway, an allowance for drift will need to be made so that the aeroplane tracks straight over the ground along the extended centreline.

### Maximum Demonstrated Crosswind

The maximum demonstrated crosswind component (in knots) in the Flight Manual is the figure at which factory testing has shown that directional control can still be maintained. It is affected by the size of the rudder, its distance from the C of G, and the availability of asymmetric braking. It is not a legal limitation but a guide to what limit should be applied to crosswind landings. It is modified by several factors, for example, technique, individual currency and competency.

State the maximum demonstrated crosswind component for this aeroplane, as well as any club or organisation limit.

### Calculation of Crosswind Component

To calculate the crosswind component the pilot must first know or estimate the wind velocity (W/V) – its speed and direction.

This information may be provided by METAR – routine meteorological reports, TAF – aerodrome forecasts, ATIS – the Automatic Terminal Information Service, the ATC control tower, or windsocks.

METAR and TAF winds are given in degrees **true** and must first be converted to magnetic in order to calculate the angular difference between runway heading (magnetic) and wind direction.

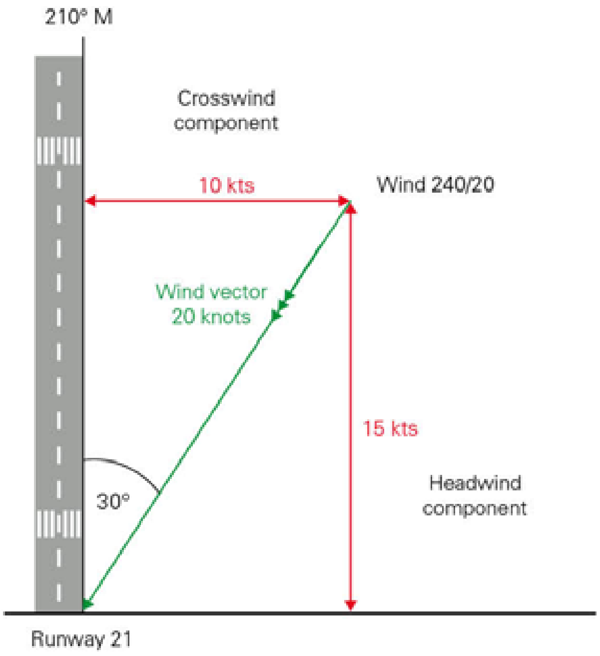
In some instances the crosswind component may be stated – requiring no further calculations.

Once the angular difference between wind direction and the runway heading is known, the various methods of calculating the crosswind component can be discussed.

### *Vector Diagram*

The vector method requires pencil, paper, protractor and ruler. As an example, assume a W/V of 240 degrees magnetic at 20 knots and a runway heading of 210 degrees (RWY 21). Calculate the angular difference between the runway and the wind direction; this is the wind angle, in this case 30 degrees. Draw a vertical line to represent the runway. From near the bottom of this line, draw a line at the wind angle from the vertical, 20 units (wind speed) long. Break this vector down into its vertical and horizontal components and measure these to give headwind (15 knots) and crosswind (10 knots).

Figure 2



### *Flight Manual*

Commonly, a vector diagram is supplied in the Flight Manual in graph form and is a more practical method of calculating crosswind.

> It's a good idea to include a photocopy of this graph in the handout to this lesson and to have a large laminated version for reference during the briefing.

### *Navigation Computer*

Although the presentation is a little different, the same calculation can be made using the navigation computer.

### *Windsocks*

Most aviation windsocks are 25-knot windsocks. This means that when the wind strength is 25 knots the windsock stands straight out. The angular difference between runway and wind direction is estimated visually and may require a mental calculation to derive the crosswind component (see Formula below).

### *Tower*

Where ATC is provided on the aerodrome you can request the crosswind component from the tower, but your student should be able to calculate it for themselves using one of the methods above.

### *Formula*

The crosswind component is equal to the speed (V) of the wind multiplied by the sine of the angular difference (XWC = V × Sineθ). Therefore, in the example given above (Rwy 21 – W/V 240/20) the angular difference is 30 degrees, and the sine of 30 degrees is 0·5. This means that half the wind strength is crosswind (20 × 0·5 = 10).

To be completely accurate this method requires a calculator or memorisation of the various sines of angles between 0 and 90 degrees. However, there is a simple way to estimate it.

Imagine that the minutes on the face of your watch are equivalent to the angular difference between the runway and the wind direction. If the difference is 30 degrees, then thirty minutes is half way around your watch face, therefore the crosswind component is half the wind strength. If the angular difference is 45 degrees, then that is three-quarters of the way round your watch face and the crosswind component is three-quarters of the wind strength. If the angular difference is 60 degrees or more then consider the crosswind component to be the full strength of the wind.

**Figure 3**

### Further Considerations

The ability to maintain directional control about the normal axis is the limiting factor for crosswind landings. Although it may be easy enough to keep the aeroplane aligned with the runway during the round-out and landing, as the airspeed decreases, rudder effectiveness will reduce and it may be difficult to prevent weathercocking. Therefore, as the crosswind component increases, the amount of flap used for the landing is normally reduced. This reduces the surface area on which the crosswind can act after landing and therefore improves directional control.

Although the landing distance may be adequate when calculated using the group rating system or P-charts, any landing with reduced flap will increase the landing roll. In addition, if the crosswind is not steady, an increase in approach speed may be required to compensate for windshear and gusts.

Therefore, the pilot-in-command must consider the runway's overall suitability in relation to crosswind component, approach/threshold speed and available length.

Remind the student to anticipate the effect of a strong crosswind on the groundspeed, in particular on base leg.

# Airmanship

Calculating the crosswind component, assessing the gustiness of the day, reviewing the aeroplane's limitations and discussing the configuration to be used all contribute to improving the student's situational awareness.

The aeroplane can land in crosswinds of greater than the demonstrated crosswind component provided the correct technique is used, and it is entirely **necessary** to do so.

Where this exercise is simulated using a non-active runway, remember aircraft taking off and landing into wind have right of way.

# Aeroplane Management

The controls must be positioned correctly, taking account of the wind, when taxiing, on takeoff and landing.

Discuss the use of brakes as required to assist directional control.

# Human Factors

In accordance with aeronautical decision making (ADM) principles, the student should be asked on subsequent flights to assess other runways for landing suitability.

# Air Exercise

## Takeoff

On lining up, the high reference point used to keep straight during the climb will need to be adjusted from normal to prevent drift, and provide a straight track over the ground along the extended centreline. The ailerons are fully deflected into wind and the elevator maintained neutral or very slightly down.

During the takeoff roll the amount of aileron is reduced as the increasing speed makes the ailerons more effective and some weight retained on the nosewheel to improve directional control.

At a safe flying speed the aeroplane is rotated with ailerons neutral. The aim is to lift off cleanly, preventing the aeroplane from skidding sideways across the runway. In addition, the higher rotate speed will allow the aeroplane to accelerate quickly to the nominated climb speed. Using the nominated high reference point as a guide, after liftoff a gentle balanced turn into wind is made to track along the climb-out path.

## Circuit

During the climb out, ensure the wings are level and the aeroplane is in balance. Check for straight tracking and adjust the reference point as necessary to maintain the extended centreline.

On the crosswind leg, select a reference point with an allowance for drift in the normal way. A component of head or tailwind may become apparent in the distance travelled over the ground to reach circuit altitude.

The turn onto downwind should be made at the same distance out as a normal circuit. A wider downwind leg may be advisable if a particularly strong crosswind toward the runway exists, as this will decrease the time spent on the base leg. More commonly the effects of a headwind or tailwind on the crosswind leg will require less or more anticipation of when to start the turn onto downwind. A suitable reference point, so as to track parallel to the runway, is chosen. The approach is assessed and a decision made on runway suitability, approach/threshold speed and maximum flap setting to be used. The correctness of the downwind spacing is assessed and if necessary, the reference point altered to maintain a parallel track.

The turn onto base is normal and continued onto a suitable reference point with an allowance for drift.

Once established on base leg, additional flap up to the maximum to be used for the landing is normally extended.

The head or tailwind component experienced on base will affect the turn onto final and must be anticipated. The turn is continued onto a suitable reference point into wind that allows for drift, and tracks the aeroplane straight along the extended centreline.

Throughout the descent the aiming point is monitored in the normal way and the power adjusted to maintain a steady rate of descent to touchdown – power controls the rate of descent.

The recommended crosswind landing technique is a combination of the following two methods, the 'kick-straight' method and the 'wing-down' method.

### The Kick-Straight Method

The advantage of this method is that the aeroplane is flown in balance throughout the approach, round-out and hold-off. The disadvantage is that it is not easy to master.

On the approach the aeroplane is crabbed into wind, and just before touchdown, brisk or positive rudder is used to yaw the aeroplane's nose into line with the runway. Into-wind aileron is used to keep the wings level.

Although this method sounds simple at first, it takes considerable skill in timing the application of rudder. Too early, and the aeroplane will drift downwind, touching down with sideways loads, perhaps off the runway. Too late, and the aeroplane will touch down at an angle to the runway, applying large sideways loads and the aeroplane may rapidly depart the runway.

### The Wing-Down Method

The advantage of this method is its ease of execution, but there may be limitations in the Flight Manual that affect this method.

On short final the aeroplane's nose is aligned with the runway by applying rudder and sufficient into wind aileron, to prevent drift, while controlling speed until the flare with elevator. This results in the aeroplane sideslipping into wind at a rate that negates the drift.

The round-out and hold-off are flown in this wing-down attitude and the landing made on the windward wheel first.

Although this method sounds more difficult, it is easier to execute and requires less judgement.

Many modern light aeroplanes have a restriction on sideslipping, especially with flap extended, and therefore the recommended procedure is a combination of these two methods.

### The Combination Method

Throughout the approach, the aeroplane is crabbed into wind, in balanced flight, preventing drift.

During the round-out, the wing down method is applied. The aeroplane's nose is aligned with the runway through smooth rudder application and sufficient aileron into wind used to prevent drifting off the centreline.

> Unless a strong crosswind exists this should not require full or even large control deflections. If large amounts of aileron are required to maintain the centreline, then it is unlikely that rudder effectiveness will be sufficient to keep straight throughout the landing roll. In this situation, unless rudder effectiveness can be improved with an increase in speed, a go around should be carried out and an approach with a different speed/flap configuration conducted. Alternatively the runway's suitability may need to be reconsidered.

The landing is made on the windward wheel, which will create a couple that lowers the other main wheel. The rudder is centralised and the nosewheel lowered rather than held off, and some weight maintained on the nosewheel for directional control. At the same time, aileron into wind is increased as the speed reduces.

Throughout the landing a small amount of power (1200 rpm) may be used to improve control and the throttle closed at touchdown.

Keep straight on the runway centreline by reference to a point at the far end of the runway and apply differential braking as required.

No more than neutral elevator should be used to put some weight on the nosewheel so as to avoid wheel-barrowing.

## Airborne Sequence

### On the Ground

Ensure that the student places the controls in the right position, allowing for wind.

## The Exercise

By now, the student should be well practised in the circuit procedures. However, for the crosswind landings you will need to demonstrate, follow through, talk through and then allow the student to practise with decreasing input from you.

Where practical, the student should be gradually introduced to crosswinds of increasing intensity, commensurate with skill, including experiencing the various speed/flap configurations appropriate for varying wind conditions.

Do not combine a flapless and crosswind landing at these early stages, but it is still possible for the student to practise the emergency procedures previously covered.

# Glide Approach

This lesson teaches the student to land the aeroplane without engine power. Initially this is taught as part of the circuit lessons, but is equally important in the forced landing without power lessons.

From a position of about 1000 feet agl downwind, the students must be able to reach the 1/3 aim point, preferably without flap. Once a landing is assured various methods are used to reduce the L/D ratio and increase the rate of descent so as to touch down as near to the threshold as practical.

## Objective

To complete a landing without engine power from the 1000 foot downwind position.

## Considerations

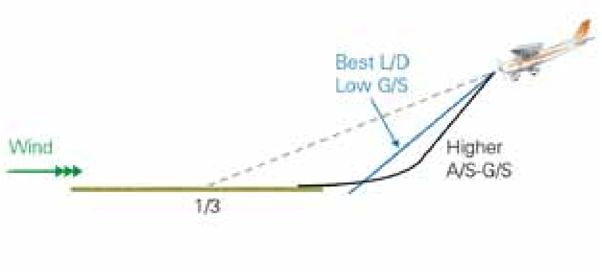
There are a number of factors that will affect the ability of the aeroplane to reach the 1/3 aim point. Once it is assured that the aeroplane will reach the 1/3 aim point, the aim point is moved towards the landing threshold, generally by applying flap, so as to use all the available landing distance.

As this exercise will be practised on the home aerodrome, the student should be encouraged to initially aim 1/3 of the way into the runway. Once they are more proficient, the distance available can be progressively reduced by requiring them to stop before an arbitrary point on the runway.

### Headwind on Final

If it becomes apparent that a stronger than expected headwind on final is causing the aeroplane to undershoot (aim point moves up the windscreen), it may be necessary to lower the aeroplane's nose and increase the airspeed. This will increase the groundspeed, allowing the aeroplane to better penetrate into the wind. This is one of the reasons for aiming 1/3 into the field and delaying flap.

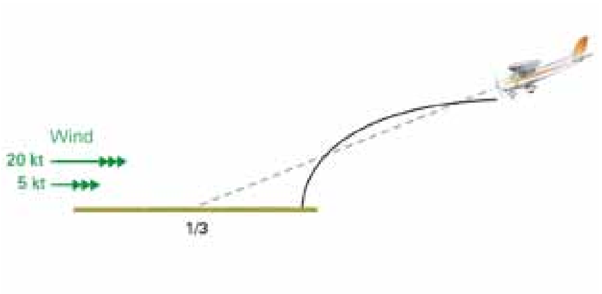
**Figure 1**



### Windshear on Final

The only method of countering windshear when no power is available is to increase airspeed. Aiming 1/3 of the way into the field provides a buffer against this eventuality and is also another reason for delaying the use of flap.

**Figure 2**



### Moving the Aim Point

Assuming that the 1/3 aim point can be easily reached from about 500 feet agl, the L/D ratio is reduced by:

#### *Flap*

Flaps are the first option for increasing the rate and angle of descent, because they increase the drag very effectively.

#### *Airspeed*

As discussed previously, gliding at any speed other than the airspeed for best L/D will decrease the range. Decreasing the airspeed to achieve this increases the risk of a stall, especially if the third option of S-turns is to be used as well. Therefore, increasing the airspeed is recommended. This method, however, is not particularly effective when used on its own.

> Increase the airspeed by relaxing backpressure, not by pushing the control column forward.

When combined with flap, only a small increase in airspeed will be required to dramatically increase the rate of descent. However, the increase in airspeed means the aeroplane will float in the round-out, so if it is used, it should be used early rather than late. After round-out the airspeed will rapidly dissipate due to the high drag produced by the flap.

#### *S-Turns*

An S-turn not only increases the total distance to touch down, but also decreases the L/D ratio, as a result of the increased drag generated in the turn. In the modern low-drag training aeroplane this method is not particularly effective.

It should be noted that excessive use of S-turns indicates poor judgement and a poor forced landing plan. It should not be used as a standard manoeuvre, but as a compensation for a judgement error. Most commonly an S-turn is used when the final track has been overshot and some height needs to be lost.

#### *Sideslip*

A sideslip is an unbalanced manoeuvre, where the controls are ‘crossed’. For example, right aileron is applied in conjunction with left rudder to prevent the turn or to keep straight.

Due to the comparative ineffectiveness of the rudder in most modern training aeroplane types, full rudder will be required to keep straight, even in a relatively shallow banked sideslip.

Once again, in the modern low-drag light aeroplanes, this manoeuvre is not particularly effective unless it is combined with the use of flap.

Some aeroplanes have a restriction against sideslipping with flap down (refer Flight Manual). This is generally because the flap blankets the tailplane in a sideslip, destroying the airflow over the tailplane. In most cases, where the tailplane normally provides a down load this results in an abrupt nose-down pitch and total elevator ineffectiveness. Although the pitch down ceases when the rudder is centralised (sideslip is stopped) this is an undesirable characteristic, especially near the ground.

If this manoeuvre is not restricted, it is vital that airspeed is increased or at least maintained. If the aeroplane were permitted to stall in this configuration (controls crossed) a spin is almost inevitable.

If sideslipping with flap is permitted, the resulting rate of descent is usually very impressive. When the student first sees the ground rushing up, there is a tendency to increase backpressure to arrest the high sink rate rather than decrease the amount of rudder being used. Therefore, if this manoeuvre is to be used it should be taught at altitude before this lesson (refer CFI). It is also more appropriate to use sideslip in the base turn rather than when close to the ground.

The factors affecting rate of descent should also be applied in the above order, flap first then increase airspeed, so that a safe margin over the stall speed is maintained during the following manoeuvres, then S-turn or sideslip.

## Airmanship

This is only a simulation and the safety of the aeroplane and crew are paramount. Therefore, power should be used at any time the safety of the aeroplane is in doubt, or on the "go around" instruction.

Glide approach practise must, however, be treated with some seriousness and the importance of a successful outcome stressed.

Plan the glide approach practise with consideration for other traffic, as the exercise does not entitle you to the right of way. At controlled aerodromes it may be appropriate to request a "glide approach" so that ATC can sequence following traffic.

Consistent with good aviation practice, no passengers should be carried during glide approach practise.

If increasing airspeed to lose height, be aware of the limiting flap speed – although this would not be a consideration with an actual engine failure. Anticipate the round-out earlier to compensate for the high rate of descent and excess airspeed.

In addition, the effects of up-slope and down-slope on approach judgement are discussed.

## Aeroplane Management

Whenever the engine is at idle the carburettor heat should be HOT.

## Human Factors

Visual limitations in relation to optic flow rates and depth perception, as a result of the high descent rates are discussed.

## Air Exercise

Confirm spacing and configure the aeroplane late downwind. Reduce power, maintain height, apply carburettor heat early, and trim in preparation for the glide attitude.

At the 1000-foot area abeam the threshold, the throttle is fully closed and the base turn started.

The approach is judged by reference to the 1/3 aim point, down to about 500 feet agl. At this point the question is asked, "Can the 1/3 aim point be easily reached?"

| Yes | No |
|---|---|
| Manoeuvres to reduce the L/D ratio are applied where necessary in sequence and combined to modify the touchdown point. | Delay the application of flap until the answer is a positive yes. |

# Airborne Sequence

### On the Ground

Nothing new in here, just perfecting ground operations.

### The Exercise

Use the full length of the runway available as it makes the demonstration of how easily height can be lost (but not regained) much clearer.

For most aerodromes, choosing an aim point 1/3 into the field will result in the aeroplane being excessively high in relation to the threshold.

This is the whole point of the 1/3 aim point. There is no possibility of the aeroplane being flown through the first fence. When the chosen landing site is shorter, the 1/3 aim point is still 1/3 of whatever length is available, and the possibility of flying through the first fence remains constant. Only the possibility of overrunning the far end of the landing site increases.

From this excessively high position, most or all of the various methods of increasing the rate of descent can be demonstrated.

Once the forced landing lessons have been completed, more realistic field lengths can be simulated by restricting the amount of runway available, for example, from the threshold to the 300-metre (1000-foot) markers. In this case the 1/3 aim point will be about 100 metres in, and only those manoeuvres that are required (in sequence) will be used to modify the actual touchdown point.

The countering of strong headwinds and windshear, by maintaining the 1/3 aim point to about 500 feet agl and then increasing airspeed, are demonstrated and experienced when conditions permit.

If the aeroplane is low, or more commonly high or fast at the threshold, and the ability to make a safe landing is in any doubt whatsoever – carry out a go around. During the subsequent go around, remind the student that maximum braking was still an option (if it would have stopped the aircraft in the space available). Do not put the aeroplane in a position where these have to be used during a simulation.

Although during an actual forced landing the aeroplane may be forced onto the ground so as to apply maximum braking, during the simulation a normal landing is carried out with brakes as required.

### After Flight

Let the student know that there will be lots more practise at this manoeuvre and will serve to complete the forced landing lessons.

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# Vacating and Joining at Aerodromes

This lesson covers vacating and joining at controlled and uncontrolled aerodromes. Elements may be combined with other training area exercises (refer CFI).

Where no other method is published, the standard overhead join procedure is the preferred method for joining the traffic circuit at an unattended aerodrome. It is used when the pilot-in-command needs to find out the runway in use, familiarise themselves with the aerodrome traffic and conditions, or when required by ATC.

The *Standard Overhead Joining* poster is a good resource for this briefing.

## Objectives

To vacate and join the circuit in accordance with applicable procedures.

To join an uncontrolled circuit in accordance with the standard overhead join procedure.

## Considerations

Discuss vacating the uncontrolled aerodrome first. As with a clearance, all of these methods are also available at controlled aerodromes.

### Uncontrolled Aerodromes

#### *Vacating*

Leaving the circuit at an uncontrolled aerodrome is usually done from one of the circuit legs, climbing straight ahead on the runway heading to 1500 feet above aerodrome level, or from crosswind or downwind, or climbing to overhead – remembering that turns are always in the circuit direction.

#### *Standard Overhead Join*

Rule 91.223 *Operating on and in the vicinity of an aerodrome* requires the pilot to "… observe other aerodrome traffic for the purpose of avoiding collision, and, unless otherwise authorised or instructed by ATC, conform with or avoid the aerodrome traffic circuit formed by other aircraft." The standard overhead join procedure is a recommended means of complying with this rule, by being 500 feet above aerodrome traffic and then sequencing appropriately.

At an unattended aerodrome there will be no ATC instructions, and there may be no ATIS to forewarn the pilot of runway in use and wind conditions.

If the aerodrome is listed in AIP *Vol 4*, circuit direction will be shown on the aerodrome chart. This information and an estimate of the surface wind can provide a clue to the circuit direction.

Even if the runway in use is known, the pilot may elect to carry out the standard procedure if they are unfamiliar with the aerodrome layout and unsure of the location of other traffic.

The term 'overhead' is used because the aeroplane is flown over the aerodrome at a safe altitude above the circuit to look down and determine which runway is in use, or most suitable, and to sight any traffic.

It is important to realise that there may be traffic without a radio, NORDO (non-radio), and your only method of avoiding collision with them is to sight them and work out what they are doing from their position and movements.

Discuss the information found on the aerodrome chart that is applicable to the standard overhead join procedure. This includes; aerodrome elevation, runways available and their suitability, circuit directions, specific aerodrome instructions, the location of windsocks, and how to hold the chart to aid orientation. If the aerodrome is unfamiliar to the student, a study of the aerodrome chart should be carried out before flight.

Discuss the requirement to terminate the flight plan with ATC after landing at uncontrolled aerodromes.

> Simulating a standard overhead join by 'walking and talking the pattern' beforehand can be a useful tool to prepare the student for this exercise.

## Controlled Aerodromes

### *Vacating*

When vacating a controlled aerodrome, all of the previously mentioned options are available. In addition, a clearance to turn in the opposite direction to the published circuit may be given by ATC, or requested by the pilot. If a non-standard clearance is required, keep a good lookout and request it before takeoff.

### *Joining*

When joining at a controlled aerodrome, the pilot-in-command has the option of requesting a standard overhead join. This is a good idea if the pilot is unfamiliar with the aerodrome layout, the active runway, or the position of the various circuit legs. ATC also has the option of instructing the pilot to carry out a standard overhead join.

However, the most common method of joining at a controlled aerodrome is to be cleared by ATC to join on the downwind, base, or final approach legs. Such a clearance may be for an aerodrome traffic circuit opposite to the published circuit for that runway; for example, "join right base" for a runway with a lefthand circuit.

Another possible clearance is to "cross overhead and join downwind". This is not a standard overhead join.

It is good aviation practice to establish the aircraft on an extension of the circuit leg to be joined, well before reaching the circuit area.

Where ATC is in attendance, but ATIS is not available, common practice is to request joining instructions. ATC will inform the pilot of the conditions and clear the pilot to join the circuit in the most appropriate way.

When ATIS information has been received before reaching the reporting point for circuit joining, the pilot should state or request from ATC the preferred method of joining.

A clearance to join downwind, base, or final does not absolve the pilot from giving way to other aircraft already established in the circuit.

### *Aerodrome Flight Information Service*

Where an aerodrome flight information service (AFIS) is provided, joining and departing procedures specific to that aerodrome will apply. This may include the standard overhead rejoin.

When joining at an aerodrome with AFIS a radio call at 5–10 miles (or a position determined by the airspace) is required to state your position, altitude, intentions and POB. The AFIS will advise the ATIS, QNH and traffic information. The arriving aircraft then advises more specific intentions based on the information received.

## Airmanship

Preparing the aeroplane for arrival involves the use of AIP *Vol 4*, the VNC (Visual Navigation Chart 1:250000 or 1:125000 if applicable) and joining checklists.

Revise the right-of-way rules and emphasise the requirement to make turns in the circuit direction.

If a downwind leg will not be flown, the aeroplane is prepared for landing before circuit entry by using joining and prelanding checks.

There is a tendency for the student to rely on radio calls during the overhead join, and to make too many. It is critical that a good lookout is carried out to identify all aircraft operating in the circuit, including those without radios.

The overhead joining procedure is used to determine the runway in use and the position of traffic in order to sequence accordingly. It does not presume a right of way over existing circuit activity. Orbiting overhead may be necessary until safe sequencing is available.

## Aeroplane Management

Before entering the circuit, the aeroplane's speed will need to be reduced to below 120 knots, where applicable, as circuit speeds are normally restricted to this.

The landing light should be on.

## Human Factors

As the student is orbiting overhead encourage them to get oriented by using the aerodrome chart and wind socks for indications of runway in use.

The limitations of vision are revised in relation to closure rates and objects that do not produce relative movement.

There is a lot of information to take in while approaching and orbiting overhead. Encourage the student to approach it systematically.

## Air Exercise

### Vacating

Discuss the way you would normally vacate your home aerodrome circuit, and the way you would vacate the other type of aerodrome.

### Uncontrolled Aerodrome Joining

When joining at an unattended aerodrome, a radio call addressed to the circuit traffic is made between 5 and 10 NM from the aerodrome, stating your position, altitude, and intentions. The standard overhead join procedure is carried out in three main phases.

### *Standard Overhead Join*

#### *Approach*

Approach the aerodrome to cross overhead at not less than 1500 feet above aerodrome level (refer landing chart) unless otherwise stated on the landing chart; for example, at Palmerston North 1500 feet amsl is used because of airspace above.

When calculating the altitude to join overhead at, round up – assuming there is no overlying airspace restriction. For example, if aerodrome elevation is 150 feet, rejoin altitude would be 1650 or 1700 feet not 1600 feet. The reason for rounding up is to maintain a 500-foot buffer over aircraft in the circuit, which may have rounded up the circuit altitude. At altitudes above 1500 feet it is harder to distinguish the windsocks, and more altitude will need to be lost on the descent. In addition, if all aircraft rejoin at the same altitude it should be easier to see each other.

The aeroplane should be positioned overhead and right of centreline, so that the student can look out of their window, down and across the whole aerodrome, observing traffic, windsocks and ground signals or markings.

### *Determine Runway in Use*

Firstly the student must determine which runway is in use, as this sets which direction to make all turns, and the traffic and non-traffic sides.

Runway in use can be worked out by observing the windsocks, or other traffic already established in the circuit. If the runway in use cannot be determined quickly, make a turn to the left and continue to orbit left, until it is determined.
If it is then found that a righthand circuit is in use, make all further turns to the right.

Be aware that many airfields have alternate circuit patterns for helicopter and glider traffic. If they are in use, joining aircraft must sequence into the circuit without causing conflict.

Both the traffic and non-traffic side must be identified to avoid descending onto aircraft already in the circuit. One method of identifying the traffic side is to have the student imagine they are lined up on the chosen runway ready for takeoff. If they were to takeoff which way would they turn at 500 feet – this establishes the traffic side.

Once the runway in use has been established and the circuit direction is confirmed (refer landing chart), a turn is made in the circuit direction to position the aeroplane on the non-traffic side.
As aerodromes are potentially areas of high traffic density, use no more than a medium angle of bank. At this point it is good aviation practice to make a radio call advising traffic of the runway you are joining for.

Aircraft already in the circuit have right of way. This means that if aircraft in the circuit are using a runway considered unsuitable for your operation, the responsibility of avoiding conflict is on the joining aircraft, even if the runway in use is out of wind.

Regardless of which way the aeroplane is turning, the turn is continued until the centreline of the runway in use is crossed, and the aeroplane enters the non-traffic side.

> Avoid giving too much attention to ground features during these phases, maintaining a lookout for other aircraft is more important as NORDO aircraft will not be heard and must be seen.

### *Descend to Circuit Height*

When established on the non-traffic side descend to circuit altitude. A low rate of descent is preferred because of the potentially high traffic density around an aerodrome. Common practice is to use a cruise or powered descent.

The aeroplane must cross onto the traffic side of the active runway only when at circuit altitude. They should also track over the upwind threshold. Crossing the upwind threshold provides the longest possible downwind leg, while at the same time still providing maximum vertical separation from high-performance aeroplanes taking off.

As the downwind leg will be shorter than normal, the prelanding checks can be completed during the descent on the non-traffic side or on the crosswind leg (refer CFI).

On this crosswind leg, correct for drift, in order to track at right angles to the runway. A good lookout will need to be maintained for aircraft flying on the downwind leg. Do not turn in front of any such aircraft – always position behind.

The downwind radio call is made as soon as the aeroplane is established on the downwind leg, and the circuit is completed in the normal manner.

## Controlled Aerodrome Joining

The standard overhead join can be carried out at controlled aerodromes, with a clearance from ATC. More normally you will join via one of the circuit legs, usually downwind or via base leg.

Consult AIP *Vol 4* for differences, particularly where there are neighbouring aerodromes.

## Airborne Sequence

### On the Ground

Make sure the student has all the necessary information to hand, and they have briefed themselves on the landing chart.

### The Exercise

Vacate the circuit the way you are either cleared by ATC, or the way you discussed in the briefing.

They will have already seen, in previous lessons, how to vacate the circuit, but you may need to prompt some of the radio calls.

If you will be using your home aerodrome for the standard overhead joining procedure, head away in an unfamiliar direction, to add a little realism.

Begin the exercise between 10 and 5 NM from the aerodrome, over a local feature or VFR reporting point.

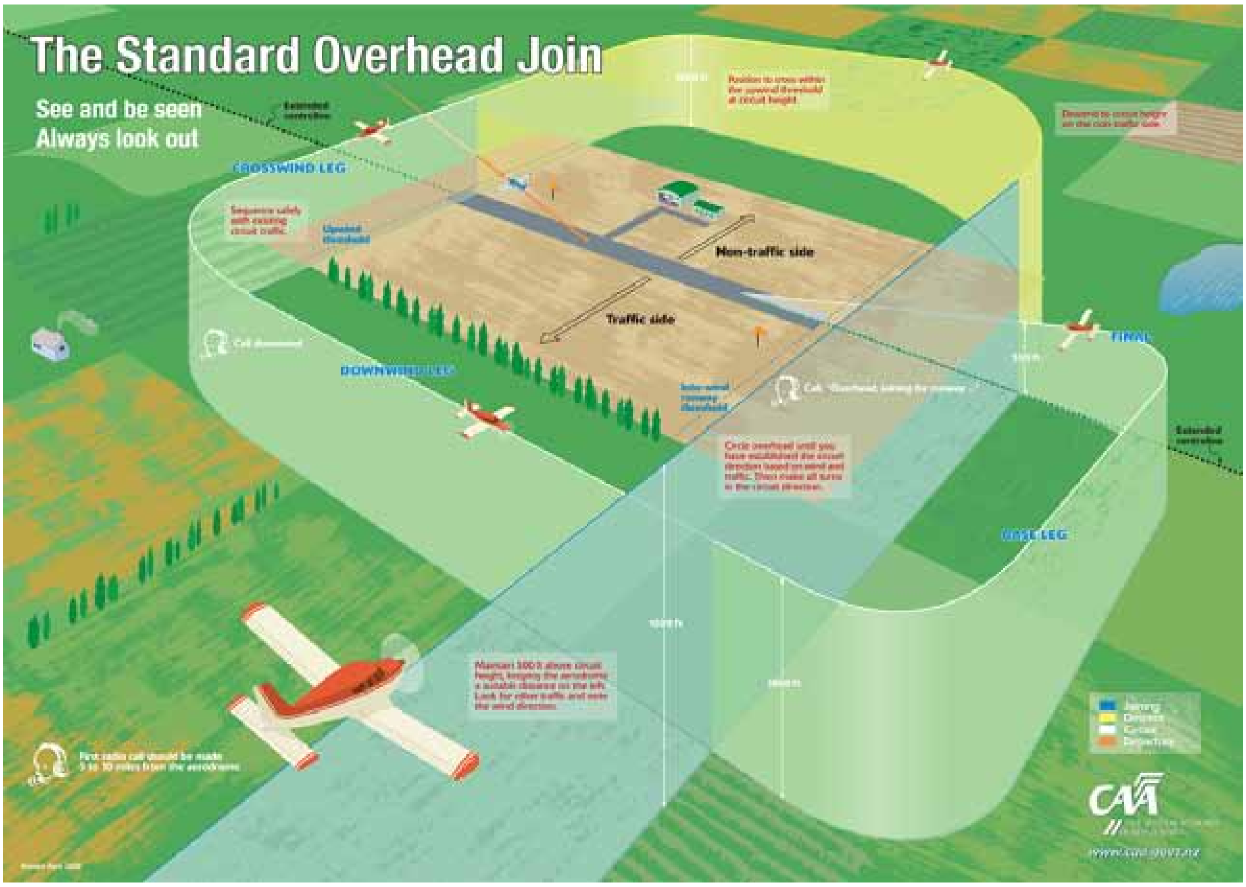
Talk through the standard overhead join procedure, and then have the student practise before any solo practise.

From the downwind leg, an approach and landing or go around can be carried out before vacating the circuit for student practice. If this is your home aerodrome, you may want to skip the landing, however, if it is an unfamiliar aerodrome landing practice would be beneficial.

### After Flight

There probably won't have been time to cover every method of vacating and joining the circuit, so advise the student that you will take the opportunity in future lessons to practice these different methods.

Figure 1



CIVIL AVIATION AUTHORITY
OF NEW ZEALAND
*Te Mana Rererangi Tūmatanui o Aotearoa*

**CIRCUIT TRAINING**

# Radio Failure

Although modern aeroplane radios are reliable, the student needs to know the procedure to follow in the event of a communications failure. It is recommended that once the standard overhead join procedure has been mastered by a student, simulated radio failure procedures should be taught before any solo exercises in the training area.

When the student's home aerodrome is controlled, the CFI will provide guidance on what the student should do in the event of a radio failure outside the circuit. The exercise can be simulated if arranged with ATC in advance, and outside peak times.

However, if a diversion is required, training in this procedure will need to be given before solo exercises outside the circuit.

## Objective

To join at a controlled or uncontrolled aerodrome in the event of a radio failure.

## Considerations

Legally an aircraft cannot enter a control zone without a clearance, so should the student break this rule or divert? Generally, ATC can be expected to accept an aircraft returning to the controlled aerodrome under these conditions, especially if the transponder code 7600 is used.

If a clearance to enter the control zone has been received before the failure, then continuing in accordance with the clearance is what will be expected. If the clearance did not specify a method of joining, a standard overhead join may be the best option, as ATC will be able to predict the aeroplane's movements.

If a radio failure has occurred, it is unlikely to be detected until an attempt to make contact is initiated, for example, when tuning into the ATIS, or when requesting joining instructions. In the case of an uncontrolled aerodrome, where position and intentions only are transmitted, it may not be detected at all.

The general causes of communications failure are:

- wrong frequency selected,
- on/off and volume switch turned down,
- the aeroplane altitude too low and/or range too great,
- alternator failure (although battery power should still be available and the alternator failure detected by other means),
- comm box switches not selected to headphones,
- avionics or master switch accidentally selected off,
- radio loose in its cradle,
- avionics master off,
- faulty headset connections, or
- a popped circuit breaker.

Check for simple solutions first, by recycling – or turning on – master switches or avionics selectors.

Many modern radios can be tested for signal reception by selecting the test function and signal transmission confirmed by the small ‘T’ illuminating when the press-to-talk switch is depressed.

## Airmanship

Anticipate what the wind is likely to be, and therefore circuit direction.

Preparing the aeroplane for arrival involves the use of AIP *Vol 4*, Visual Navigation Charts (VNC), and joining checklists.

Revise the importance of using eyes and ears to lookout. Using the 20 degree per 2 second visual scan technique and listening to radio calls (if available) builds situational awareness, and the student should be able to identify aircraft by both means.

The right-of-way rules are revised, and the requirement to make turns in the circuit direction emphasised.

Terminate your flight plan with ATC after landing.

## Aeroplane Management

Before joining the circuit, the airspeed should be reduced to below 120 knots and landing lights turned on.

## Human Factors

Information processing limitations and the use of mental models to retain situational awareness will help the student to draw a mental picture of the position of reported traffic.

## Air Exercise

With a communications failure established, refer to *AIP New Zealand* Emergency Section for the procedure to follow. Obviously it will be of some benefit to the student to have read this section before an in-flight communications failure.

The main points of this procedure are:

- transmit blind (as all normal calls will be made, this action can be simulated)
- squawk 7600 (touch)
- turn on all lights
- use a cellular phone to communicate if available

Once a radio failure has been identified, the student should be instructed to aviate and navigate – remaining clear of controlled airspace, while a possible cause of the problem is investigated.

From the CFI’s determination of the procedure to follow in the event of a radio failure, choose from the two options below.

### Uncontrolled Aerodromes

The join procedure is exactly the same as the standard overhead join, except that transmissions should be made ‘blind’. A keen lookout for other traffic should be emphasised. If in any doubt, return to the orbit overhead at 1500 feet.

Radio failure is simulated and the trouble-shooting sequence or checklist carried out. Completing this sequence gives the student practice in prioritising Aviate – Navigate – Communicate, and often demonstrates the limitations of information processing and the effects of stress. It is recommended that the student be given adequate practice in systems knowledge and fault detection on the ground, before flight.

With the radio failure established, the AIP *Vol 4*, VNC, and checklist can be referred to and the communications failure procedure adopted.

### Controlled Aerodromes

The student will need to know the meaning of the various light signals that will be used by ATC and how to respond to them.

> Radio failure while in the circuit will also require knowledge of the light signals. Therefore, the meaning of light signals and how to respond is best covered in one of the pre-solo circuit revision briefings recommended earlier. The meanings and response need only be revised here by reference to AIP *Vol 4*.

With the radio failure established, the AIP *Vol 4*, VNC, and checklist can be referred to and the communications failure procedure adopted.

Enter the control zone and carry out the standard overhead join procedure, watching out for the light signals and responding appropriately.

Report the communications fault to the control tower after landing.

## Airborne Sequence

### On the Ground

Make sure the student has had time to study the particular communications failure procedures for your home aerodrome, as well as the general procedures from *AIP New Zealand*.

### The Exercise

Organise with the Tower to show you the light signals.

Simulate radio failure at different times to assess the student's decision-making while operating in the circuit, in the training area, and entering and exiting controlled airspace.

# Forced Landing without Power Pattern

This briefing covers the determination of wind direction, the selection of the most suitable landing site, initial configuration of the aeroplane for best gliding performance, and the pattern flown to achieve a successful forced landing. The *Considerations* lesson covers checks and further decision making considerations.

We have already discussed the main reasons for engine failure (fuel, air, spark) in the *Engine Failure after Takeoff* lesson and how sensible precautions can minimise risk – preflight inspection and planning, run-up, checks, safety brief and SADIE .

In addition, the student is familiar with the need to produce an automatic response in emergency situations, and with the glide approach.

This lesson discusses the ideal procedure to follow in the unlikely event of a total or partial engine failure in the cruise at altitude (above 1000 feet agl as a guide) where more time is available to plan and consider options than the EFATO. Later exercises will provide practise in adopting this procedure from a lower altitude.

A partial engine failure or rough running is more common than a total failure, but this is still rare. The recommended procedure for dealing with the partial power failure begins with the same steps as a total failure, and therefore the pattern is relevant to both.

A total power failure will be simulated by closing the throttle.

## Objective

To be able to select an appropriate landing site and carry out the pattern for a forced landing without power.

## Considerations

### Configuration

State the configuration required to achieve the best L/D ratio for the aeroplane ( ________ knots, no flap and propeller windmilling), and its effect on range. The effect on range of using other airspeeds will be discussed in the next briefing, *Forced Landing without Power – Considerations*.

> Although drag is reduced by stopping the propeller, this procedure is not recommended, or required, to achieve the objective of this lesson (refer CFI).

### Wind Indicators

The various methods of determining the wind speed and direction are discussed, with initial emphasis on direction, because the plan is based on wind direction. Adaption of the plan is needed when wind strength is recognised, and in the latter stages of the plan.

The most relevant indicators are those at ground level: smoke, dust, crop movement, tree/leaf movement, wind lanes and wind shadow on water, and drift.

### *Smoke*

Smoke is a clear indication of wind direction and strength, and rarely available when you need it.

### *Dust*

Dust from dirt roads, river beds or ploughing, as well as ground spread fertiliser, may indicate wind direction and strength.

### *Crop Movement*

Ripples move downwind across the top of crops, especially wheat and hay fields.

### *Tree/Leaf Movement*

The tops of Poplar-type trees lean with the wind.

Willows, after initial spring leaf growth, indicate wind by showing the silver underside of their leaves in winds of 8–12 knots or more.
The silver side of the tree is the windward side.

### *Wind Lanes*

Wind produces effects on the surface of the water. Light winds, 5–15 knots, can ruffle the surface and, when viewed up or down wind, these disturbances form streaks of parallel lines, indicating the wind direction – but it can be difficult to resolve the 180-degree ambiguity unless wind shadows exist near the shore.

Above 15 knots, the wind may drive spray or foam in parallel lines. These too can be misinterpreted by 180 degrees, although the streaking may be more marked when looking downwind compared with the upwind.

Fresh water typically forms white caps at 12–15 knots, and seawater at 15–18 knots.

### *Waves and Ripples*

Waves and ripples form at right angles to the wind and move downwind. The first whitecaps appear between 7 and 10 knots. From altitude, however, it may be difficult to determine the direction of wave movement.

### *Wind Shadow*

Wind shadow can be seen at the upwind end of a lake or pond. It is an area of calm water where the shoreline protects the water from the wind, creating an area of calm water. This effect is most noticeable in winds of 5 knots or more, when the sunlight reflects off the water's surface. A small version of this can be seen as you walk out to the aeroplane after rain. Puddles of water will display this same effect when the wind is blowing. Wind shadow is best seen on small ponds or lakes of stationary water, rather than large expanses of water.

Any indication of wind seen in flight should be noted in case it is needed in the future.

### *Cloud Shadow*

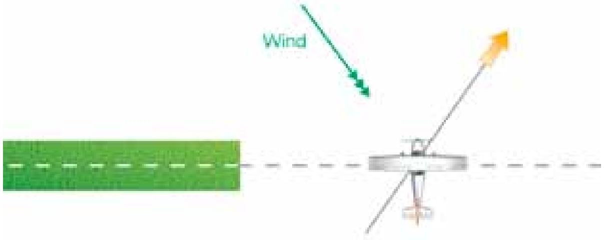
The movement of cloud shadow over the ground gives the wind direction and some indication of speed, at the cloud level. This is used only as a guide, however, as the wind on the ground will probably be different. Likewise, the 2000-foot wind and area forecasts are only a guide to the wind's general direction and strength. Apply local knowledge and orographic effects to estimate the wind on the ground.

### *Drift*

Drift can be useful, as it is what you are experiencing at altitude, but it takes experience to recognise it correctly. Be aware that it can be induced by flying out of balance.

The pilot needs to develop an awareness of where the aeroplane is heading compared to where it is tracking. When flying across the extended centreline of any landing area, if drift is present it can be seen.

Figure 1



### *Local Knowledge*

The other means of determining wind direction and strength are related to local knowledge and the aerodrome of departure. Local knowledge includes terrain and local effects, such as anabatic or katabatic winds, and sea or land breezes. Relevant conditions at the aerodrome of departure include the 2000-foot wind forecast, the windsock and the known takeoff direction. The usefulness of these indicators is relative to the distance of the aeroplane from the aerodrome – and the intervening terrain.

## Choice of Landing Site

The choice of the most appropriate landing site is usually a compromise and is discussed using the mnemonic *the seven S's, C and E*.

The seven S's are: Size, Shape, Slope, Surface, Surrounds, Stock and Sun. The C is Communication and E is for Elevation.

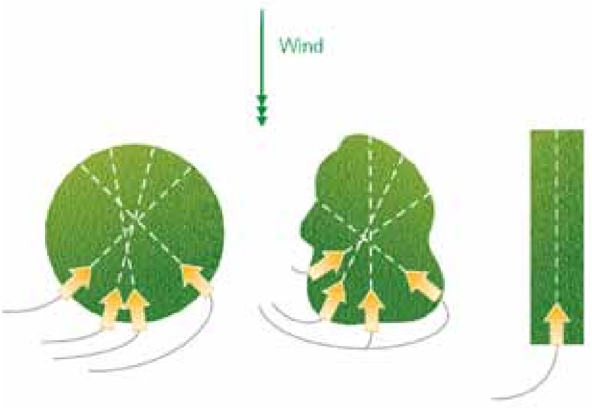
### *Size*

The ideal is for the longest possible landing area into wind, within gliding distance (to be discussed further in the *Considerations* lesson).

### *Shape*

Shape is mentioned because the student may limit their search for a landing site to only those sites that resemble a runway. In fact, the perfect shape is a circle, as multiple approach paths into wind are available. Even a square is preferable in contrast to a narrow paddock with only one approach path.

Figure 2



### *Slope*

An uphill slope for landing is preferred over level ground. A down-slope should be avoided – it would take a very strong wind to override the disadvantages of a downhill landing. Slope can be difficult to detect at altitude, and when slope is apparent from altitude, generally the terrain is very steep. However, water runs downhill, so creeks that narrow give some indication of slope (ie, they are narrow at the higher end) and the dam wall on farm water storage ponds also indicate downhill slope. Significant 'white water' in any flow indicates significant gradient.

### *Surface*

A firm surface is recommended, not so much for stopping distance but to avoid the nosewheel digging into the soft surface and somersaulting the aeroplane. Determining the type of surface from altitude can be done by comparing the texture of the local aerodrome's grassed areas with those of various paddocks.

Surface also includes anything on the surface, such as stock, crops, fences and stumps.

### *Surrounds*

Where possible a landing site that has a clear field on the approach end and the upwind end should be chosen to provide for undershoot and overrun during the forced landing. For the training exercise, a clear go around and climb-out path is also considered.

An approach over a road will quite likely bring you into contact with power wires running along the road.

### *Sun*

Sun is normally only a problem at sunrise and sunset, particularly in winter. Under these conditions an approach in the direction of the sun may blind the pilot on final. Accepting some crosswind may be better than an approach directly into a low sun.

### *Communication*

All of the previous factors are the priority, but if there is a choice available to land near habitation, especially where there is little of it, it will put you closer to help. For example, if you are over a ridge and to one side is a remote area and the other has habitation – choose the habitation.

### *Elevation*

Based on local knowledge, charts or comparing the altimeter reading with terrain perspective, the height above sea level of the landing site needs to be estimated. This is because the procedure is planned on heights above ground level but flown on heights above sea level with reference to the altimeter.

The pilot should be able to recognise heights without the use of the altimeter, for example, the circuit height is generally 1000 feet – have the student fix that as a metal picture they can use during this exercise. Do the same for 500 feet and 1500 feet.

### Situational Awareness

The ability to quickly implement the forced-landing procedure is markedly enhanced by good situational awareness. Throughout the flight the pilot should observe wind indicators and the approximate elevation and suitability of the surrounding terrain. This does not require the pilot to choose a specific forced-landing site and update it continuously in cruise. By taking notice of their environment the pilot should know where the wind is coming from and where in relation to the aeroplane, the more suitable terrain is for a forced landing. Should an emergency develop, an immediate turn toward this area is made and then a specific field chosen.

Choosing a flight path that takes into account the terrain over which they are flying shows good airmanship.

## Airmanship

Revise the checks that will only be carried out by touching the control.

The student should be advised that, although this exercise may be carried out solo – with clear limitations imposed – it is illegal to carry anyone other than people performing an essential function during forced-landing practise.

### Simulating Engine Failure

There are at least two methods of simulating the engine failure. Your CFI will determine the organisation’s practice. Simulating engine failure in a variety of ways is more likely to expose the student to the real life possibilities, and they are more likely to react appropriately, rather than to just one particular stimulus.

One method is to set the mixture to idle cut-off, thereby encouraging the student to close the throttle and apply carburettor heat, as they would in the real situation. If using this technique make sure the throttle is fully closed before returning the mixture to RICH.

Another method is to partially close the throttle, and leave the student to respond by selecting carburettor heat to HOT and closing the throttle.

Once the student has gained some competence in this exercise you can introduce engine failures with little or no warning – as it would be in the real world.

The simulation is ended with the instruction to “go around”, at which point the student is to immediately carry out a go around. In later lessons more emphasis will be placed on the student’s decision making to initiate the go around without prompting.

It is also important, in later lessons, for the student to complete the exercise through to the landing. This can be completed by conducting the forced landing over an appropriate aerodrome.

Dual forced landing practise qualifies as a bona fide reason to fly below the height prescribed in 91.311(a)(2). See 91.311(c) for the conditions required.

When practising solo, unless operating in a Low Flying Zone, the go around will be at 500 feet agl (see CFI for the organisation’s limits).

## Aeroplane Management

As a prolonged climb will be required before starting the exercise, a period of level flight is recommended to allow the engine temperature to stabilise before closing the throttle.

To maintain adequate engine operating temperatures and pressures during the prolonged glide, the engine is warmed or cleared every 1000 feet (minimum) by smoothly opening the throttle to full power and closing it again. This ensures that normal power will be available for the go around, clears the spark plugs of lead/carbon deposits and puts warm air through the carburettor, preventing ice build-up. If the engine runs rough during the engine warm, consider warming or clearing more often (every 500 feet), delay closing the throttle again until smooth running is achieved, or begin the go around immediately or at a considerably higher altitude than the minimum. This will depend on the engine's running characteristics and the terrain.

> There is no need to select carburettor heat COLD during the engine warm as no attempt is being made to continue using full power. In addition, the effectiveness of the carburettor heat is dependent on engine temperature, therefore, the application of full power will ensure carburettor ice is cleared.

## Human Factors

Avoid turning your back on the chosen landing site.

Information processing loads are high in this first lesson, but with practise the overload will reduce, and more information can be introduced.

Avoid mindsets by revisiting and evaluating any decisions made, especially those relating to wind.

## Air Exercise

The exercise starts from an appropriate cruising altitude (refer CFI), not a height above ground level, as the aeroplane is normally flown by reference to the altimeter.

The initial actions, planning and flying the procedure are discussed.

### Immediate Actions

**Apply carburettor heat and close the throttle**. Carburettor heat will remedy a real icing problem or prevent one during the simulation.

**Convert excess speed to height**, since there may be an appreciable difference between the cruise speed and the recommended glide speed. The average training aeroplane may not actually increase height, but at least preserve it.

**Set glide attitude and trim**. As the best glide speed is approached, allowing for inertia, the attitude is selected for the glide and the aeroplane accurately trimmed to maintain this attitude.

**Confirm wind direction and select suitable landing area**. If situational awareness has been maintained, the wind and the approximate elevation of surrounding terrain are confirmed. The aeroplane is turned toward the most suitable area for a forced landing. It should be stressed that – if the student has not been maintaining their situational awareness – valuable time will be wasted while these factors are assessed.

**Make the plan**. See the notes below on making and executing the plan.

**Make a MAYDAY call** (simulate only during training)

### Trouble Checks

When there is time available for diagnosis, as there is during a forced landing, carry out the *Trouble Checks* to see if you can get the engine restarted.

***F*** ***F**uel*

Selector ON, fuel pump ON (if applicable), change tanks (touch).

Fuel pressure and the contents gauges are checked and compared with the fuel tank selected.

***M Mixture***

RICH, carb heat HOT, primer LOCKED.

These are checked and the mixture, in the case of partial power, altered (touch) to see if there is any improvement in power or smoothness.

***I Ignition***

LEFT, RIGHT or BOTH (touch), check temperatures and pressures

Trying LEFT (touch) and RIGHT (touch) magneto positions for smoother running may keep the engine running. Try to restart the engine with the ignition key if the propeller is not windmilling (touch).

Check the temperatures and pressures for any reading outside the green range.

***P Partial Power***

Check

Set the throttle to about one third open to see if any power is available. If no power is available, the throttle must be closed again so as to prevent the engine unexpectedly bursting into life at an awkward moment. In the simulated exercise the partial power check serves to warm the engine.

## The Plan

A specific landing site or the best compromise needs to be chosen and the approach planned.

Planning the approach begins with selecting a minimum of three reference points:

- an aiming point 1/3 of the way into the field in the landing direction
- a 1000-foot agl area
- a 1500-foot agl area

The aim is to fly the approach as similar to a lefthand circuit as possible, unless terrain, cloud, obstacles or gliding distance favour a right hand circuit.

Start selecting the points from the ground up as there is little point choosing a 1500-foot area if you are 1300 feet.

Stress that the 1000-foot and 1500-foot references are above ground level, and that these provide valuable orientation information if the landing site is lost from view.

> Some organisations recommend an additional 2000-foot agl area (refer CFI).
>
> When the considerations of a righthand circuit are introduced (refer CFI), the plan is simply flipped over, to produce a mirror image on the righthand side of the landing site.

### *Landing Aim Point*

The first step is to divide the available landing distance into three and choose a definite reference or aiming point at about 1/3 of the way into the field. The logic behind this is that it is better to taxi, even at high speed, through the far fence than to fly into the threshold fence.

Although a positive reference point on the field is best, it does not have to be in the field itself, but can be abeam the 1/3 aiming point, one or two paddocks over.

### *1000-foot Area*

The 1000-foot area is at 90 degrees, or right angles to the threshold, usually 3/4 of the normal circuit distance out (refer CFI). This area should be about the size of a football field or four to six suburban residential sections.

> There is a natural tendency for the student to hug the field, resulting in a very tight turn to final and little or no opportunity to adjust the approach. The downwind leg should never be closer than three-quarters of normal circuit spacing.

### *1500-foot Area*

The 1500-foot area is a larger area further back from the 1000-foot area.

From anywhere within this area, at 1500 feet agl, it will be possible to glide to the 1000-foot area and arrive at about 1000 feet agl.

This area may be over the field if low, or swung out wider than downwind if high, as if the aeroplane is on a string held at the 1000-foot area.

### *Altitudes*

The next step in the planning process is to transform the 1000-foot and 1500-foot areas into altitudes that will be seen on the altimeter, by adding on the estimated elevation of the chosen landing site.

> It will be shown a little later how the downwind spacing compensates for any error in the estimate of elevation. A point worth making here is that it is always better to overestimate than underestimate and that if there is any doubt, add two or three hundred feet onto the estimate of the landing site elevation.

### *Positioning*

The most important part of the plan is assessing progress into the 1500-foot area from wherever the aeroplane happens to be.

The ideal procedure starts from the non-traffic side, flying parallel to the chosen landing site to provide a standard reference to which variables can then be applied during later training.

The positioning process is assisted by asking at regular intervals, "Am I confident of reaching the 1500-foot area at ________ feet?" If any doubt exists, a turn toward the area should be started immediately. If no doubt exists, the turn can be delayed.

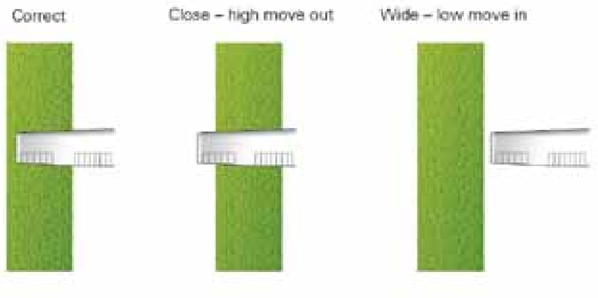
Reconfirming wind, especially wind speed estimates, by acknowledging drift may result in a plan adjustment, especially in stronger winds.

Once the 1500-foot area has been passed, the aeroplane is positioned on the downwind leg.

### *Spacing*

On the downwind leg it is vital that the spacing is assessed in relation to the nominated point on the aeroplane's airframe to establish the correct circuit spacing. It is this process that compensates for any misjudgement at the 1500-foot area, and any error in estimating the landing-site elevation.

Figure 3



**Caption:** An example of how spacing is assessed using the parallel markings on a low wing aeroplane.

In a high-wing aircraft, position the 'runway' within the outer third of the strut.

In the classroom, put a piece of paper, representing the landing site, on a desk or the floor and give the student a model aeroplane. Ask them to stand in the downwind position and place the model at the chosen downwind spacing.

By lifting the model aeroplane higher, you can show that the aeroplane is now too close or too high. At the new height the student must move out from the landing site to once again position the airframe feature onto the diagram.

Lowering the model will have the reverse effect (too wide or low) and force the student to move in toward the diagram to re-establish the correct spacing.

At the 1000-foot area, abeam the threshold, the approach phase starts.

### *The Approach*

How soon the base turn is started depends on the wind strength. Strong wind, turn sooner. Light winds, turn later.

The base turn can be adjusted but **never extend the 1000-foot area downwind**.

The aeroplane should be turned to track on base leg at 90 degrees to the landing direction.

From the base leg, further adjustments can be made if necessary. If the approach appears too low, the turn onto final can be made early. Conversely, if too high, the base leg can be extended or the turn widened to pass through the centreline.

Throughout the approach, from the 1000-foot area down to approximately 500 feet agl, continual reference is made to the ⅓ aim point and to maintaining glide speed. No checks are carried out during this segment. The student should be familiar with the glide approach as covered in the circuit lessons.

It is very important to offset drift during the base leg, so as to ensure that the aeroplane tracks correctly in relation to the field.

The student should be repeatedly asking, "can I reach the ⅓ aim point?"

In extremely strong winds, or if a headwind is encountered on base, this may require the aeroplane to be turned to point directly to the ⅓ aim point.

The aim of this process is to position the aeroplane at about 500 feet, so as to touch down at the ⅓ aim point, preferably without flap.

If there is a need to use flap earlier, because you are grossly high, then flap is used. Application of flap in stages is used to bring the actual landing point back toward the threshold from the ⅓ aim point, so as to make maximum use of the length available.

The approach and landing phase of this lesson will be covered in more detail in the following *Considerations* lesson.

## Airborne Sequence

### On the Ground

No new material included here. The student should know all of the checks on the ground and be able to take you to the training area with little input from you.

### The Exercise

During the climb and transit to the training area point out the various wind indicators and surface types (ploughed, swampy). Encourage the student to evaluate the field type while they are carrying out the go around. Also, give the student some opportunity to practise estimating the elevation of various landing sites, preferring a rounding-up estimate if in doubt.

### Before Starting

Before starting the exercise, all available indicators of wind should be observed or discussed, the initial forced-landing site pointed out, and the student asked to estimate its elevation.

The various reasons for choosing the landing site are discussed in relation to the seven S's, C and E.

> The introduction to forced landing without power is never carried out onto an aerodrome or agricultural airstrip. This is because a major part of this exercise deals with assessing the wind without a windsock or known active runway and the suitability of the landing site, which is not a designated landing area. In addition, all airfields attract aircraft and have an aerodrome traffic pattern around them, requiring radio calls to be made for the information of other traffic. Even if you carry these out, they form a distraction to the lesson.

The planning process is discussed next, specifically choosing the ⅓ aim point, the 1000-foot area, the 1500-foot area, and how to initially achieve the 1500-foot area.

Throughout this process, the chosen landing site is kept on the left of the aeroplane (student's side) and the aeroplane is held in a gentle level turn so that the landing site can be continually observed.

> There are two common errors an instructor can make.
>
> 1. Getting too close to the landing site, requiring steep angles of bank or flight out of balance to observe the field. At the heights commonly used to start this exercise, the aeroplane needs to be at least 2 NM away from the field (at least twice circuit spacing).
> 2. Not allowing for drift during the gentle turn to observe the landing site – a constant radius turn is required to maintain a constant distance.

## The Pattern

Before the throttle is closed to simulate the engine failure, all the considerations of wind, elevation, landing site and reference points are discussed. The aim is to demonstrate the ideal forced-landing pattern, and later exercises will require the student to adapt this pattern for the conditions under which the power failure is simulated.

The value of the demonstration/patter will be negated if the student is not aware of which landing site is being used and what features define the 1/3, 1000-foot and 1500-foot references.

The engine failure will be simulated from ________ feet by closing the throttle. The first demonstration/patter and student practise should be conducted at a suitable altitude so as to introduce the exercise gently and allow them time to put the briefing items into practice.

It is recommended that the exercise begin with the initial actions and a demonstration/patter. This should consist of how the aeroplane is being positioned for the 1500-foot area, the use of spacing downwind to make the 1000-foot area, and how to fly the base leg to make the 1/3 aim point. The checks will be covered in the next lesson.

The aeroplane is positioned on the non-traffic side of the chosen landing site, facing into wind, preferably at least 2500 feet agl to give information-processing time. Closing the throttle is at your discretion so, once all relevant points about the approach have been observed by the student, position the aeroplane appropriately and start the simulation.

Carburettor heat is selected to HOT, the throttle closed, the initial actions carried out and the plan activated. Except for the regular engine warm, no other checklists are completed.

Throughout the approach you should draw the student's attention to the relevant features and wind. The 1500-foot area is relatively easy to achieve because it is such a large area, and the 1000-foot area cannot be missed if the spacing is correct. Problems invariably arise in the judgement of the approach to the 1/3 aim point. This is because the student has spent several hours in the normal circuit, and all their experience in judging an approach has been in relation to a threshold or runway end. It is vital, throughout the base leg, that you repeatedly draw the student's attention to the 1/3 aim point and ask if the student is confident of placing the aeroplane's wheels on the ground at that point.

Judgement of whether the 1/3 aim point can be reached or not is facilitated by maintaining a constant airspeed and noting whether the aim point moves up the windscreen, down the windscreen, or remains constant.

At this point the objective of this exercise has been achieved. The measure of success is whether or not the 1/3 aim point could be easily reached from this position. Regardless of the answer to that question, you tell the student to go around. You or the student must assess whether an earlier go around is advisable due to turbulence, terrain, stock or nearby habitation.

In following lessons the aeroplane will be taken below 500 feet and the student will have the opportunity to more accurately assess if the aiming point will be reached.

The aeroplane should be repositioned to the ideal forced-landing start position using the same landing site for student practise.

### *Student Practise*

The student should be encouraged to say how confident they are about reaching the 1500-foot area and the 1/3 aim point and their allowance for the wind. If not, you may need to prompt the student with questions, especially if you doubt the aeroplane's ability to reach the nominated references.

Do not use terms such as:

1. "This approach looks high/low/correct."

   Emphasise what the student should be looking at to judge the approach: "This approach looks high in relation to the water trough (1/3 aim point)."

2. "Delay flap until you're sure of getting in." You could be "sure of getting in" from 3000 feet agl over the landing site!

   Emphasise, "Delay flap to about 500 feet agl and ensure the water trough (1/3 aim point) can be reached." Provide for exceptions, by stating that "If flap is needed then use it."

3. "Can you make/reach the field?" This draws the student's attention away from the 1/3 aim point to look at the overall landing site. Students who go high/overshoot are usually doing this. Students who go low/undershoot are always looking at the threshold.

   Emphasise the 1/3 aim point, eg, "Can you reach the water trough?"

Where possible, this exercise concludes either with a demonstration forced landing onto the home aerodrome, or the student is encouraged to fly the pattern down to about 500 feet agl. During the latter exercise, you make all radio calls so that the student can concentrate on the pattern. Maintain situational awareness and beware of other traffic, as a simulated forced landing does not give you automatic right of way.

### After Flight

The handout on this lesson should include a complete set of checks to be learnt before the next lesson.

Your student will be ready for solo exercises to the training area soon, and they should be showing progress in that direction. Encourage them to work on any weaker areas before they are sent solo.

# Forced Landing without Power Considerations

This is the second part of the forced landing without power lesson. It builds on all of the pattern information learnt in the previous lesson and introduces the checklists and further considerations.

In the previous lesson the student practised the FLWOP pattern and the considerations of how the pattern is planned. They have had the chance in the mean time to start to learn the checks and revise the last lesson. The whole procedure is completed and practised in this lesson.

Aviate and then navigate remain the prime considerations of any emergency. Where stress levels are high, always revert to aviate first, navigate second, and use only spare capacity for anything else.

## Objectives

To carry out the recommended procedure in the event of a total or partial engine failure, incorporating the appropriate checklists.

To practise aeronautical decision making (ADM) to troubleshoot and rectify a partial power situation.

## Considerations

### Considerations

The probable causes of engine failure are revised, and the methods of avoiding this are emphasised.

The various factors affecting gliding range are discussed. The effects of L/D ratio, altitude and wind are relevant to the first requirement of landing site selection, ie, the site is within easy reach.

### Best L/D

As was seen in the *Climbing and Descending* lesson, glide range depends on the best lift to drag ratio.

When the aeroplane glides in the configuration for the best L/D ratio ( ________ knots, no flap, propeller windmilling), the angle of attack is about 4 degrees, the shallowest glide angle is achieved, and the range is greatest.

If the nose attitude is lowered, to glide at a higher airspeed, the range will be reduced. If the nose attitude is raised, to glide at a lower airspeed, the range will be reduced. This can be verified with the VSI.

The visual illusion created by raising the nose – trying to stretch the glide – will require careful explanation.

Although raising the nose can make it look like the aeroplane will reach a more distant field, the aeroplane sinks more steeply than it would if flown at the best L/D ratio. This can also be confirmed with the VSI.

With the aeroplane trimmed to maintain an attitude for the best L/D ratio, if the reference area or point does not move down the windscreen, or at least remain constant – it cannot be reached.

The gliding ability of every aeroplane varies but for the average light training aeroplane, *within easy reach* is commonly described as: look down at an angle of about 45 degrees and scribe a circle around the aeroplane; anything within the circle is *within easy reach*.

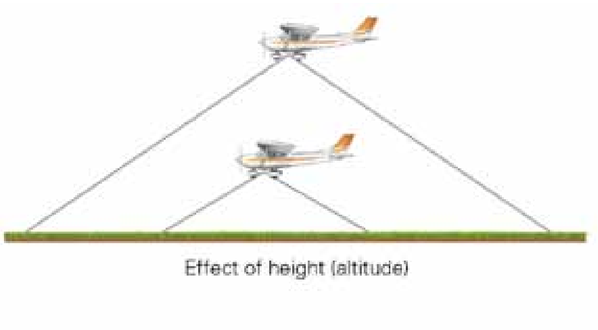
### Height

The size of the circle will obviously be affected by height.

Therefore, another of the most useless things to a pilot is introduced – sky above you!

Never fly lower than you must!

Figure 1



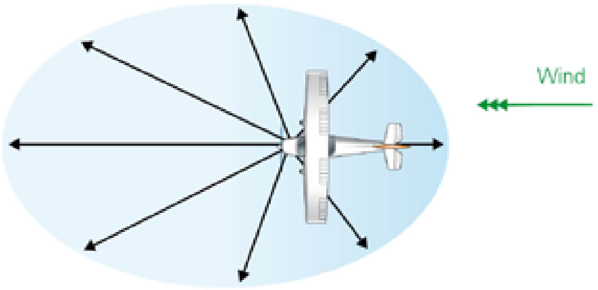
Effect of height (altitude)

Altitude (height) will also affect the amount of time available for planning and completing the recommended checklists.

### Wind

The glide range is increased by a tailwind and reduced by a head wind. Therefore, the effect of wind on range will be to elongate the circle downwind, producing more of an egg shape than a circle.

Figure 2



### Partial Power

At the completion of the trouble checks, a check for partial power is made by opening the throttle to full power. If there is no response, the throttle is closed and the forced landing without power continued.

However, if some power is available, for example, 1800 rpm at full throttle, a range of choices becomes available. These will require the application of aeronautical decision making and pilot judgement.

The first decision to be made is whether to continue with the forced landing by closing the throttle, leaving the engine at idle and not relying on the available power. The alternative is to use the available power to transit to a more suitable landing site. This decision must be made with the knowledge that a partial power failure may become a total power failure at any time.

Even if the decision is made to close the throttle, partial power may be available if required on final approach – but of course, cannot be relied upon.

Other factors that will affect the decision are:

- The effect of wind.
- The suitability of the nearest landing site.
- The amount of power available. For example, is there sufficient to fly level at not less than the endurance speed or is a gradual descent required to maintain airspeed?
- The type and height of terrain to be crossed in transiting to a more suitable landing site. For example, will flight over a built-up area be required, or can leapfrogging from landing site to landing site be accomplished?

- The cause of the power reduction (if known). For example, no oil pressure and reduced power can quickly become a total power failure.
- The aeroplane's altitude. Never fly lower than you must.

## Airmanship

The engine failure will be simulated from ________ feet by closing the throttle.

> Ensure there is sufficient height to complete the checklists without undue haste during early student practise.

Revise the trouble checks, and which items are to be touch-checks only.

Introduce the pre-flight passenger briefing. The pre-flight passenger brief is used to describe:

- the type and location of emergency equipment on board,
- the method of getting out of the aeroplane, and
- passenger's actions following a forced landing.

Time spent on the ground reduces the time required to explain these points in the event of an emergency, and it improves the passenger's chances of exiting the aeroplane successfully.

Inform the student that from now on it is their responsibility to initiate the go around, without prompting from you, at an appropriate height (refer CFI). However, if at any time you instruct them to go around, the student must consider the simulation ended.

The student should be reminded that, when authorised, this exercise may be carried out solo, but some limitations will apply.

In later lessons, this procedure will be carried out onto aerodromes (or landing sites) so that the glide approach can be incorporated and the complete forced landing procedure practised. However, the student should be aware that simulated forced landing practise does not provide them right-of-way.

## Aeroplane Management

Stabilise the engine temperature before commencing the exercise.

Warm the engine every 1000 feet, minimum.

## Human Factors

Do not concentrate on the checklists at the expense of the pattern.

Stress is minimised by knowing the appropriate procedural response to the unexpected, regular practise and thorough pre-flight planning.

## Air Exercise

### Action Item Checklist

Engine failure will be simulated at 3500 feet agl for the first lessons, but will lower with more practise.

1. Immediate Actions
   a. Select carb heat HOT and close the throttle.
   b. Convert excess speed to height.
   c. Select glide attitude and trim (best gliding speed for type).
   d. Confirm wind direction and select suitable landing area.
   e. Plan the approach and execute.
2. Trouble Checks (FMI)

   ***F Fuel***
   Selector ON, fuel pump ON (if applicable), change tanks (if applicable) (touch).

   ***M Mixture***
   *RICH, carb heat HOT, primer LOCKED.*

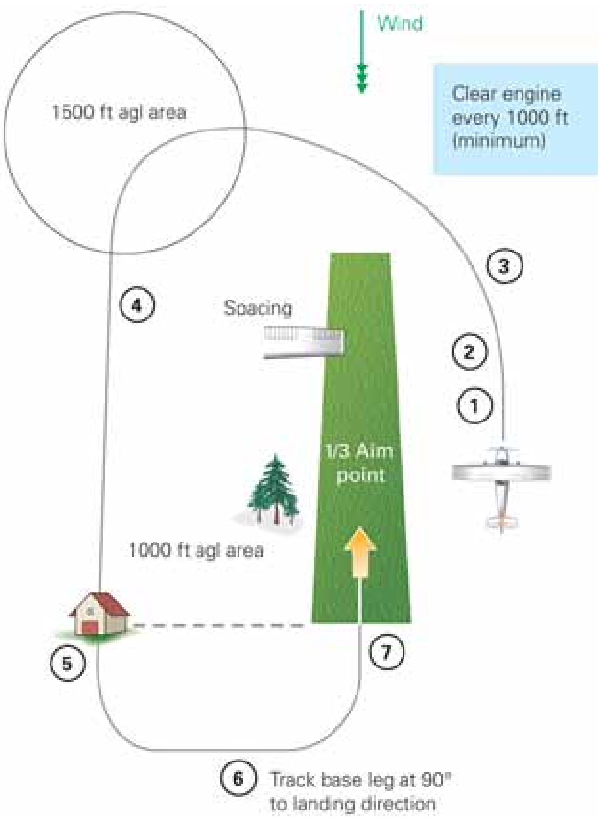
   ***I Ignition***
   BOTH (touch), check temperatures and pressures.

   ***P Partial Power***
   check.

   Assess the approach

3. MAYDAY call. Select 7700 and activate ELT.
   Passenger brief.
   Engine warm.
   Assess the approach
4. Achieve 1500-foot area.
   Pre-landing checks.
5. Achieve 1000-foot area.
6. Fly the approach.
7. Go around or landing.

Figure 3



## Aviate – Navigate – Communicate

The principles of Aviate – Navigate – Communicate must be followed during FLWOP training.

| | |
|---|---|
| **Aviate** | Fly the aeroplane accurately and carry out the checks thoroughly. |
| **Navigate** | Maintain situational awareness. Keep the selected landing site in view at all times. Fly the aeroplane pattern so that you achieve this, adjust as necessary. |
| **Communicate** | Carry out a simulated MAYDAY call. Communicate with others on board to reassure and assist them. |

## Immediate Actions

Select the carburettor heat HOT and close the throttle fully.

Convert excess speed to height by holding the level attitude until the speed approaches best glide speed, and then select glide attitude and trim. Glide speed of this aeroplane is ________ knots.

Check the aeroplane is maintaining the glide speed, re-trim as necessary. This will need to be checked regularly throughout the pattern.

The importance of good situational awareness comes into prominence here. Knowing the elevation of surrounding terrain and the wind direction (approximately) at all times will help if the engine fails unexpectedly.

With the wind direction confirmed, choose a landing site (with reference to the 7S's, C and E), and plan the approach. Identify the 1/3 aim point, the 500-foot area, the 1000-foot area and the 1500-foot area.

The most important part of the plan is assessing progress into the 1500-foot area from wherever the aeroplane happens to be. "Am I confident of reaching the 1500-foot area at ________ feet?" If any doubt exists, a turn toward the area should be immediately started. If no doubt exists, the turn can be delayed.

## Trouble Checks

***F*** ***F**uel*

Selector ON, fuel pump ON
(if applicable), change tanks (touch).

Fuel pressure and the contents gauges are checked and compared with the fuel tank selected.

***M*** ***M**ixture*

RICH, carb heat HOT, primer LOCKED.

These are checked and the mixture, in the case of partial power, altered (touch) to see if there is any improvement in power or smoothness.

***I*** ***I**gnition*

LEFT, RIGHT or BOTH (touch), check temperatures and pressures

Trying LEFT (touch) and RIGHT (touch) magneto positions for smoother running may keep the engine running. Try to restart the engine with the ignition key if the propeller is not windmilling (touch).

Check the temperatures and pressures for any reading outside the green range.

***P*** ***P**artial Power*

Check

Set the throttle to about one third open to see if any power is available. If no power is available, the throttle must be closed again so as to prevent the engine unexpectedly bursting into life at an awkward moment. In the simulated exercise the partial power check serves to warm the engine.

## Transmit MAYDAY

Assuming the partial power check proved no power is available, make a simulated MAYDAY call. The call can be spoken, but do not press the push-to-talk button!

The mayday transmission must be done reasonably early in the pattern as height is being lost, reducing the effective radio range (line of sight). Normally this transmission is made on the frequency in use. However, if there is no response, or the frequency in use is considered inappropriate (for example, 119.1 aerodrome traffic), a change to 121.5 (touch) should be made and 7700 (touch) selected on the transponder.

If the Emergency Locator Transmitter (ELT) can be activated remotely from the pilot's seating position, select it ON (touch).

## Brief the passengers

Valuable time can be saved here if a thorough briefing of the emergency equipment and exits has been given before flight, however, you are still responsible for advising passengers of the circumstances and what you need them to do, succinctly and clearly.

If time permits, the chosen landing site and the direction of the nearest habitation should also be pointed out to the passengers.

Exits are unlocked (touch if applicable), but normally left latched. Depending on aeroplane type, exits may be jammed partially open. This prevents the doors from jamming closed should the airframe become deformed. However, it may also weaken the airframe – or it may not be permitted in flight (refer Flight Manual and CFI).

Check for loose objects, harnesses are tight, and all sharp objects such as pens and glasses are removed from pockets.

The passengers are also reminded to adopt the brace position on short final and are given a meeting point. The meeting point is nominated in relation to the aeroplane or some prominent ground feature. It is usually ahead of the aeroplane (upwind), assuming a landing into wind – to minimise the risk of burns should fire break out.

## Warm the Engine

Warm the engine every 1000 feet of the descent. The last engine warm will be just before the 1000-foot area.

### Achieve the 1500-foot Area

"Am I confident of reaching the 1500-foot area at ________ feet?" If any doubt exists, a turn toward the area should be immediately started. If no doubt exists, the turn can be delayed.

The downwind leg starts from the 1500-foot area. It is vital that on the downwind leg the spacing is assessed in relation to the nominated point on the airframe to establish the correct circuit spacing.

### Prelanding Checks (FMI)

These checks take the place of the normal prelanding (downwind) checks.

***F*** ***F****uel*
OFF (touch)

***M*** ***M****ixture*
IDLE CUT-OFF (touch)

***I*** ***I****gnition*
OFF (touch)

These checks are carried out to minimise the risk of fire.

***M*** ***M****aster*
Switch OFF (when appropriate)

In addition, the master switch should be turned off (touch) to isolate electrical current. However, for aeroplanes with electrically operated flap, this action is delayed until the final flap selection has been made.

### Achieve the 1000-foot Area

At the 1000-foot area, abeam the threshold, start the turn onto base leg while allowing for wind.

Throughout the approach, from the 1000-foot area down to the go around point, continuous reference is made to the 1/3 aim point. No checks are carried out during this segment.

### Approach

Judgement of the approach is helped by repeatedly asking, "Can I reach the 1/3 aim point?"

The aim of this process is to position the aeroplane at about 500 feet agl, so as to touch down at the 1/3 aim point, preferably without flap.

From a position of about 500 feet agl, when clearly able to touch down at the 1/3 aim point, the actual touchdown point is brought back toward the threshold by extending flap.

### Go Around

At the appropriate height (refer CFI) initiate the go around. Have the student make an estimate of their ability to land within the available space, and where they think they would have touched down, had the approach continued.

Future lessons can be carried out over aerodromes, where the student will be able to complete the exercise to the ground.

### If Landing

During the landing, braking should be used as required and the cabin kept intact.

The pilot-in-command has a responsibility for the safety of the passengers. Where possible, the aeroplane is secured and evacuated and first aid administered if required. If the aeroplane is inverted, ensure passengers support themselves before releasing seatbelts.

Ensure the ELT is activated and stay with the aeroplane. It is much easier for searchers to find the aeroplane, than two or three people wandering around dazed and disoriented. In addition, the aeroplane may provide shelter if required.

Where possible contact ATC by phone. Use of the aeroplane's radio is not generally recommended because turning the master on may cause a spark and subsequent fire. You should contact the operator to inform them of your status.

As pilot-in-command you have a responsibility for the aeroplane. Tie the aeroplane down, secure documents and removable equipment.

Do not admit liability. This is a standard insurance requirement. For example, if you've just landed in a farmer's crop, don't suggest that the aero club will replace it!

Never attempt to take off again. Not only is it illegal to move the aeroplane after an accident (unless it is to prevent injury or further damage), it is poor aviation practice.

For more information on survival after a forced landing refer to the *Survival* Gap booklet.

## Airborne Sequence

### The Exercise

Give the student plenty of time to observe the indications of wind direction and strength and to choose a suitable landing site. Revise planning the forced landing pattern before closing the throttle.

Begin the exercise at a suitable height (preferably 500 feet higher than the initial introduction to forced landings) to allow discussion of the checklists during the descent. Although a demonstration and patter may be given the first time the checklists are introduced, it may be of more value to allow the student to fly the pattern and have you do, call or discuss the checks as the plan unfolds (refer CFI).

Once the lesson is complete and during the return to the aerodrome, a partial power failure may be simulated and the considerations discussed.

Once the basic approach pattern has been mastered, the commencement altitude, circuit direction, and choice of suitable landing site should be continually varied so as to expose the student to a wide range of conditions.

### After Flight

Regular revision of these two exercises (total and partial power failure) will need to be simulated throughout the student's training, as occasional practise will have little real value.

Let the student know that the checks they were given after the last lesson must be committed to memory, as they could be needed at any time.

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