RECREATIONAL AVIATION AUSTRALIA

CHAPTER FIVE

A Guide to Practical Flight Instruction

To enable the Instructor candidate to have a more complete understanding of the role of the flight Instructor, this chapter has been provided with examples of how to structure lesson planning and deliver in flight patter.

RAAus flight Instructors are in the unique position of introducing and training members to “Rise aloft in a flying machine and by skilful manipulation of the controls, alight again upon the ground and join that select band of intrepid aviators who have successfully broken the bonds that hold lesser mortals earthbound” © David Eyre

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Introduction

Although much of this training can be considered purely mechanical, following established patterns, there is a unique art and skill to presenting these lessons well. Development of this skill will enable the Instructor to impart clear information and consistent patter to the student leading to steady progress through the required elements. The genuinely motivated Instructor will also impart a true appreciation of the control needed for the flying machine to elegantly 'break these bonds.'

This chapter is intended to offer both the Instructor candidate and experienced Instructors sample briefing structures to build on to create their own unique style of instructing. It sets out standard techniques and phrases which will enable the Instructor to meet the required RAAus standards and provide a ready reference for all Instructors to refresh and improve their techniques.

The information in this chapter is presented in a number of sections.

- Tips for the Instructor – making the flight relevant to the student.
- Recommended in flight patter- to ensure effective and consistent language is used.
- Example briefings for the early lessons and recommended core content.

Chapter 6 will show the Instructor candidate how to structure ground based briefings using recommended RAAus briefings and lessons. This process uses three essential elements to form a standard flight training sequence, which usually consists of the Short Brief, what the student can expect to learn during the flight exercise, the flight, consisting of a demonstration, critique, feedback, monitoring and coaching the student to achieve the required standard, and the debrief to identify any deficiencies and guidance provided for improvement.

Flight syllabus sequence

In 1917, Major Robert Smith-Barry of the Royal Flying Corps developed a system of flying training which is still effectively in use to this day. The system of theoretical knowledge, pre-flight briefing, dual flight training, solo practice and post flight critique was constructed around a syllabus intended to be followed sequentially. The RAAus syllabus follows this basic structure which will be expanded on during this chapter.

It is vital that the student progress through syllabus elements in a structured sequence. The student should be permitted to develop competence and skills in each element before moving onto the next. As an example it is pointless to teach a new student circuits during the first lesson. A basic circuit consists of combining elements such as straight and level, climbing, descending, stalls, stall recovery and positioning and judgement which is impossible to develop without practice. Until the student is competent in all aspects of upper air work, circuits will be challenging or near well impossible to complete competently.

Determining competency

The RAAus Syllabus of Flight Training provides specific elements required for each unit along with guidance for Levels of Knowledge and Application. This section refers to 5 specific levels of competence. 5 indicates the need for further instruction in the lesson, while 4 indicates the need for further practice. A standard of 3 is required for the candidate to achieve for competence for solo flight, while 2 relates to requirements when training candidates for RAAus Pilot Certificate and 1 when training for Instructor ratings. Each of these levels is outlined in more detail in the extract from the Syllabus of Flight Training below.

The syllabus also provides additional information for how to assess the competency standards based on the elements within the syllabus. These are also provided in this section, but in practical terms how does a new Instructor determine a candidate meets a specific standard of competence? What is competence and how do we judge or assess this?

Competence can be defined many ways, and the experienced Instructor or CFI may simply say "you can tell when someone is ready", whether for solo, Pilot Certificate or Instructor rating. While this may be true after many years of instructing and valuable real world experiences have been gathered, for the new Instructor some assessment tools and guidance is invaluable.

Competence must comprise a number of interwoven and linked skills, some of which are specific technical flight tolerances, others less tangible and usually observed by the Instructor. Some of these nontechnical skill used to be referred to as Airmanship and include Threat and Error Management, Situational Awareness, Cockpit or Crew Resource Management and Aeronautical Decision Making. Repetition of these demonstrated skills and the intangible ability to manage and maintain situational awareness form another of the threads.

Cross referencing competency

To confirm or test for competency of a skill element or task, the Instructor must examine and measure the performance of the candidate in a range of different scenarios or environments. This may be categorised as assessment within a range of variables. The Instructor should be able to identify that the candidate is controlling the aircraft with correct actions, ensure the candidate recognises and corrects errors, and manages the aircraft within tolerances in a range of simple or complex scenarios.

The assessing Instructor should be skilled at "loading" a candidate to ensure they confirm basic skills and appropriate decision making. Further, the Instructor must be able to identify development of trends, slips and errors, particularly in regard to sustained errors during the assessment phase. An example would be the candidate consistently demonstrating good lookout and situational awareness in the training area, which may break down with increased workload in the circuit or during simulated emergencies. This process of assessment should also be applied by Examiners and Instructor Trainers when assessing Instructor candidates with the increased workload of instructional tasks.

Definitions

There is an astonishing amount of literature regarding competence and how to determine and assess it. A search for definitions for competence reveals a variety of descriptions including: "A cluster of related abilities, commitments, knowledge and skills that enable a person to act effectively in a situation", "the ability to do something successfully or efficiently", however the bottom line for our Pilot Certificate and Instructor candidates is, can the candidate safely and consistently manage a variety of normal and abnormal situations in flight and on the ground?

Further guidance material

CASA produced CAAP 5.59A-1(0) which provides guidance including definitions of Airmanship from ICAO, judgement, formative and summative assessments, technical and nontechnical skills and more. Instructors and candidates are recommended to spend additional time researching and reviewing further documents at their leisure.

Flight tolerances

Flight tolerances are a measurable component of competence and must be applied when training and assessing Instructor candidates. Likewise similar tolerances must be applied by the Instructor to assist in determining the competence of the Pilot Certificate candidate prior to recommendations to the CFI for first and subsequent solo and issue of Pilot Certificate.

The table below provides **recommended tolerances for issue of a RAAus Pilot Certificate**. An Instructor candidate should meet or exceed these flight tolerances when assessed under simulated in-flight delivery conditions.

Table 4

Flight path or manoeuvre		Flight tolerances
Taxing aircraft		± 1.0 metres of centreline
Nominated heading		± 10°
Climb airspeed		-0 / +5kts
Level off from climb and descent		± 150 ft
Straight and level	Altitude	± 150 ft
	IAS	± 10 kts
Power descent airspeed		± 10 kts
Glide		-5 / + 10 kts
Turns		Angle of Bank ± 5°
Turns onto nominated headings		Heading ± 10°
Steep Turn		Heading ± 10°
		Height ± 150 ft
Final approach airspeed		-0 / +5 kts
Landing	Touchdown	± 60 m
	Centreline tracking	± 2 m

SYLLABUS OF RECREATIONAL FLIGHT TRAINING

LEVELS OF KNOWLEDGE AND APPLICATION

The following syllabi specify the MINIMUM standard of knowledge required. The competency codes outlined below specify the levels required for each individual item within a particular subject, as follows:

- 5 requires further instruction specific to the lesson. The student did not reach the required standard to move onto the next lesson, or requires further instruction of a specific activity within the lesson, or sections of the lesson could not be completed.

- 4 outlines the need for further practice. The student demonstrated an understanding of the content of the lesson but has not met the requirements of competency code 3. The student will benefit from further practice gained during the normal progression though the syllabus. They can progress onto the next lesson, or may benefit from a refresh of multiple activities across multiple lessons.

- 3 is the required competency for solo conduct of the intended operation. This code represents the competency of the member to perform the activity correctly without instructional assistance under carefully supervised conditions in a safe environment.

- 2 is the competency required for the operation to be safely completed at a Pilot Certificate level. This represents the student's ability to be able to competently and without instructional assistance, perform the activity correctly and adjust actions to cope with emergencies under uncontrolled environments.

- 1 is the requirement for Instructors wishing to teach the endorsement. This standard represents the Instructor's ability to competently perform the required activity with a high degree of accuracy and in a professional and competent manner in uncontrolled environmentsments and adjust actions to cope with emergencies in a highly consistent manner, facilitating the instruction of the activity to a student.

These codes are the basis of assessing competency in the required fields of the syllabus. In order to establish consistency, accuracy must be witnessed by the instructor on greater than two occasions to ascertain proficiency in the required exercise. Attainment of these competency standards is required to be recorded in the student training records.

Training outside the briefed lesson

Throughout the upper air training sequences it can be tempting for the flight Instructor to introduce elements out of sequence or ask the student to undertake lessons not yet briefed or practices.

For example, when requiring changes in direction during the level and straight element, the Instructor may try to talk the student through completing a turn and expect the student to achieve a certain standard in turns.

To avoid student overload and confusion, and have them attempt to understand a sequence they have not yet been briefed on, the Instructor should take over and conduct any turns required to manoeuvre the aircraft during this lesson, allowing the student to focus on the straight and level element only. Patience on behalf of the new Instructor is required to ensure the student focusses on the intended lesson. The student should not attempt turns until they have been properly briefed and introduced to the turning element.

Likewise, expecting the student to take-off or land the aircraft in the first few lessons may create additional stress for the student. The skills and techniques for this advanced lesson must be developed over time and should not yet have been briefed. It is therefore recommended to introduce take-offs as a distinct lesson forming part of climbing and descending or the circuit lesson specifically, and likewise landings should not be attempted until the student has demonstrated an appropriate level of skill at basic upper air work.

The repetition of these basic lessons by the Instructor may result in an understandable boredom for the Instructor, however this boredom does not justify rushing new students through basic lessons. Practice and competence in the basic upper air lessons will ensure the student moves through the syllabus with ease, building on previous lessons.

If Instructors are concerned that the student could perceive this separation of elements as the Instructor showing off or attempting to keep some flying for themselves, it could be argued that the student will benefit more from observing the Instructor demonstrate accurate flying through other sequences or elements such as the take-off, circuits and landing. It is imperative at all times the Instructor flies the aircraft accurately, in balance and with due regard for all procedures.

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Section 1:

Tips For The Instructor Making The Flight Relevant To The Student

There are five essential steps when providing a practical flight lesson.

Explanation (ground)	A pre-flight brief on what the student can expect during the flight
Demonstration (in air)	The flight Instructor demonstrates and patters what is happening
Student follows through	The student follows through while the flight Instructor patters
Student practices	Flight Instructor patters and corrects faults
Analysis (ground)	Post flight brief- mentions strengths and deficiencies and provides suggestions for improvement

In the air these steps can be summarised as:
- Demonstrate
- Direct
- Monitor
- Coach

Above all else, this chapter emphasises that in order for students to learn the flight Instructor's task is to facilitate the Learning process. If the Instructor can relate a lesson to an element of the student's everyday life, experiences or already understood skills, the relevance of the lesson will also make more sense. As an example, if the student rides horses, the Instructor can talk about holding the controls in a light grip and light control inputs much like the gentle inputs or pressure of the reins when turning a horse.

Similarly, if the student has driven high performance sports cars or ridden motorbikes, parallels can be drawn between the type of inputs for the steering wheel or handlebars and the control column.

In-flight briefing

Some Instructors do not carry out pre-flight briefings but rely on briefing the student as the flight progresses. This is not recommended and may lead to poor learning outcomes for the student.

Pre-flight briefings are conducted:

- To check student progress with aviation theory knowledge.
- To revise aspects of all flight training to date.
- To briefly revise the previous flight.
- To give an in-depth explanation of the new flight sequence.
- To outline what the student can expect during the flight.
- To set out the aim and the expected outcome of the flight.

The pre-flight brief is also an opportunity to build rapport with the student, answer any queries and generally settle the student down.

In-flight briefings are not acceptable because:

- There is no opportunity to refer to the knowledge which has been gained during a proper pre-flight briefing.
- The student is concentrating on flying the aircraft and often is not capable of absorbing in-flight explanations.
- There may be communication difficulties in the in-flight situation resulting in poor comprehension by the student.
- The Instructor may be distracted from tasks such as monitoring the environment, basic lookout and airmanship.

Not conducting formal pre-flight briefings indicates a lack of discipline by the Instructor and willingness to shortcut established practices. It is also contradictory to basic PMI techniques, indicates a lack of consideration for student development and possible indifference to students learning processes.

Part of any effective pre-flight briefing is skilful questioning by the Instructor to ensure the student has adequately understood the aim of the previous lesson and remembered this information.

All training flights must be preceded by a pre-flight briefing.

Revision and practice sessions

- It is absolutely vital not to assume that the student has an understanding of an exercise. Always allow for revision periods. Ensure the student can competently carry out the exercise and don't be tempted to move on because the exercise has been completed with previous students. Remember, this is the first time the student has completed this exercise in their training and they deserve an uninterrupted opportunity to get it right.

- Make it part of your instructional technique to always revise previous exercises and allow time in each session for practice.

- At times, a whole flight session may be devoted to revision and practice of previous elements to ensure the student has reached the appropriate competency before moving on.

Student self-patter

If the student is capable, they can be encouraged to self-patter such things as the entry to a climb or descent or before turning. For example, the entry to a turn "All clear right, all clear left, all clear in front, turning left" This type of self-patter can become so ingrained as a good habit that it readily transfers to other disciplines, such as driving a car.

Further tips for the Instructor

Flight Instructors develop their own techniques for dealing with the many areas of flight and ground briefings. This is expected to allow for personal style and mannerisms to provide the best possible outcome.

However, during this process, Instructors can forget the essentials, including awareness of student needs and the proper instructional techniques to be used.

The tips in this chapter are offered from experienced Instructors to provide guidance for the new Instructor to develop good instructional skills. Rather than teaching the Instructor "how to suck eggs" they are intended to assist Instructors to be aware of issues which may not have been considered. They may be regarded as "tricks of the trade" because they offer specific methods to enable the student to receive the core message.

The Instructor candidate may use these tips for any section.

Teaching to aircraft type and location

A common issue encountered when assessing Instructors who may have operated one type of aircraft and only trained at one location is the tendency to teach to aircraft type and location. The Instructor makes comments which are only relevant to the aircraft being used for training.

‘This aircraft will not stall,’ ‘we use this procedure when deploying flaps,’ and the like.

Likewise, the Instructor, possibly in an effort to be helpful, will point out a geographical feature only found at the local airport to use for turning onto a particular leg of the circuit or for orientation purposes, such as roads, houses, mountains or water. The only constant feature for pilots conducting circuits is a runway, whether dirt, gravel, grass or tar. This must be the only reference used for spacing, turning for various legs and judgement of approaches, etc. The student must not focus on the runway to the detriment of the previously trained processes of referencing the horizon and relevant references once runway alignment and spacing is confirmed.

The only constant for distance judgement is a feature on the aircraft, whether the strut for a high wing, two thirds, or halfway along the leading edge of a low wing aircraft, and distances ahead and behind. Judgement using aircraft features and runways as references, when developed will also assist the student to manage forced landings and precautionary landings using the same techniques for paddocks or unfamiliar airfields, airstrips and ALAs.

If the Instructor is successful at providing generic but relevant information, the student should be able to operate any similar type of aircraft at any location with ease and a minimum of transition training. This will also reduce the number of Runway – Loss of Control accidents for pilots in new types or at new or unknown runways and ALAs.

Likewise, it is an easy trap for an Instructor to teach the student the radio calls required only at their location. When the student operates at a different airfield, problems can arise. The student may have been taught in a busy environment requiring minimal radio calls, or the local airfield owner may demand radio calls for all legs of the circuit. The student, if not aware of standard radio requirements outlined in the Aeronautical Information Publication (AIP) or Civil Aviation Advisory Publications (CAAP) will be confused about requirements.

Remember the intent of training is not to produce a clone of the Instructor capable of only operating at one location in one aircraft, but a well-rounded, professional and competent pilot the Instructor can observe with pride. Our category of training can be the affordable basis for a civil or military flying career and as mentioned in the PMI, primacy is difficult to overcome. “Teach it right the first time!”

Prompting information

A useful resource for the new Instructor is to use standardised briefings as provided in Chapter 6 and Appendix 5 as prompts to ensure all required elements are included. Just as vital is ensuring actions are taught in correct sequences, and so it can be useful to have the sequence written on a card and placed where the Instructor can see it. For example:

Axis	Control	Input		Primary E ect		Secondary/Further	Use
Lateral	Elevator	Control Column	forward rearward	Pitch	down up	_	Attitude an Airspeed
Longitudinal	Aileron	Control Column	right left	Roll	right left	Slip - Yaw	Directio
Normal	Rudder	Rudder Pedals	left right	Yaw	left right	Skid - Roll	Balance

Once the Instructor has memorised the sequence, the prompts may no longer be required.

Reassurance and relaxing

It is obvious that many students can be anxious about flying. Indeed, some pilots will continue to be anxious throughout their flying career. The thoughtful flight Instructor will recognise when the anxious student is allowing this tension to have a deleterious effect on the progress of the student.

Simply reminding the student to ‘relax’ does not have much effect. It is more effective to be specific with words such as ‘relax your grip on the controls’, ‘relax the tension in your legs’. Use of humour when relevant can encourage the student to relax ‘release the Vulcan death grip’.

The other aspect is for the flight Instructor not to add to student anxiety by using negative phrases, such as ‘if you use too much rudder, you might cause the aircraft to spin’.

Unfortunately in the past some flight Instructors have shown off by demonstrating their ability to recover from unusual manoeuvres.

The professional flight Instructor should always fly smoothly and not indulge in abrupt manoeuvres which may add to a student becoming anxious.

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Section 2:

Recommended Core Content For Flights

Taxiing

An often overlooked element of many lessons is the incorporation of taxiing and the many considerations related to this apparently simple exercise.

Elements relevant to this vital ground handling aspect of flight training include:

- The type of surface (grass, tarmac, gravel, dirt).
- Any slope (relevant to taxiways or runways).
- Wind direction.
- Wingtip and propeller clearances.
- Other traffic.
- Slipstream and jet blasts.
- Correct seat adjustment and appropriate vision of the student/pilot.
- Windscreen cleanliness.
- Management of aircraft energy and inertia.
- Blind spots.
- Aerodrome layout.
- Instrument checks.
- ATC clearances (if relevant).
- Right of way rules.
- Aerodrome signs and markings.
- Situational awareness and courtesy to other aerodrome users.

Taxiing is generally introduced as part of the Effects of Controls lessons, however due to the large number of considerations and gaining of competence required by the student, elements and discussions regarding taxiing are usually incorporated into lessons up to first solo.

Taxiing forms a large part of the responsibilities of the Instructor initially, gradually becoming the sole responsibility of the student by first and subsequent solo. If a student has limited practical experience with machinery or primacy with farm machinery a separate session for taxiing experiences and control may be appropriate.

Taxiing means the manoeuvring of the aircraft on the ground under its own power, and requires common sense and concentration. The student must be aware of the difficulties inherent in manoeuvring an aircraft, including wingspan width and the potential for collision with buildings, other aircraft and other objects and the practical considerations to manage a vehicle which cannot reverse. Further the engine drives the propeller to create movement rather than directly driving the wheels as for most land based vehicles.

Objective

Correctly use the aircraft controls to manoeuvre the aircraft on the ground at an appropriate and safe speed with consideration of the prevailing weather conditions. In order to demonstrate the aircraft is fully under the student or pilots control, adherence to accuracy of alignment to the taxiway or runway centrelines and bringing the aircraft to a stop at nominated points.

Considerations

Starting the aircraft

The aircraft or school recommended checklists must be used to start the aircraft, and the student must be briefed on considerations such as propeller wash, and ensuring the area is clear. A loud and clear call through an open window or door must be made to advise anyone in the vicinity the aircraft is starting by calling “Clear prop” or similar. After start, the appropriate checks for oil pressure and avionics, etc. must also be conducted.

Throttle use

Aircraft movement over the ground results from application of power via throttle. (It is recommended the Instructor avoid references to aircraft speed over the ground, as a key component of the Effects of Controls lesson is to present the concept of the speed of the aircraft resulting from relative attitude to the horizon rather than power application).

Due to inertia, initial movement will require more power, which must be reduced once the aircraft is rolling. Many a story can be told of the student or pilot applying significant power to move the aircraft initially, then losing control of the aircraft because they did not reduce the power and the brakes would not slow or stop the aircraft.

Taxi movement will be affected by the surface and slope operated on, the effect of wind and the amount of power applied. Some aircraft engines specify a minimum RPM to reduce damage to gearboxes, or reduce spark plug fouling. Instructor should also refer to their CFI for school preferences.

When stopping, the student should ensure the nose wheel (or tail wheel) is straight, and once the throttle is set to the preferred RPM, apply brakes. The slope, surface (wet or dry) and wind will all affect the ability to stop.

Directional control

Controlling the direction of the aircraft is accomplished via rudder pedals and steering to the nose or tail wheel. For three axis aircraft, steering is naturalistic, left rudder moves the nose left, right rudder moves the nose right. Many tail wheel aircraft also have differential brakes which, when used intelligently can greatly assist to manoeuvre the aircraft on the ground.

For weight shift trikes and wheel based Powered Parachutes the connection to the steering is less intuitive and best taught by referencing steering " from the outside of the required turn". While a reference to a billy cart may assist in grounding a known primacy, an alternative method after demonstration is to patter "push from the outside of the required turn". It is vitally important that the student uses heels to effect the change of direction and doesn't couple any movement of the footbrake or throttle during the steering exercise.

Wind affects directional control, as the aircraft generally weathercocks into wind due to the effect of wind on the vertical fin. Judicious use of combinations of aileron and elevator will assist to manage this effect. For tail wheel aircraft, taxiing is usually accomplished with full back pressure on the elevator to ensure authority on the tail wheel. For nose wheel aircraft, the elevator may simply be required to be maintained in a neutral position. Weight shift aircraft require careful management of the wing while taxiing, as the wing will act as a sail if not treated appropriately.

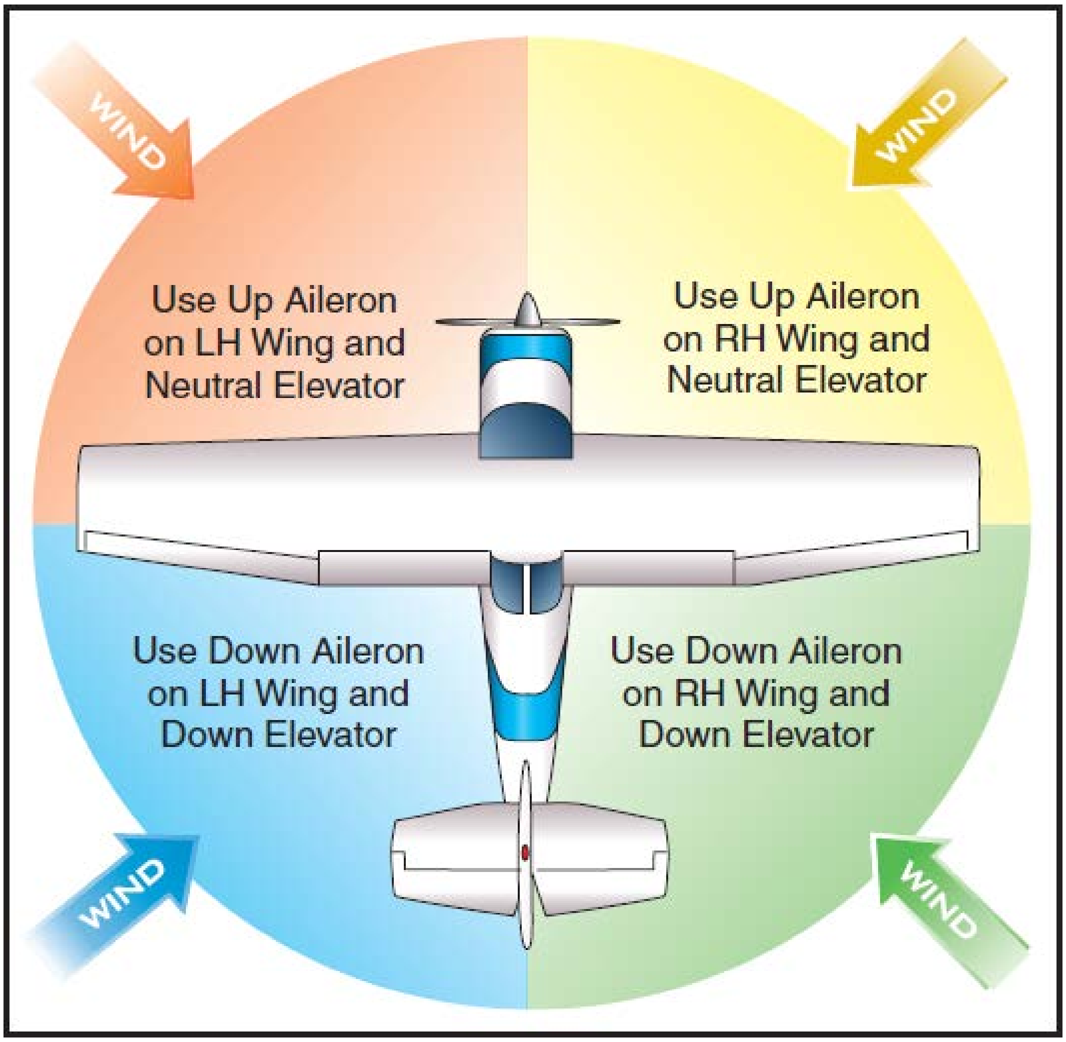

Diagram 1. Guide to taxiing control deflection

Regardless of the aircraft type, the student should be directed to look at a point somewhat in the distance rather than just ahead of the aircraft.

Airmanship

The student must be made aware of the right of way rules relating to ground operations including requirement to pass aircraft on the ground pilot to pilot. Aerodrome markings, including taxiway holding points and runway gable markers must be explained. If operating from a private or grass field, the student must still be made aware of aerodrome markings as they will encounter them at larger aerodromes. The student must be made aware of windsock locations, and how to interpret the windsock accurately.

Radio use and appropriate calls when taxiing must be explained and delegated to the student as their workload and capacity allows. While it may seem natural to the Instructor to require the student to make all required calls, in reality, many students struggle to achieve control of the aircraft and transmit coherent calls. Careful management of this important aspect of taxiing is required and responsibility should be slowly given to the student. Remember you are leading by example and should make all radio calls slowly and clearly.

Aircraft management

The easiest way for a student to irritate an Instructor or CFI is by using power against brakes while taxiing. While this is generally not deliberate on the part of the student, it may result from a poor explanation of appropriate actions to commence aircraft movement, or confusion with the everyday movement of a car.

The first action to slow an aircraft should always be to ensure the throttle is at the recommended idle RPM, then applying brakes to slow the aircraft if required. In extreme or emergency circumstances the higher drag from grass may be required to slow the aircraft.

In some cases, Instructors may choose to drive with students in a car to determine if the students jerky or late corrective actions or failure to respond to potential threats is an inherent problem in an area the student should have developed skills through practice for most of their adult life or is simply overload in a strange environment.

The Instructor must ensure the seating position of the student enables full rudder deflection (and use of two brakes if fitted). The seat must be locked securely and the student must be able to easily reach all controls and see over the instrument panel. Ensure the student uses appropriate positions for hands and feet when using the controls. This includes ensuring heels are on the ground if toe brakes are fitted, or that the hand or foot throttle in weight shift aircraft is used appropriately for taxiing.

Ensure the student appropriately warms the engine prior to moving the aircraft, however run up checks and the associated additional noise from engines should be avoided close to buildings or hangars to avoid possible conflict with people or animals and with consideration of neighbours. Once the aircraft is moving, a brake check should be conducted, by closing the throttle and checking correct action of the brakes, before continuing to move the aircraft. While a brisk walking pace has been the standard reference for taxiing speed, the reality is an appropriate speed to ensure safe control of the aircraft is a more sensible guide.

The Instructor should point out the parallax error inherent with side by side seating, and ensure the student is aware of the perception the aircraft will be too far to the right when on the centreline of the taxiway or runway. Deviation from the centreline should be corrected early and often as correct maintenance of the centreline must form part of the assessment of competence of the student. Likewise, the Instructor must lead by example and maintain runway or taxiway centreline, avoiding the tendency to maintain too far to the right. The maintenance of taxiway centrelines will also ensure the wings of most RAAus aircraft will not infringe or collide with aerodrome obstacles, although wingtip clearance must always be considered.

Protection of the propeller and aircraft empennage must be an important consideration, careful use of power and avoiding full stops on gravel runways should form part of any taxiing briefing. Students should keep the aircraft moving on gravel or dirt to avoid damage and reduce dust, which could decrease visibility.

Likewise the student must consider any difficulties or dangers when taxiing behind other aircraft, as a result of propeller wash or jet blasts from larger aircraft.

Ensure the student considers the dangers of taxiing across unprepared areas on the aerodrome or cutting across corners, as many accidents and damage to propellers have occurred when taxiing through long grass, rolling off the runway edge or failing to see drainage ditches or gable markers.

Run up location

The student should consider the appropriate location to use carburettor heat (if fitted) to avoid ingestion of dust, grass or rocks, as air from this source is unfiltered, which may result in damage to the engine. Likewise engine checks should be completed in a clear area to reduce damage to the propeller and empennage of the aircraft from prop wash.

The student should consider wind direction in relation to the best positioning of the aircraft to face into wind to assist with engine cooling, and the direction propeller wash will be directed, avoiding open hangars and other parked or taxiing aircraft. Finally the student should consider where the aircraft is aimed and what evasive or corrective actions may be required should the brakes fail to hold the aircraft while the higher RPM for engine checks is used.

Many aerodromes have specific run up bays, or concrete areas which are regularly swept for rocks and debris.

Human Factors

Familiarity with right of way rules, aerodrome markings and layout, windsock indications and clear understanding of control inputs will assist the student to manage aircraft taxiing competently and confidently.

The cleanliness of the windscreen is critical to safe operation of the aircraft, both on the ground and in the air. The student should be familiar with the appropriate technique for cleaning windscreens to ensure scratches are not produced or incorrect chemicals turn a windscreen milky or opaque. Likewise, blind spots created by door pillars, wing roots, canopy frames or high and low wings must be explained, and the student must understand the need to move the upper body to ensure obstacles are seen and avoided.

Ground exercise

The exercise consists of teaching the appropriate hand and feet positions and techniques for operating aircraft controls, and ensuring seating position, blind spots, parallax errors and appropriate decision making is understood.

Start the aircraft, applying sufficient power to overcome aircraft inertia, test the brakes and maintaining an appropriate taxiing speed, manoeuvre the aircraft to the run up area, making suitable radio calls and ensuring the aircraft park brake is fully applied. Once the student has observed a demonstration of the correct techniques, they may practice the techniques and be encouraged to verbalise their thoughts and observations as to taxiing considerations to assist kinaesthetic development. In order for the student to develop an appropriate feel for pedal movement required the instructor should initially encourage divergence to either side of the centreline, rather than only just focussing on maintaining the centreline. Practiced deflection will assist the student develop feel for the required movement and correlate that to their visual stimuli. The Instructor must recognise that steering with the feet and legs is usually foreign to most students and requires the development of appropriate muscle and kinaesthetic memory.

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The Flight Effects Of Controls

EFFECTS OF CONTROLS - 3 AXIS

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1. AIM

To operate the primary and ancillary controls in flight and on the ground and feel and understand the primary, secondary, and further effects they have on the aircraft.

2. APPLICATION

- Control grip & feel
- Cockpit layout/adjustments
- Demonstrate/Practice sequence
- Visual flight focus outside cockpit
- Introduction of pre/post flight actions

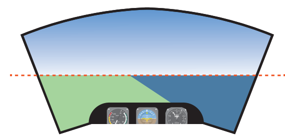
5. AIRMANSHIP AND HUMAN FACTORS

- Control handover process - CRM "I have control / you have control", "follow me through"
- VFR - see and be seen
- Clock code, relative height / distance
- Horizon is main reference
- Land features
- Limitations on lookout - SA
- Limitations of memory
- More comfortable with practice /workload
- Uncoordinated lesson by nature
- Demonstration / practice process - CRM
- Self assessment - I.M.S.A.F.E

4. FLIGHT EXERCISE

On the Ground

- Control speed with throttle and brakes
- One hand on control column and other on throttle
- Dual controls fitted
- Power - controls movement
- Brakes - control slowing / stop
- Pedals - control steering



In the air

Attitude flying is achieved by referencing nose and wings to the horizon

Axis	Control	Input		Primary Effect		Secondary/Further	Use
Lateral	Elevator	Control Column	forward rearward	Pitch	down up	_	Attitude and Airspeed
Longitudinal	Aileron	Control Column	right left	Roll	right left	Slip - Yaw	Direction
Normal	Rudder	Rudder Pedals	left right	Yaw	left right	Skid - Roll	Balance

Airspeed

- Increased airspeed - firmer control feel & response rate, less movement needed
- Decreased airspeed - reduced control feel & response rate, more movement needed

Slipstream

- Increased power → increased slipstream
- Increased flow over elevator → more effective control
- Affects vertical surfaces → yaw
- Effect balanced with rudder

Power

- Power decrease → nose pitches down / yaws right
- Power increase→ nose pitches up / yaws left
- Must balance with rudder

Trim

- To relieve the pressure
- If holding back pressure - trim backwards
- If holding forward pressure - trim forwards

Flap

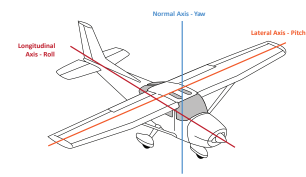
- Extending flap → increase in lift and drag → pitch change - trim change required
- Retracting flap → decrease in lift and drag → pitch change - aircraft will sink

3. UNDERPINNING THEORY

Lift

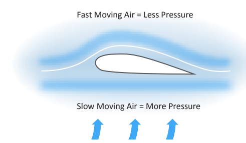
- As air flows over the wing, increased speed above the wing results in reduced pressure = Lift
- Lift can be altered by changing the shape of the wing, the angle of attack, and the airspeed

Aeroplane Axes



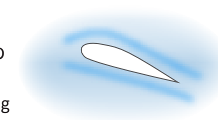
Primary Controls

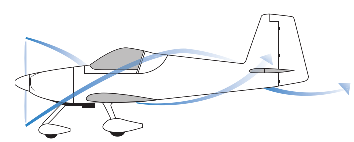
- Elevator pitches aircraft - changing attitude
- Aileron rolls aircraft - changing direction
- Rudder yaws aircraft - balanced flight
- Slipstream affects the rudder and elevator



Ancillary Controls

- Trim tabs provide a force to hold primary controls
- Flap changes shape of wing, increases lift, drag, and L/D ratio - changes pitch trim change required
- Carburettor heat assists in preventing and reducing icing in the fuel delivery system





6. OUTCOMES AND EXPECTATIONS

- Student identifies and understands control actions and responses.
- Can identify and reference the horizon correctly.
- Is comfortable in the airborne environment.

AIR EXERCISE

To ensure the student fully understands the effects of controls, both primary and ancillary, it is recommended to deliver the Effects of Controls lesson in two distinct flights, which have been described below.

Allow the student to enjoy the sensation of being airborne and relax in the aircraft prior to taking the controls, which will ensure they are receptive to the lesson. The Instructor should ensure the take-off maintains the centreline, the climb is balanced and on track and the nominated height is achieved accurately.

Be on the lookout for signs of the student becoming airsick. ALWAYS carry motion sickness bags and make the student aware of them and where they are stowed within easy reach. It may be believed that mentioning airsick bags may make the student become uneasy, however the student will be is less worried if they are aware they can grab a bag in a hurry if necessary.

BRIEFING CONSIDERATIONS – EFFECTS OF CONTROLS - Flight 1 of 2

PRIMARY EFFECTS OF CONTROLS

Elevator. When demonstrating the elevator, use smooth control movements. It can be very disconcerting for the student to see, and feel abrupt over pitching. Remember also that the pitching motion induces positive and negative 'g' which in turn, can induce air sickness.

The objective of the flight is to make the student aware of the control input, relative movement of the aircraft as a result, particularly in reference to the horizon, and further effect. It does not require over-controlling or abrupt movement of the controls to demonstrate this.

As will be noted in the Patter Section, after indicating changes to the airspeed, the Instructor must ensure the student is referred back to the attitude of the aircraft. As we fly visually ensure the student is constantly looking at the horizon and does not become fixated on the instruments.

Ailerons. When demonstrating the primary effect of Roll, inform the student you will be operating the controls to prevent secondary or further effects initially. Use opposite rudder and elevator to minimise further effects allowing the student to only see the primary effect.

Rudder. Ensure the same technique is used when demonstrating the primary effect of Yaw. Inform the student you will be preventing secondary or further effects. Use opposite aileron and elevator to minimise secondary and further effects. Using these techniques will ensure that the student only sees the primary effects and not wonder why you are putting in additional inputs.

SECONDARY AND FURTHER EFFECTS OF PRIMARY CONTROLS

Elevator. It is vital the student is referred back to the attitude relative to the horizon after indicating any instruments.

As an example, begin by flying level and ask the student to read the airspeed. Refer the student back to the horizon and as you move the control column back ask the student to observe the nose pitching up. Once stabilised, ask the student to read the airspeed and then refer them back to the attitude relative to the horizon whilst you patter the effect on airspeed of the pitch up of the nose attitude.

Use the same technique to indicate the lower nose attitude and subsequent increase in speed. This ensures the student always refers to the attitude relative to the horizon and encourages visual flying rather than being fixated on instruments.

Your patter should use the consistent term ‘Pitch’ as used in your briefing when using the elevator control.

‘When I move the control column back, you will see that the nose pitches up.’ Not, ‘the nose moves up’, or worse, ‘the nose goes up’

Ailerons. It is vital to match and coordinate your words with the response from the aircraft. As an example ‘Student, you will note that when I move the control column to the left, the aircraft will Roll----Slip-----Yaw to a nose down attitude.’ Only use these critical and consistent terms as the aircraft actually rolls, slips and yaws.

Rudder. The same technique must be used when demonstrating the secondary and further effect of rudder.

The consistent terms, Yaw----Skid----Roll to a nose down attitude must be coordinated with the observed reaction of the aircraft.

COMPLETION OF FLIGHT 1 - EFFECT OF CONTROLS

You can now let the student informally fly the aircraft and attempt control inputs with you pattering. To return to the airfield, ensure you fly the aircraft while indicating key features of the training area which lead back to the airfield. You must fly an accurate and consistent circuit entry and circuit, landing on the centre line and observing all procedures. Allow the student to simply observe and enjoy this part of the flight, to assist them to absorb the key elements of the brief lesson.

BRIEFING CONSIDERATIONS – EFFECTS OF CONTROLS Flight 2 of 2

Demonstrate and patter the aircraft start sequence, taxiing the aircraft, conducting pre-take-off checks, the take-off and climb out for the start of the second part of Effects of Controls.

Airspeed. Ensure the power is set to maintain height during these demonstrations, resulting in changes of airspeed due to attitude changes. This will also assist the student to recognise the differing feel and effect of the controls due to airspeed and not power changes from the engine.

When demonstrating the increased stiffness and response of controls at a higher airspeed, ensure you move the control column more slowly and with slightly larger inputs. This exaggerates the increased responsiveness of the controls.

When demonstrating reduced responses and control feel at lower airspeed, it may be useful to move the controls fairly quickly and with smaller inputs. This exaggerates the relatively reduced feel and reduced responsiveness of the controls.

It is useful to demonstrate the control response at lower airspeed after the demonstration at higher airspeed. This is because with the higher nose attitude and the lower airspeed, the next demonstration can move smoothly to slipstream effect.

Slipstream. With the speed reduced and selecting a relatively high power setting, the controls should be moved in such a way that the student can feel that the ailerons now have reduced effectiveness and response. However, due to the effect of the slipstream over those surfaces, the rudder and elevator have an increased effectiveness.

Power changes. This can be an effective demonstration by first advising the student you will not correct yaw or pitch initially while changing power. Allow the aircraft to pitch up and yaw left (assuming normal engine rotation) by smoothly applying full power, then ensure the student is observing the attitude and yaw change relative to the horizon and a nominated point. Next, without abrupt changes, smoothly remove power, allowing the aircraft to pitch down and yaw right, again ensuring the student is referencing the horizon and a nominate point.

Do not continue the demonstration to the point the aircraft enters a steep nose down spiral.

Now prompt the student as to which control inputs would correct these effects and ask them to maintain a straight and level attitude while you make smooth power changes to full and idle power. This embeds the basic understanding of rudder and elevator applications, relevant to power changes. Finally, ask the student to make power changes while controlling the secondary and further effects.

Trim. Inform the student that trim systems generally work in a natural sense. To hold a nose down attitude, the trim needs to be moved forward, to hold a nose up attitude, the trim needs to be moved back.

Whether using electric or manual trim, ensure the student references the attitude and uses the primary controls to set the attitude prior to trimming. The student must never use the trim to set the attitude.

A useful exercise at this point is to have the student hold an attitude using elevator, while you override the trim. Place the aircraft in an out of trim condition, then ask the student to re-trim. This can beconducted for forward and backward pressures to ensure the student understands the attitude must be maintained with elevator and trim simply relieves the forces on the control column.

Some aircraft have the trim control set in the roof or on the side of the cockpit as a winding mechanism much like a window winder.

The student should be explained in this instance the trim works like a screwdriver. Screwing up, in a clockwise direction will hold a nose up attitude, while screwing down in an anti-clockwise direction will hold a nose down attitude. It should be emphasised that the pre-take-off checks ensure the trim is set to the recommended position, however an out of trim condition in a RAAus aircraft should never result in loss of control.

Flap. Depending on the aircraft type, some aircraft will pitch up with the application of flap and some aircraft will pitch down. The student must not only have this pitch change demonstrated but also be aware of how to manage it.

The student must be made aware of the flap operating limitations indicated by the white arc on the airspeed indicator for the flap operating range.

It is expected that the Instructor will cover elements 1 and 2, as with many other elements over the course of many lessons.

IN-FLIGHT PATTER - EFFECT OF CONTROLS Flight 1 of 2

(While sitting in the aircraft before start up)

You have Control/I have Control

Instructor. OK student, during the briefing we discussed the importance of knowing who has control of the aircraft. We will now practice this. You have control.

Student. I have Control.

Instructor. That's good. Remember to speak clearly. Once you have taken over you are now In Command and responsible for the aircraft. OK now, I have Control .

Student. You have Control.

Instructor. When I am in control I may direct you to follow me through on the controls. Just place your hands and feet lightly on the controls, now you can see what I am doing, hear what I am saying, and feel what I am doing.

The Instructor should then proceed with the start-up, pre-take-off checks, taxi, climb out and level out at the appropriate height.

Instructor. OK student, we are now at 3000 ft. Are you feeling comfortable? Continue to follow me through.

I want you to look outside at the horizon. Your head should be held naturally, don't try to look over the nose of the aircraft, but make sure you are looking directly ahead, not on an angle to the propeller or spinner. Sit relaxed and tell me what you can see of the cowling or windscreen against the background or what we call the horizon. Is there a screw, rivet or other reference level with the horizon at the moment? This is known as the level attitude, and using the same indication in the cockpit will ensure you maintain the same straight and level attitude.

Elevator - Pitch. Continue to look outside. You can feel me moving the control column gently back and you will see the nose pitch up.

You can now feel me moving the control column forward and you can see the nose is pitching down.

We can use the control column to pitch the nose back to the original level position.

Now I want you to try this, remember to use gentle pressure on the control column.

You have Control.

Student. I have Control. Student practices. Instructor patters.

Instructor. That was good student. Now follow me through again. I have Control.

Student. You have Control.

Instructor. We have learnt that the elevator is controlled by backward and forward movement of the control column. Note again, backward pressure on the control column----pitches the nose up and forward pressure----pitches the nose down (demonstrate again).

Are you still feeling comfortable student? OK.

Ailerons - Roll. We will now look at the operation and effect of using the ailerons. As before, look outside at the attitude of the aircraft against the horizon. As I move the control column to the left, you will note that the aircraft rolls to the left. Note: For an effective demonstration technique, refer to Section 1 Tips for Flight Instructors.

Instructor. The more I move the control column, the more the aircraft rolls. To stop the roll I will need to move the control column to the right. To return to wings level I will then need to move the control column even further to the right and when the wings are level, position the control column in the neutral position.

Instructor To reinforce. Moving the control column left, rolls the aircraft to the left and moving the control column right, rolls the aircraft to the right. We can use the control column to either roll the aircraft or to fly wings level.

You can now practice this. You have Control.

Student. I have Control. Student practices Instructor patters.

Rudder - Yaw

Instructor. You will remember that during the briefing we discussed how the rudder causes the aircraft to yaw. Once again, follow me through and continue looking out to the horizon. I have Control.

Student. You have Control.

Instructor. If I apply pressure with my left foot to the left rudder pedal you will note that the nose of the aircraft yaws left, more pressure, more yaw.

To stop the yaw I can centralise the rudder.

The same happens to the right if the right rudder is used.

You can now practice this. You have Control.

Student. I have Control. Student practices Instructor patters.

Note: For an effective demonstration, refer to Section 1

Tips for Flight Instructors That is good, student. I have Control.

Student. You have Control.

Instructor. It is important for you to understand that these effects are all relative to the aircraft axis. For example, if I roll the aircraft to the left, and pitch up, you will note that the nose still pitches relative to the aircraft.

Maintaining the nose high attitude and bank angle, if I yaw the aircraft to the left, it still yaws to the left even though it is banked to the left.

Instructor. You will recall that during the briefing we discussed the secondary and further effects of using the controls.

Elevator - Airspeed. Now I will demonstrate the further effect of elevator, as there is no secondary effect. Glance at your airspeed indicator. What is it reading? Yes, XX knots.

Now look out at the horizon, note that when I move the control column back, the nose pitches up.

Now if we glance at the airspeed indicator, what's happening? Yes, the speed is decreasing.

Look outside again. When I move the control column forward, the nose of the aircraft pitches down until it is below the horizon.

Now glance at the airspeed. What is indicated? Yes, it shows that the speed is increasing. So, we can see that pitching the aircraft also has an effect on the airspeed.

Ailerons - Roll - Slip - Yaw. Looking outside again.

Remember we also spoke about the secondary effect of the ailerons. First we will have a good lookout. Note that when I move the control column to the left that the aircraft will first roll, slip and yaw to a nose down attitude, from which I will recover.

Again, if we use the ailerons to roll the aircraft right---- we find the roll will lead to a slip and the slip will then lead to a yaw, and a nose down attitude. I will recover.

IN-FLIGHT PATTER - EFFECT OF CONTROLS Flight 2 of 2

Demonstrate and patter the start, take-off and climb for the start of flight 2 of Effect of Controls.

Instructor. OK, student, here we are again flying level at 3000 ft. During the briefing, we noted that apart from the primary effects of pitch, roll and yaw other effects also occur, and we will now have a look at these.

Airspeed. Firstly, the effect that airspeed has on the controls.

To show you this I am reducing the power to ensure we maintain level and reduce the effect the slipstream has on the controls.

I am now moving the control column forward to pitch the nose down in order to increase the speed.

Higher airspeed. Trimming the aircraft to maintain a relatively higher airspeed in a glide.

We are now descending at XX knots. Looking outside. Following me through, you can feel that the controls have an increased feel and are more effective with a better response than at the previous speed. Feel the elevator, the ailerons and the rudder.

Lower airspeed. Let us look now at the effect of a lower airspeed. Still with the power reduced I will pitch the nose to a higher attitude and trim.

The airspeed is now XX knots. Looking outside.

Again following me through, feel that the effectiveness of the elevator is reduced, the response is not as before and that the control has a reduced feel. The same with the ailerons, and the same with the rudder.

Slipstream effect. Whilst the power is reduced I will demonstrate the effect that the slipstream has on the aircraft. You will recall that the slipstream is the spiral of air being generated by the propeller.

As the aircraft is now flying relatively slowly with only a little slipstream, with me you can feel that all the controls feel less responsive, they have reduced feel and are less effective.

I will now increase the power and therefore the slipstream, and hold the same low airspeed. Follow me through and you will now feel that the ailerons still feel less responsive and are less effective, due to our low speed, however feel that the elevator has increased response and is more effective due to the increased airflow from the slipstream. And the rudder, feel how much more effective and sensitive the rudder pedals feel.

We can see then, that the effect of slipstream from the propeller increases the effectiveness of the rudder and elevator but, being outside the slipstream, the ailerons are not affected. I am now returning the aircraft to the level attitude and the normal power setting again. During the briefing, we also discussed the effect that increases and decreases in the power setting had on the aircraft. So let's have a look at these effects.

Power changes. Here we are flying straight and level with a power setting of XX rpm and the aircraft trimmed.

If I increase the power to full, looking outside, you will see that the aircraft pitches up and yaws to the left.

To control the pitch change we apply forward pressure on the control column, and to prevent further yaw we apply sufficient rudder to prevent further movement to the right.

If I gradually reduce the power from full to idle, looking outside, you can see that the aircraft pitches down and yaws to the right. I can now prevent the aircraft pitching further by applying back pressure to the control column and prevent the yaw by applying sufficient pressure to the left rudder pedal. More about this in the next lesson.

Trim

Instructor. During the briefing we spoke about the use of the trim and you would have noticed that I have been referring to and using the trim. I will now demonstrate how this works in practice.

The aircraft is currently in a trimmed condition, if I release the controls the aircraft remains in steady flight, straight and level. Looking out the front.

If I now move the control column back note as before that the nose pitches up. If I now relax the control column, the nose will pitch down to its original position due to the effect of the original trim position.

If I want to keep the nose high position, I can pitch the nose up and by feeling the pressure on the control column, relieve this pressure by holding the nose steady and move the trim control back until there is no pressure felt on the control column. The aircraft is now trimmed for that higher nose attitude.

To return to level flight, looking out the front I will pitch the nose back to the level attitude, hold the control column steady and adjust the trim forward until the pressure is once again relieved on the control column.

At this point, student, I emphasise that the trim is not to be used to change the attitude. The attitude is changed with the control column and the pressure on the control column is relieved with the trim.

You can now practice this.

You have Control.

Student. I have Control. Student practices Instructor patters.

Note: The student should now be given ample opportunity to operate the controls and become used to the feel of the controls with the Instructor offering some light patter.

On the return to the airfield, the Instructor can introduce the next exercise of Level and Straight by a brief demonstration and patter.

The Flight
Straight and Level

STRAIGHT AND LEVEL - 3 AXIS

1. AIM

To establish and maintain straight and level flight, at a constant airspeed, constant altitude, in a constant direction, and in balance.
To regain straight and level flight.
To maintain straight and level flight at selected airspeeds or power settings.

2. APPLICATION

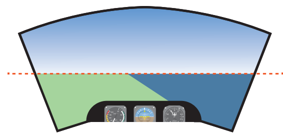
- Smooth throttle movements
- Coordination of controls
- Elevator (pitch) controls attitude
- Power controls climb / descent

5. AIRMANSHIP AND HUMAN FACTORS

- Lookout - SA - method for scanning, training area boundaries, maintaining visual horizon
- “I have control / you have control”
- Scan - work cycle
- Threat referencing - CLOCKCODE Principle
- Blind Spots

4. FLIGHT EXERCISE

- Horizon
- Demonstrate stability
- Power setting
- Attitude for level



Establishing Straight and Level

Attitude elevator - set attitude
Power set to maintain level

aileron wings level
rudder in balance

attitude
relative to horizon
no yaw - stand on the ball

Trim to relieve pressure - hands off

Maintaining Straight and Level

Lookout **ahead**
Attitude **reference position**
Instruments - to confirm - not set
- Altimeter and RPM checked every time
- O he ti s rumtn nts en ad gauges, less frequently

Regaining Straight and Level

- Attitude to set airspeed / power setting correct
- Attitude confirmed
- Wings level and balance ball centered
- Reset power (as required)
- A P T

Straight and Level at Different Airspeeds

- Attitude controls airspeed
- Inverse relationship between power / attitude
- Power changes must be balanced with rudder
- Manage secondary effects and balance

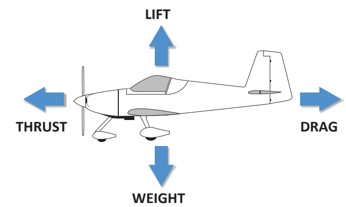
Power + Attitude = Performance

Performance	Mid	Low	High
Power	Cruise	Reduced	Higher
Attitude	Normal	Higher	Lower
Airspeed	80-90 knots	60 knots	110 knots

3. UNDERPINNING THEORY

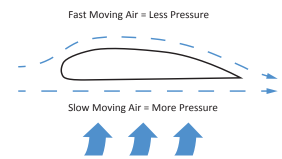
- The horizon is the line where the land or sea meets the sky
- All references use the aircrafts attitude to the horizon
- Concepts of aerodynamic stability and relevance to flight.

The Four Forces



- Lift, Weight, Thrust, Drag
- Equilibrium when Lift = Weight and Thrust = Drag
- Forces don’t act through the same point → moment arms → couple
- Lift and Weight couples balanced by tailplane force
- Changes in Thrust → pitch changes

Lift



- Air over the wing accelerates compared to air passing under the wing
- $L = C_L \frac{1}{2} \rho V^2 S$
- L = Angle of attack × Airspeed
- Angle of attack altered with elevator

Performance

Power + Attitude = Performance

$$PWR + \frac{IAS}{A\ of\ A} = P$$

6. OUTCOMES AND EXPECTATIONS

- Student understands use of primary controls to maintain S&L flight
- Student configures aircraft correctly for any required performance
- Student recognises and corrects deviation with appropriate scan & work cycle
- Competencies +/- 150 ft, +/-5kts, +/- 10 degrees
- Effective use of CLOCKCODE and See & Avoid

RECREATIONAL AVIATION AUSTRALIA

BRIEFING CONSIDERATIONS - STRAIGHT AND LEVEL

Once the aircraft is established in level flight, remind the student the aircraft is set to a level attitude with the elevator, held level and then trimmed. Remind the student the attitude referenced to the horizon is the primary reference for level flight. Confirmation of the success of this is referenced to the relevant instruments.

Straight and Level flight. Remind the student the horizon is also the primary reference for keeping the wings level.

While some Instructors ask the student reference the wing tips against their relative horizons to maintain wings level, due to parallax errors this can be problematic. As the student is sitting to the left of the centreline of the aircraft, they may perceive a different view of the far wingtip to the near wingtip. It is recommended to use a feature directly in front of the student which they can relate to the horizon.

The student must be made aware of the tendency to look across the centre of the cowling to the propeller or spinner rather than directly ahead of their seat.

They must focus on the feature directly in line from the student's eyes from the left seat to avoid offset of the feature to the right. As the student and the Instructor are offset from the centreline of the aircraft they cannot both use the same reference point.

The Instructor should advise the student to choose a feature in line with the student's eyes when looking straight ahead at the horizon. This feature will invariably be slightly different to what the Instructor will sees.

Balanced flight. During the briefing it should be clear the purpose of the rudder is to ensure that the aircraft is not yawed. While the student will not yet be able to "feel" the aircraft out of balance, it may be useful to demonstrate this while holding the wings level. As a secondary reference the balance indicator, commonly called "the ball", indicates if the aircraft is slipping or skidding. You may reinforce the further effects of yaw during this section.

Because small amounts of imbalance may not yet be felt by the student, the key is to ensure that the student flies visually with wings level and references the ball to determine imbalance. Ensure the student does not focus only on the balance ball.

Straight and Level at various Airspeeds and Power settings. It is important that the Instructor reinforces the information learned in Effects of Controls. Attitude has a direct relationship to airspeed and power controls climb, level altitude or descent.

When demonstrating the effects of power when straight and level it is important to make smooth power changes. Abrupt power changes result in aircraft responses that disrupt smooth flight and are not good practice for the engine life as all those little moving parts have to accelerate or decelerate rapidly.

Remember that you have already dealt with power changes during the Effect of Controls element. This therefore becomes a perfect opportunity to reinforce these effects of power changes. The student should now be given plenty of practice, accompanied by corrective patter as necessary.

Other manoeuvres during the lesson. During the course of any flight the student should be observing and possibly following through other manoeuvres such as climbing and descending, turning, etc. It is important that the Instructor is not tempted to add these additional elements to the planned lesson. The student should simply observe and monitor these manoeuvres.

IN-FLIGHT PATTER – STRAIGHT AND LEVEL

The student should have gained additional confidence to take on additional tasks.

Instructor. OK student, we are now established in the training area at 3000 ft. Continue to follow me through on the controls. First, we will conduct a lookout using the scan technique we discussed in the briefing.

You will recall that we also explained the use of the CLOCKCODE. What is the relative position of that convenient geographical feature? (Mountain, boat, cloud, etc.)

Student. Example response, 10 o'clock.

Instructor. Yes, that is correct, but what else?

Student. Ten o'clock, low and moving to the east.

Instructor. Good, remember, you are an essential member of this crew. If you sight another aircraft, or object of importance, you must report it to me. Now student, you will remember that in the previous flight we learnt the action and reaction of using the controls. During this lesson we will get to use these controls to make the aircraft do what we want it to.

Instructor. During the briefing we spoke about how to keep the aircraft level. I will now formally demonstrate this to you. Continue to follow me through. Look out straight ahead in front of you at the horizon, not across to the centre of the cowling. Note where the nose attitude is relative to the horizon. This is the level attitude.

Find a reference inside the aircraft to help you identify this again. Because the aircraft is inherently stable and I have trimmed it, the attitude stays the same if we relax our hold on the control column. We now check the relevant instruments, to confirm what we see. The altimeter shows a constant height, the vertical speed indicator is showing neither climb nor descent and the airspeed is constant. We immediately return to the horizon outside again.

If there is a disturbance and the nose pitches up, I will ease forward on the elevator control to pitch the nose back to where it was before.

If I don't do this, the aircraft will climb, like this.

You will note that the nose is slightly higher than before and a quick check of the instruments shows that the altimeter indicates an increase in height, the VSI indicates a small rate of climb and the airspeed is slightly reduced. Looking outside again, we pitch the nose back to level, pause to settle the aircraft and then check the instruments before looking outside again at the attitude. We shouldn't need to re-trim.

I emphasise that the check of the instruments must be quick and with purpose. Before you check the instrument, visualise which instruments you are checking. Your eyes should go straight to that relative instrument.

Looking outside again, if there is another disturbance and the nose pitches down, we use the elevator to pitch it back to its original level position.

I will now pitch the nose up and down to various positions and I want you to practice restoring it to the level attitude. You have Control.

Student. I have Control. Student practices. Instructor Patters.

Instructor. That's good student. I have Control.

Student. You have Control.

Instructor. I will now demonstrate how we keep the aircraft straight, continue to follow me through. You will remember from the briefing the importance of looking straight in front of you to choose a reference point. Tell me what reference point you have chosen.

Student. The gap in the mountain.

Instructor. Good, continue to look at that point. You will note that the wings are level. You can see this because the view out the front is level with the horizon reference point. With the wings level, provided that the aircraft is balanced, the aircraft will fly straight. For example, if I use the aileron control to lower the left wing, you will see that the aircraft is banked to the left. Because the aircraft is banked to the left, the nose will yaw left away from your reference point.

To correct this we will first of all use the ailerons to roll the wings level. Because we are now not flying to your reference point we will need to bank slightly to the right and when you have the reference point in front of you, you can then level the wings.

We will talk more about the coordination of ailerons and rudder shortly.

You can now practice this with small degrees of bank to the left and right and then make the necessary correction. You have Control.

Student. I have Control. Student practices Instructor Patters

Instructor. I have Control.

Student. You have Control.

Instructor. We have been emphasising that the primary reference for control is assessing the attitude of the aircraft relative to the horizon.

When we control the balance of the aircraft of the aircraft with the operation of the rudder the primary reference is still the horizon and a reference point, and we confirm this with the balance indicator, the ball.

For the moment, continue to look straight ahead. It is possible to fly level and straight but be out of balance. In other words, the aircraft is yawing with the tail of the aircraft not following the nose.

Continue to follow me through. A quick glance at the airspeed and we see XX knots. Looking ahead again at your horizon reference point. If I apply left rudder like this, I can keep straight to your reference point by banking to the right. At this point you can feel uncomfortable and feel like you are skidding in your seat.

Another quick glance at the airspeed and note that it is now XX knots although we are still flying level and straight. Note also that the ball is hard over to the right.

This is a very inefficient way of flying, we will take longer to get from A to B, use more fuel and it is tiring and uncomfortable. To correct this state of affairs, we apply right rudder and keep straight with the use of ailerons until the wings are level and the ball is centred.

It is also possible to keep straight and level but without noticing it, by being slightly out of balance, like this. It is important therefore to reference the ball by glancing at it to check we are still in balance.

I want you to practice this. I will disrupt the aircraft and you will restore it to level, straight and balanced flight. You have Control.

Student. I have Control. Student practices Instructors disrupts and patters

Instructor. That was pretty good, student. I have Control student.

Student. You have Control

Instructor. We have been emphasising that the primary reference for control is assessing the attitude of the aircraft relative to the horizon.

When we control the balance of the aircraft of the aircraft with the operation of the rudder the primary reference is still the horizon and a reference point, and we confirm this with the balance indicator, the ball.

For the moment, continue to look straight ahead. It is possible to fly level and straight but be out of balance. In other words, the aircraft is yawing with the tail of the aircraft not following the nose.

Continue to follow me through. A quick glance at the airspeed and we see XX knots. Looking ahead again at your horizon reference point. If I apply left rudder like this, I can keep straight to your reference point by banking to the right. At this point you can feel uncomfortable and feel like you are skidding in your seat.

Another quick glance at the airspeed and note that it is now XX knots although we are still flying level and straight. Note also that the ball is hard over to the right.

This is a very inefficient way of flying, we will take longer to get from A to B, use more fuel and it is tiring and uncomfortable. To correct this state of affairs, we apply right rudder and keep straight with the use of ailerons until the wings are level and the ball is centred.

It is also possible to keep straight and level but without noticing it, by being slightly out of balance, like this. It is important therefore to reference the ball by glancing at it to check we are still in balance.

I want you to practice this. I will disrupt the aircraft and you will restore it to level, straight and balanced flight. You have Control.

Student. I have Control. Student practices Instructors disrupts and patters

Instructor. That was pretty good, student. I have Control student.

Student. You have Control

Instructor. Remember during the briefing we discussed how we use different attitudes to set our airspeed and then will require different power settings to maintain straight and level? I will now demonstrate this. Continue to follow me through. Note our current attitude relative to the horizon, giving us an airspeed of XX knots and the required power setting to maintain this.

I will simultaneously pitch the nose down and increase the power.

Forward pressure is required on the control column to stop the nose pitching up with a touch of right rudder to correct the left yaw. As the aircraft accelerates I need to hold forward pressure on the control column to maintain our new attitude. When the aircraft settles I can trim forward to keep level.

Now you will note that we have a slightly lower nose attitude and an increase in speed to XX knots with a higher power setting. Due to the inherent stability of the aircraft, and if it is properly trimmed, we can relax on the controls and maintain steady flight.

To demonstrate a lower speed maintaining straight and level, I will simultaneously pitch the nose up and decrease the power setting. As the power decreases, the nose wants to pitch down and yaw to the right. To maintain straight and level flight I will hold back pressure on the control column and apply left rudder. When the aircraft has settled I can trim to relieve control column pressures.

You will note that the airspeed is now XX knots and that we have a higher nose attitude to keep level.

I will now set the attitude to our original attitude and increase the power to our original setting and once the aircraft has settled, trim.

Now you can try these sequences. You have Control.

Student. I have Control. Student practices adjusting the attitude and power setting for various speeds. Instructor patters.

Instructor. Just one more point to remember, remember we spoke about stability. The inbuilt stability of the aircraft will correct small disturbances, which allows us to be quite relaxed on the controls. If we are not relaxed and constantly make changes we will over control the aircraft. This leads to a rough ride and increased pilot fatigue.

Ok, student, using these skills you can now return to the airfield, telling me what the appropriate features are and how you are identifying you are headed in the correct direction. Note: It is inevitable that during the course of the lesson some turns will be required. As outlined earlier the Instructor should conduct these turns to avoid dilution of the primary exercise, straight and level.

RECREATIONAL AVIATION AUSTRALIA

The Flight
Climbing And Descending

CLIMBING AND DESCENDING - 3 AXIS

1. AIM

To climb or descend the aircraft to a pre-determined height, at a rate and airspeed appropriate for the nominated phase of flight.

2. APPLICATION

- For use in all phases of flight to change the altitude of the aircraft
- Appropriate climb/descent angles for phase of flight
- VFR - conditions considered
- Minimum and maximum heights

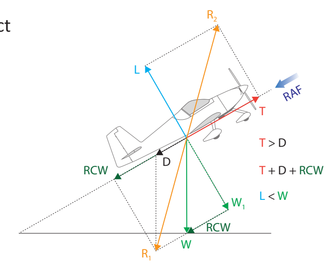
5. AIRMANSHIP AND HUMAN FACTORS

- Lookout and situational awareness SA - monitor for changes in level
- Blind spots managed during climb or descent
- Horizon remains primary reference
- Pre-plan required performance
- Understanding vestibular system and pressure equalisation
- Monitoring and management of temps & pressures
- Smooth throttle movements
- Carb heat HOT for descent

3. UNDERPINNING THEORY

Changing power settings is the primary method for creating required force to climb or descend the aircraft.

- Power: Primary control for aircraft height change
- Elevator: Sets airspeed and angle of climb/descent
- Rudder: Balance to control changes due slipstream effect
- Amount of available power determines ultimate climb performance, Vx, Vy



Climbing

- Aircraft is in equilibrium when climbing
- Lift is not increased
- T must be greater than D
- Rate of climb (climb performance) depends on excess power available

Climb Performance

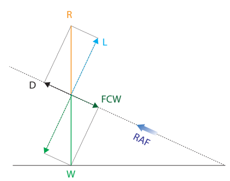
Power More power, better climb performance
Altitude Limits the performance
Weight ↑ weight - ↓ rate of climb
Flap ↑ drag - ↓ rate of climb
Wind Affects climb angle and distance covered

Climb Configurations

Performance	Power	Attitude
Best RoC	Full	_____kts
Best AoC	Full	_____kts
Cruise	> Cruise	_____kts
Recommended		_____ kts

Descending

- Aircraft is in equilibrium when descending
- Airspeed maintained by lowering nose attitude
- FCW balances D



Descent Performance

Power Controls rate of descent
L/D ratio Efficiency of wing, steepness of glide
Weight ↑ weight ↑ FCW - ↑ glide speed
Flap Needs ↑ FCW to balance D - ↑ rate of descent
Wind Affects descent angle and range

Descent Configurations

Performance	Power	Attitude
Glide	Idle	_____kts
Powered		_____kts
Cruise		_____kts

4. FLIGHT EXERCISE

Climbing

Entry

Lookout Above / Around
Power Full power, balance
Attitude Climb attitude, wings level, balance
Trim To maintain attitude
Airspeed Controlled with attitude

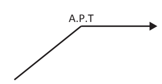
Maintaining

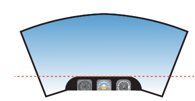
Lookout
Attitude
Instruments

Change - check - hold - trim

Exit

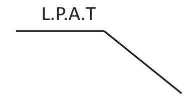
Attitude Select and hold S+L attitude, adjust as speed increases, balance
Power Wait for aircraft to accelerate, then set cruise power, balance
Trim To hold S+L attitude





Descending

Entry



Lookout Below/Around
Power Carb heat HOT, throttle, balance
Attitude Hold S+L attitude until glide speed, then set glide attitude (high performance) to
Trim Maintain attitude

Airspeed = _____ RoD = _____
Airspeed controlled with attitude

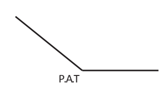
Maintaining

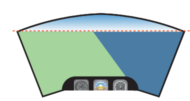
Lookout
Attitude
Instruments

Change - check - hold - trim

Exit

Power Carb heat COLD, increase power to cruise, balance
Attitude Simultaneously set to S+L, balance
Trim To hold S+L attitude





6. OUTCOMES AND EXPECTATIONS

- Correct sequence of actions and control through a range of climb and descent scenarios and configurations
- Recognition of errors and appropriate corrections applied
- Required standards: Heading +/- 10 degrees, Nominated height +/- 100ft Airspeed +/- 5 kt, aircraft balanced for all exercises

RECREATIONAL AVIATION AUSTRALIA

BRIEFING CONSIDERATIONS - CLIMBING AND DESCENDING

As the student is now gaining more experience and confidence the flight instruction can be commenced on track to the training area. By now the student should be taxiing, and conducting the pre take-off checks and possibly some radio calls.

Lookout

Reinforce normal lookout procedure and emphasise that because we are changing from one altitude to another, it is even more important to conduct a thorough lookout.

During the climb, the nose should be pitched down periodically to lookout every 500 ft. The same lookout procedure applies before entering and during the descent.

Remind the student of the need to assess the weather.

Management of engine temperatures and pressures. Emphasise that before changing altitude and before the lookout the relevant engine temperatures and pressures should be checked prior to entering the climb. During the climb or the descent as part of the periodic lookout, the student should check the 'T's and P's' continue to be in the normal range.

Indicate the appropriate actions if the 'T's and P's' are not normal, or are becoming critical.

General Handling. Reinforce the pre-flight briefing regarding the climb entry LPAT, leveling from climb or descent LAPT and entry to descent LPAT.

Note: In high drag aircraft like Drifters or Thrusters, entry to the descent is LPAT due to the high drag resulting in excessive speed reduction when the power is decreased.

Demonstrate how to coordinate control inputs with the power changes.

Ensure the student is not paying too much attention to the airspeed indicator instead of holding a constant attitude.

Check the student understanding of Vy and Vx or the various rates of climb or descent profiles, and these can be practiced once the student demonstrates a good understanding of basic climbing and descending.

During the exercise, the student should concentrate on accurately leveling at the nominated height and continue to ensure accurate level and straight flight is maintained between climbing and descending.

Whilst pattering, the Instructor should reference descent or climb rate.

Carburettor heat use. Use the opportunity to describe potential conditions for carburettor icing, particularly relevant when descending. Because many descents are performed with some power the student may mistakenly believe that icing cannot occur. When in doubt---apply full heat!

Revision. Allow the student to practice straight and level flying between climbing and descending exercises. Monitor the student's flying and be prepared to critique his flying to prevent lapses into bad habits.

Accurate flying. Leveling out from a climb or descent should be as accurate as possible. Accepting standards less than nominated during the brief is not consistent. The Instructor must insist on accurate flying at all times. The nominated heights, bank angles, speeds, etc. are examples of areas that the student was briefed about on the ground and is therefore aware of. Not only will this result in a sense of achievement for the student, clearly understanding what the expected flight tolerances are, but also instilling the self discipline required for In-Command flying.

The Glide Descent The glide descent should be introduced as part of this exercise. It is important that the student gains confidence in the aircraft being flown with the power reduced to idle.
Descents with flaps It must be emphasised that flaps must not be extended with the speed above the flap extension speed Vfe.

Other climb and descent exercises. Vy and Vx climbing can be introduced during other exercises. Practice of normal climbing is sufficient during this initial exercise. Emergency descents should be introduced later.

IN-FLIGHT PATTER – CLIMBING AND DESCENDING

Introduction
The student should be following through your demonstrations of take-off, initial climb and circuit departure.

Instructor. OK student, we are now at 2000 ft and tracking to the training area. During the briefing we spoke about how to enter a climb and I will now demonstrate this to you. We will use a normal climb airspeed of XX knots.

As the engine will be operating at a higher power setting we to monitor temperatures and pressures and confirm they are OK to enter the climb. Visualise where you will be looking then take a quick purposeful look to confirm the temperatures and pressures are in the normal range.

Now, from our briefing LPAT I will commence the climb. Continue to follow me as I apply full power and pitch the nose up, controlling left yaw by applying sufficient right rudder. I will set our attitude relative to the horizon and allow the speed to settle at XX knots. Now the aircraft is settled I will trim to hold that attitude. You can say these key words aloud as you do them.

Throughout the climb we continue our lookout, as we gain 500 ft we will check our climb path continues to be clear. Smoothly pitch the nose down to check ahead, then looking at the horizon, reset the climb attitude. If all clear resume the climb and check the engine instruments are still within operating limits.

As we are approaching our nominated altitude of 3000 ft, we will go through the level out procedure LAPT. Continue to follow me through.

Have a good lookout left and right and as the altimeter is indicating 3000 ft, we pitch the nose to the level attitude. As the airspeed increases we need to increase pressure on the control column to maintain the attitude and start reducing to cruise power. With the reduction in power we no longer require as much right rudder. When the attitude and airspeed are stabilised, we trim the pressure off the control column.

Remember from the briefing that we spoke about the Vy being XX knots, the speed for best rate of climb, and Vx, XX knots, as the speed for best angle of climb. Today you will be practising a normal climb at an airspeed of XX knots.

OK, student, you can now practice this, firstly your level and straight flying check. You have Control.

Student. I have Control. Student practices. Instructor monitors and patters.

Instructor. OK, student, you can now practice a climb to 4000 ft. Use a speed of XX knots for a normal climb. I will guide you along as necessary.

Student. Student practices. Instructor monitors and patters.

Instructor. That is pretty good! As we are now level at 4000 ft I will now demonstrate the descent. I have Control.

Student. You have Control.

Instructor. You will recall we enter a descent using LPAT and we must coordinate power and attitude inputs to achieve our required descent rate and nominated airspeed. The standard descent rate most comfortable for our passengers is 500 ft per minute.

Until we are familiar with the performance of the aircraft, we may need to adjust the power and attitude to achieve the nominated descent rate and speed. Lookout left and right and down our descent path, and conduct a check of the engine instruments. Assess the conditions to decide if carburettor heat is required.

Now we need to set an appropriate power setting and control the right yaw, keeping the wings level. We hold the selected attitude and confirm with a quick glance at the airspeed indicator that it is reducing towards XX knots. We can start adjusting the attitude relative to the horizon to maintain XX knots. Confirm the expected descent rate of 500 ft per minute. Now we hold this attitude, wings level, ball centred and trim.

During the descent we maintain a good lookout along the descent path and every 500 ft check the engine instruments to ensure the engine is operating within normal limits.

As we approach 3000 ft, we conduct a good lookout, especially along our intended altitude and then apply power to cruise power. As the power is increasing we start pitching the nose to our expected level attitude and coordinate the controls, preventing yaw and keeping the wings level. Once the aircraft we stabilises we trim.

OK, student when you are ready, you can practice a descent to 2000 ft. You have Control.

Student. I have Control . Student practices. Instructor monitors and patter.

Instructor. That is good. I will now nominate some climbs and descents for you to practice. Remember that the power setting controls the rate of descent and airspeed is controlled by setting the attitude with the elevator.

You have Control.

Student. I have Control. Student practices. Instructor nominates various climbs and descents.

Instructor. I have Control.

Student. You have Control.

Instructor. I will now demonstrate a Glide Descent. As discussed during the briefing, the aircraft is capable of descending with the power reduced or even if the engine is not operating.

The normal glide speed for this aircraft in the POH is XX knots. The entry to the glide descent is the same as for a normal descent, except that as a precaution, prior to removing power we will apply carburettor heat.

First we conduct a good lookout, apply full carburettor heat and then smoothly reduce the power to idle. Coordinate the controls to counteract the effect of the power reduction. Initially maintain the nose attitude and as the aircraft slows pitch the nose to hold XX knots.

When stable, trim for that attitude. You will note that we hold a constant airspeed in a glide descent and accept the descent rate shown. I will now bring the aircraft to straight and level and you can practice. You have Control.

Student. I have Control. Student practices. Instructor patters and monitors

Instructor. I have Control.

Student. You have Control.

Instructor. That is coming along well. I will now demonstrate a descent with flap extended. As discussed during the briefing, we must not extend the flaps above flap extension speed, Vfe which is indicated on the airspeed indicator as the top of the white arc and in this aircraft is XX knots.

We will choose a descent at 500 ft per minute and a speed of XX knots which is our normal approach speed when landing. We are now at 4000 ft and will descend to 3000 ft.

Although we can select full flap at this stage and sometimes it will be necessary, it is usual to select flap in stages. Firstly reducing the power we control the pitch down and yaw responses. When the airspeed reduces to below XX knots we select flap in stages. When we select first stage we must control the nose pitching in response. At this point we can adjust the attitude to maintain XX knots and we may need to adjust the power setting to settle our required 500 ft per minute rate and then trim. You will note the lower nose attitude as a result of flap use.

When we are ready we extend full flap and control the nose pitching before pitching the nose to a lower attitude to maintain our nominated XX knots. A glance at our descent rate shows that it has increased above 500 ft per minute so we need to increase the power, a touch of back pressure on the control column and when we are stabilised we will trim. To level out and raise the flap, we need to be aware that initially there will be an increase in the sink rate and the nose will pitch.

I will now apply cruise power, controlling the nose pitch and yaw and select no flap, with pauses at each stage, and adjusting the nose to the level attitude. Checking power setting and attitude and that the aircraft is stabilised, I can now trim.

As before, remember that the power setting will determine the rate of descent and the nose attitude controls the airspeed and the result will equal the required performance. You can now practice, setting up a full flap descent at XX knots and 500 ft per minute and leveling out at 2000 ft. You have Control.

Student. I have Control. Student practices Instructor monitors and patters

Instructor. Finally, if we were to apply full power from this configuration with flap extended, as we might when conducting a go-around, we must be mindful of the potential couple as a result of retracting flap and applying power. I have Control

Student. You have Control.

Instructor. Here we are established in a descent which is simulating a glide approach, and we decide we need to apply full power and conduct a go-around.

I am smoothly applying full power and making sure I manage the resulting pitching up and yaw to the left. The resulting control forces, being pitch up after full power application and pitch up resulting from previous trim for descent along with the yaw induced from propeller torque and slipstream effect must all be managed to ensure, if we conduct this manoeuvre at low level, the aircraft is maintained under control.

Once we have established a positive rate of climb, we retract the flaps and the resulting pitch change (as relevant to high or low wing aircraft) must also be managed.

Note: Ensure the student operates flaps up in stages to prevent abrupt pitch changes and loss of height.

Complete the exercise with plenty of student practice. On the return to the airfield, have the student assess when to descend to circuit height.

RECREATIONAL AVIATION AUSTRALIA

The Flight
Turning

TURNING - 3 AXIS

RECREATIONAL AVIATION AUSTRALIA

1. AIM

To roll the aircraft to a predetermined Angle of Bank (AOB), whilst maintaining the required performance and balance for level, climbing or descending flight to any predetermined heading.

2. APPLICATION

For use in all phases of flight to change the aircraft heading.

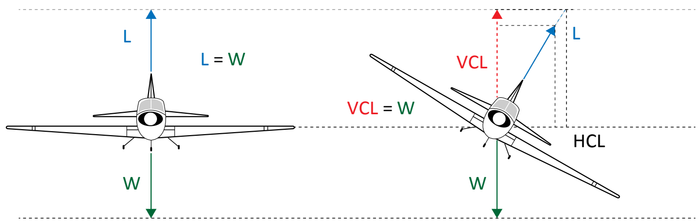
5. AIRMANSHIP AND HUMAN FACTORS

- Lookout - Situational Awareness SA
- Appropriate bank angles for phase of flight
- Blind spots in turn
- Horizon remains primary reference
- Understanding vestibular system and balance
- Banked horizon reference different in turn (side by side seating)

3. UNDERPINNING THEORY

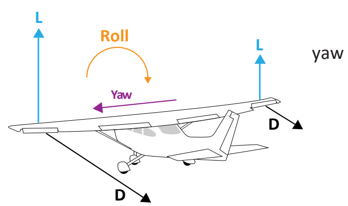
Banking the aircraft is the primary method for creating a force towards the turning direction.

- Ailerons are primary control to turn the aircraft
- Rudder for balance to overcome adverse yaw
- Elevator maintains height in the turn
- Adverse yaw explained
- Stall Speed increases in turning flight due to increased “loading”



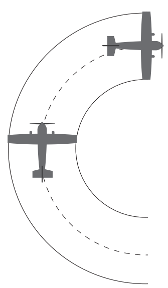
Adverse Yaw

- ↑ L on upgoing wing, also means ↑ D yawing away from turn
- Rudder to balance yaw as ailerons deflected - then neutral



Over Banking

- Outer wing travels further, more L, creates increased rolling force
- Avoid tendency to hold off bank with aileron



Performance

- When climbing and turning, angle of bank must be considered (recommend maximum 15 degrees)

4. FLIGHT EXERCISE

Adverse Yaw

- Demonstration only

Entry

Medium Level Turn

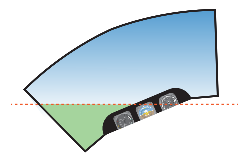
- From S+L
- Lookout
- Roll with aileron to 30° AoB
- Balance with rudder
- Backpressure to maintain altitude - ↑

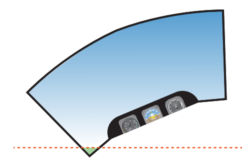
Climbing Turn

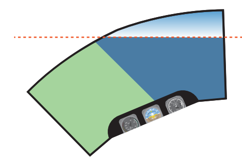
- Establish in climb
- Lookout
- Roll with aileron to set AoB
- Balance with rudder
- Hold backpressure to maintain climb airspeed

Descending Turn

- Establish in descent
- Lookout
- Roll with aileron to set AoB
- Balance with rudder
- Maintain backpressure to descent airspeed







In Turn

- Lookout - ALWAYS before turning
- Ailerons for Roll
- Rudder for Balance
- Elevator to maintain lift (power as required for steep turns)
- Turn maintenance, types of turns

Exit

- Look for reference point
- Anticipate rollout by reducing the angle of bank
- Roll wings level
- Balance with rudder
- Relax backpressure
- Reset S+L attitude
- Check **PAT**

6. OUTCOMES AND EXPECTATIONS

- Correct sequence and control through a range of bank angles up to 60 degrees and in all configurations
- Recognition of errors and appropriate corrections applied
- Required standards: Heading +/- 10 degrees, Height +/- 100 ft, Airspeed +/- 5 kts, Balanced

Introduction

Before proceeding with this lesson, ensure the student has demonstrated to you on previous flights a full understanding of the operation of controls, straight and level flight and climbing and descending.

Always allow either sufficient revision periods, or revision periods within each exercise, to make sure that this competency has been developed.

BRIEFING CONSIDERATIONS - TURNING

Lookout

As we are changing direction and our position in space, we require a good lookout. If we are turning left, we first check 'clear right', 'clear ahead, above and below', then 'clear left'. Obviously the reverse applies if turning right. Ensure you verbalise this procedure and encourage the student to do the same.

During the turn the student should be made aware of the importance of monitoring the attitude of the aircraft and only referencing instruments to confirm the picture in front. This will ensure the student does not become fixated on instruments, using the horizon and aircraft relative attitude instead.

Self-patter. Encourage the student to patter this sequence of lookout, out loud, and to make this become a habit. For example "All clear right, all clear left, all clear in front, turning left."

Direction/Compass heading. If not previously demonstrated, the alignment of the compass with a directional indicator or the EFIS should now be demonstrated. This can only be accurately done in level, un-accelerated flight. Mention the need to check the compass alignment is accurate and this can be done when lined up on the runway.

Turns to compass heading with reference to the briefed information regarding O.N.U.S may be introduced if the student is demonstrating competence, or left for later revision exercises.

Angles of bank. Turns greater than 30° angle of bank should not be introduced during this exercise.

Medium turns to 30° are to be demonstrated and the student should practice with turns completed to a geographical reference. The student should become comfortable with turns to reference points with quick scans to instruments and the majority of the focus outside. We do not teach instrument flying and this should be emphasised by referring to the outside reference.

Climbing turns up to 15° angle of bank should be shown along with a demonstration of the aircraft tendency to increase bank angles. The normal climbing speed should be used along with the recommended power setting.

Descending turns are usually demonstrated at shallow angles of bank with the power and attitude selected to manage the descent rate at 500 fpm.

Angle of bank v attitude against horizon. Most of our training aircraft have been designed with side by side seating and this arrangement will influence the way the horizon looks when the aircraft is banked from left to right. Because both the student and the Instructor are offset from the centre line, each will have a different view when the aircraft is banked either to the left or to the right.

If the student is looking straight ahead rather than across the cowling and the aircraft is banked to the left, the nose of the aircraft will appear much lower relative to the horizon. Due to this perception the student will generally raise the nose, resulting in the aircraft climbing. During the demonstration the Instructor should patter this sight picture and encourage the student to note a useful reference inside the cockpit to ensure the correct attitude is held. Reference can be made to the pre-flight briefing where this was explained.

When turning right the student will generally pitch the aircraft nose high. Again, during the demonstration, the Instructor should patter the correct sight picture. Obviously, it is critical during these demonstrations for the Instructor to fly accurately when turning in both directions!

The patter to the student will confirm the views noted are normal for turning manoeuvres and that he or she will become accustomed to these.

Coordination of Controls. The need to coordinate ailerons, rudder and elevator should be demonstrated by reviewing the effects of controls lesson and include:

- Use of ailerons alone: Point out the initial drag as a result of aileron input, the subsequent roll in the required direction, the sideslip indication of the balance ball, the secondary yaw and further nose down attitude and the feeling on the body of the sideslip forces. Most people will tend to lean away from the sideslip.

- Use of rudder alone: Point out the skid, followed by the secondary roll and further nose down pitch and the ball indication. Note the feeling of the skid forces on the body. Most people will tend to lean towards the skid.

- Now demonstrate a properly coordinated turn with the initial input of ailerons and rudder, neutralising aileron once the desired bank angle is achieved and maintenance of the attitude with elevator. Noted that the forces on the body are such that the body has no tendency to lean in the seat.

Revision periods. Commence each exercise with revision of previous exercise. It is also good practice to expand on previous exercises, for example, during this exercise, Best Rate of Climb and Best Angle of Climb can be introduced and practiced.

IN-FLIGHT PATTER - TURNS

Instructor. As discussed during the briefing, because we are changing direction when turning, it is vital we check for other users of airspace and conduct a good lookout. You would have noticed how I have conducted this during our previous flights and the lookout patter I have used. I will now formally demonstrate this to you. As usual, follow me through.

First of all, the lookout. Because we will be turning left, we will check that it is all clear to the right. Scanning round to the right, “all clear right”, then scanning to the front “all clear ahead, above and below” and to the left “all clear left” and finally “turning left.”

As discussed during the briefing for a medium level turn to the left we will choose an angle of bank of 30°. Looking straight in front we will choose a reference point on the horizon. What point can you see straight in front? (Student answers) So, coordinating the controls, we move the control column to the left and at the same time we apply gentle left rudder pressure. Once we are established at the required bank angle we neutralise the ailerons and rudder and to overcome pitch down tendency, apply sufficient back pressure on the control column.

You will note that the nose appears to you to be well below the horizon. You will recall during the briefing that this is due where you are seated on the left of the centreline of the aircraft. What you are seeing is the normal view of the horizon when the aircraft is banked to the left at 30° angle of bank.

Continue to look at the horizon but think about where the flight instruments are located on the instrument panel. Now with a quick glance confirm the balance ball is in the middle, the turn coordinator (if fitted) shows 30° angle of bank, the VSI is confirming a level attitude, no climb nor descent and looking back to the front, we may need small changes in pressure on the control to hold the turn attitude constant.

In the turn, continue to lookout particularly in the direction of the turn. You can see your reference point coming into view and just prior to it being directly in front of you we will level out by rolling the wings level and at the same time apply a little right rudder at the same time relaxing the back pressure to return the nose to the usual level attitude relative to the horizon.

Instructor tip. This demonstration is most effective at slow airspeed.

We don't generally trim in a turn, as we usually return to straight and level flight, so you will need to maintain steady back pressure in a turn for the duration of the turn.

Now I will give you a demonstration of turning without coordinating the controls, to remind you why we must coordinate control inputs. Firstly, tell me what you see when I move the only the control column to the left. Yes that is correct. The nose of the aircraft initially yawed to the right. I will recover to straight flight. The yaw in the opposite direction was caused by aileron drag, as we dicussed during the briefing.

Observe again what happens when I use ailerons alone. Left stick – initial yaw right – then roll left – and yaws left.

Now tell me what you see when I coordinate left aileron with left rudder. Yes, there was no initial movement of the nose to the right, but, the nose pitches down due to further effects as we discussed in the effects of controls exercise. To prevent this we needed to use back pressure on the control column as required to maintain the nose on the reference point relative to the horizon. Returning now to straight flight. (This is a useful coordination exercise for the student to practice during revision lessons, rolling around a point, however be careful the student doesn't become ill as a result).

OK student, you can now take over and practice some turns, full 360° turns to the left and right, starting and finishing the turn to your reference point on the horizon. You have Control.

Student. I have Control. Student practices. Instructor patters and monitors.

Instructor. Remember that we spoke about climbing and descending turns. I will now demonstrate the climbing turn. This is usually done in two moves, I have Control, and I want you to follow me through.

Student. You have Control.

Instructor. We conduct a good lookout (usual patter). I will now increase to full power, controlling yaw and pitching the nose up to achieve our climb speed of XX knots and then trim. Note our rate of climb is XXX fpm. We can now start the turn after a good lookout and noting our horizon reference point and coordinating the controls, left aileron until 15° bank angle,rudder to maintain balance and to maintain XX knots we need to lower the nose slightly, now trim.

Note that our rate of climb has dropped slightly to XXX fpm. We continue to maintain a good lookout and monitor engine temperatures and pressures. Also you will note the tendency for the angle of bank to increase, as we spoke about during the briefing, and we need to prevent this with opposite aileron.

To stop the turn we will simply roll the wings level, maintain balance and adjust the nose attitude to maintain our climbing speed and trim, checking engine temperatures and pressures. Just prior to our selected height we will pitch the nose down to the level attitude, reduce power to cruise, stabilise and trim. We are now level at 3500 and you can now practice a climbing turn to 4500 ft. You have Control.

Student. I have Control. Student enters the climb and initiates the turn and the level out. The Instructor monitors and patters.

Instructor. That was good student. During the briefing we discussed descending turns and the need to carefully control both the bank angle and the airspeed. I will now demonstrate a gliding descending turn. I have Control and I want you to follow me through.

Student. You have Control.

Instructor. First we conduct a good lookout (usual patter). Because we will be descending in a power off glide, I will now apply full carby heat and then smoothly reduce the power to idle. As the power reduces we coordinate controls with left rudder to prevent right yaw. This maintains balance and we adjust our attitude to the decent attitude using elevator and set best glide speed of XX knots and once stabilised, trim.

We will now roll to an angle of bank of 20° to the left and ailerons and a touch of left rudder to maintain balance and adjust the pitch attitude to maintain our speed and trim. We must also periodically check engine temperatures and pressures.

Just prior to our selected height of 4000 ft we will roll wings level, maintain balance and increase power to cruise power. Once stabilised we will trim and remove carby heat. You can now show me a glide descent to 3500 ft. You have Control.

Student. I have Control. Student sets up a descent and turn and then levels out. Instructor monitors and patters.

Instructor. Good. Now show me a descending turn at XX knots, at 500 fpm with 20° angle of bank. I want you to level out at 2500 ft.

Student complies. Instructor monitors and patters.

Conclude the exercise with practice of turns and climbing and descending turns.

RECREATIONAL AVIATION AUSTRALIA

The Flight Stalling

STALLING - 3 AXIS

1. AIM

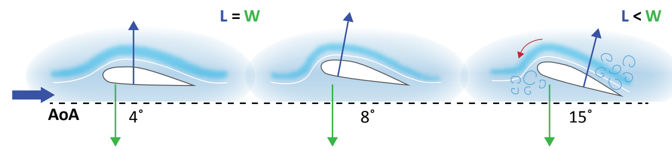
To identify the situations where the aircraft is likely to stall and recognise pre-stall symptoms. When stalled adopt the appropriate recovery actions for minimum height loss.

2. APPLICATION

Any phase of flight where critical A of A is exceeded.

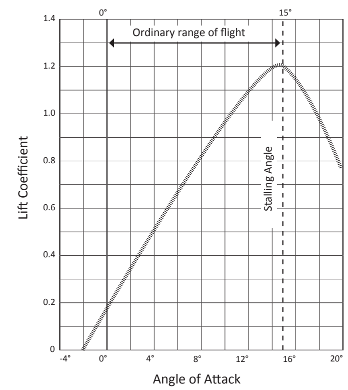
3. UNDERPINNING THEORY

- L = Angle of Attack x Airspeed
- Smooth airflow over the wing breaks down and becomes turbulent
- Breaks away from upper surface, aircraft sinks, nose pitches down



At the stall

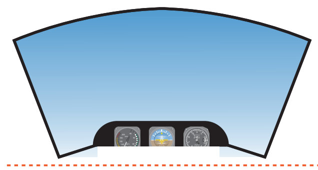
- When the wing stalls there is a ↓ in L and large ↑ in D
- Aircraft sinks, C of P moves rearwards →pitch down
- Stalls result from exceeding critical Angle of Attack
- The elevator controls the A of A of wing
- Lift/Drag curve
- Airspeeds are referenced in POH in relation to stalling
- Stall Speed increases in turning flight due to increased "loading"



4. FLIGHT EXERCISE

Entry

- **HASELL check (Minimum height I.A.W. RAAus Operations Manual)**
- Adopt slow flight to identify symptoms and reduced control
- Recognition of the stall point in various configurations
- Practice and develop recovery actions for min height loss in stall including any "incipient" rotation
- Demonstration and understanding of developing conditions due to mishandling of controls or lack of recognition
- Practice and recognition of pre-stall scenarios and appropriate actions
- Carb heat HOT
- Close throttle
- Keep straight with rudder
- Maintain altitude with backpressure



Symptoms

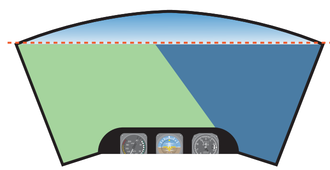
- Low and decreasing airspeed
- Possible high nose altitude
- Less effective controls - higher stick forces
- Stall warning - if fitted
- Buffet (turbulent air from wing striking tailplane)
- Control column will be fully back - no further control movement, past stall stick position
- High sink rate often undetected

At the stall

- Aircraft sinks and nose pitches down
- If aircraft yaws/rolls correct with opposite rudder only - do not use ailerons

Recovery

- Unstall wing
- Check forward with control column to reduce angle of attack
- Do not use ailerons, maintain heading with rudder only
- Aircraft will descend
- Recover to S+L with PAT



To Minimise Height Loss - max of 100 ft

- **Power + Attitude = Performance**
- Unstall, as above, check forward
- Apply full power - balance with rudder
- Raise nose to the horizon to reduce sink
- Lowering attitude assists acceleration
- Regain height and S+L

Recovery at Onset

- Normal situation - when not training
- Recover at stall warning / buffet
- Height loss - 50 ft maximum

5. AIRMANSHIP AND HUMAN FACTORS

- Lookout - Situational Awareness SA
- Counterintuitive responses and fear TEM
- Mismanagement and distraction SA
- Recognition of loss of primary control functions
- Limitations in identifying sink rate (Vestibular)
- Adherence to personal minimums and airspeed management

6. OUTCOMES AND EXPECTATIONS

- Define the stalled condition
- Developed recognition of all pre-stall symptoms in flight
- Pilot can state likely scenarios where stalling may occur
- Apply timely and appropriate corrective actions
- **Required recovery standards:** Height loss <200 ft, Heading maintenance +/- 10 degrees, Airspeed within V_a/V_{fe}

RECREATIONAL AVIATION AUSTRALIA

Introduction

During the student's theory study, stalling will appear a complex exercise and often provokes feelings of apprehension. The thinking Instructor will be aware of this and adopt techniques to minimise these feelings.

BRIEFING CONSIDERATIONS - STALLING

At the conclusion of flight prior to the stalling flight

Because the Student may have heard frightening stories about stalling it may be helpful to demonstrate a gentle stall with no flap at idle power stall.

The recommended process for this demonstration is to take control and patter:

"I am just going to show you something interesting"

Then run through the pre-stall checks and without further information:

Instructor. I am now reducing the power and you can see that the nose pitches down and yaws. To prevent height loss I am applying back pressure to the control column and sufficient rudder to stop further yaw. As the speed drops further I apply more back pressure and keeping the wings level using more rudder.

Note the reduced airspeed and the comparatively high nose attitude. I can feel that the controls are becoming less responsive and now we hear the stall warning. There is a slight buffet and a quick glance at the airspeed which is registering XX knots. The control column is now fully back, the nose pitches down and we are losing height. That was a stall and I am recovering by simply releasing the back pressure on the control column and smoothly pitching the nose attitude to just below the horizon. As the speed increases I can apply cruise power and fully recover to level and straight flight. You can see that this is a fairly straight forward procedure which we will be introducing you to during the next exercise.

Do not allow the student to try a stall, which should form part of the next exercise when the student has been fully briefed.

During the pre-flight briefing, the following areas should be part of the brief:

- As this is a flight exercise, be careful not to place too much emphasis on the lift formula.
- Confirm weight and balance will ensure the centre of gravity (C of G) is within limits.
- Referencing the aircraft POH for stall speeds, stalling characteristics and any limitations placed by the manufacturer.
- Revise the symptoms of the approach to a stall.
- Revise the recovery technique.
- Revise the pre-stall check-HASELL.
- Reassure the student you will ensure the aircraft remains in control at all times.

As the Instructor you must be confident when conducting this stall lesson and manage any apprehension you have. If unfamiliar with the aircraft fly the exercise with an experienced Instructor on type and ensure you are confident. This is particularly important if the aircraft type is unpredictable.

During demonstrations, the Instructor must use smooth control movements. It is extremely disconcerting for the student to see and feel abrupt pitching of the aircraft. For most RAAus aircraft an excessively high nose attitude is unnecessary.

Ensure airmanship is effectively managed using HASELL or other wellknown mnemonics.

Height awareness is paramount. The RAAus Operations Manual states “where the stall characteristics are known to be benign... stall recovery is completed by 2000 ft AGL”. At all times the Instructor must be prepared to manage the aircraft safely regardless of what actions the student takes. Stall characteristics listed by the manufacturer as ‘benign’ may not be correct if the aircraft is out of alignment or rigged poorly.

The Operations Manual continues “...stall recovery is to be completed by 3000 ft AGL”. Instructors should use this as a minimum standard and ensure the student understands the necessity of recovery above 3000 ft AGL.

Lookout and the clearing turn. Prior to commencing the exercise, conduct an appropriate lookout with regard to the aircraft type, being high or low wing, to ensure clear airspace for 360° around, above and below the aircraft. The lookout should include an assessment of the weather so that the exercise can be concluded above 3000 ft AGL and remain clear of cloud.

The Instructor must carefully ensure they always conduct recovery actions correctly. This can prove challenging while providing appropriate patter and should be regularly practiced. Ensure the student clearly understand the importance of recovering from the stall as the first action, and preventing further yaw with rudder. The Instructor must ensure they do not inadvertently apply aileron while recovering, and the control column must be moved forward without any sideways inadvertent aileron input.

The appropriate technique to enter the stall is to apply sufficient back pressure to maintain a specific reference point relative to the horizon resulting in a steady decrease in airspeed. Avoid the tendency to reduce the power abruptly and aggressively apply back pressure to the controls. Likewise the recovery action does not require aggressive control inputs. The professional Instructor can recover from a stall positively and smoothly. Likewise the nose should be recovered to the horizon rather than pitched aggressively low, which will result in increased height loss.

The objective of this early stall exercise is so the student 'recognises an approaching stall and completes appropriate recovery actions'. The emphasis should be is on how to recognise the signs of a stall being imminent and the correct recovery action. Basic stall recognition and recovery in various configurations can be demonstrated and practiced, however it is important to monitor the student to ensure they are coping with the lesson. Very few students can absorb all aspects of stalls in one lesson.

It is therefore recommended to conduct the lesson over two flights.

The first flight can include an introduction to slow flight and stalls in glide configuration, i.e. power at idle, no flaps and recovery with and without power, focussing on entry and recovery technique and recognition of the symptoms of impending stall.

The second flight can include power on stalls and recovery, stalls with various flap settings and in turns along with approach configuration stalls. It is recommended that the flight time also include practice and revision of previous elements with the stall component only taking half the lesson, including demonstration and student practice.

Further revision, practice and more advanced stalling should take place during the first lesson after circuit consolidation.

You can assist the student to manage this lesson by giving them specific direction on how to relax. For example, ‘Now student, just relax the tension in your shoulders and on the control.’

The point of the exercise is for the student to recognise the symptoms of the incipient stall. Emphasis should be placed on recovery immediately the first signs of an impending stall, decreasing speed, less responsive controls, increased sink rate, control column position, buffeting and stall warning occur. The student must then take decisive and appropriate recovery action.

IN-FLIGHT PATTER – STALLING Flight 1 of 2

Introduction

At this stage, the student should be managing all radio calls and under supervision be capable of taking off and climbing to the training area. If that level of proficiency has not been achieved, it is suggested that further revision be conducted ensure the student is at the appropriate competencies of the syllabus.

The student should be instructed to climb to a suitable height, in the training area and level out.

Instructor. Well student, at XXXX ft we have sufficient height for the stall manoeuvres. You will remember we need to recover from the manoeuvres by 3000 ft AGL. You will remember I demonstrated a basic stall and recovery at the end of our last session and that it was a fairly straightforward procedure. I will now demonstrate a straight and level stall, with idle power and recovery without power, to prove that the theory of stalling angle of attack works.

Instructor. First we conduct the **HASELL** check.

Height. Confirm XXXX ft to recover above 3000 ft AGL.

Airframe. Trim and flaps set as required. for this exercise, no flaps.

Security. Check there are no loose articles, harness is firm, doors and hatches closed.

Engine. Check fuel is on appropriate tank, fuel pump on. Temperatures and pressures OK Note: The use of carburettor heat will depend on prevailing conditions.

Location. Not over built up area, near controlled airspace, restricted airspace or danger areas and clear of cloud.

Lookout. Make sure there are no aircraft or other hazards in our area using the lookout process as briefed.

I will now demonstrate what we call a straight stall entry with idle power, no flaps and recovery with and without power. Note the current attitude and airspeed XX knots and note the increased sink rate and our height XXXX ft.

Looking at the horizon, I smoothly reduce power to idle, apply sufficient back pressure to the control column to maintain height and sufficient rudder to prevent further yaw. As the speed continues to decrease I apply increased back pressure and rudder to prevent further yaw. The controls are becoming less responsive and the stall warning is sounding (if fitted). We have a relatively high nose attitude, the VSI is indicating a high sink rate, which we can't feel, and the airspeed is now XX knots.

There is a slight buffet felt through the controls, speed now XX knots and now the nose pitches down even though I am holding full back pressure on the control column. That is a stall and you can see that the descent rate has now increased to XXX ft per minute.

To recover, we simply reduce the back pressure and pitch the nose to this position, just below the horizon. Now we have un-stalled the wing, the speed is increasing and control response is restored. We can now increase power and regain level and straight flight.

Note that our height loss was 700 ft.

So, you can see, student, that this exercise is fairly straight forward. As mentioned during the briefing the point is for you to recognise the signs of an impending stall and recover.

I will now hand over and you can climb back to XXXX ft and practice this stall and recovery. You have Control.

Student. I have Control. Student climbs to 5000 ft and practices stall. Instructor patters.

Instructor. I have Control.

Student. You have Control.

Student. I have Control. Student practices. a few times. Instructor patters.

At this stage it is recommended to complete the lesson with revision of previous exercises.

NOTE: For brevity by now the Instructor candidate should have a good understanding of how to construct air exercises and deliver patter. Therefore for future exercises, this chapter will only provide occasional patter references for clarity.

IN-FLIGHT PATTER – STALLING Flight 2 of 2

In this flight the student should have gained confidence in their ability to recognise the basic impending stall and carry out recovery actions.

For more advanced stalls, if the student is showing signs of being uncomfortable, revert to practice of simple stalls. Introduce advanced stall practice only when he or she is more comfortable, even if this requires an additional flight.

During the pre-flight briefing for advanced stalls, the key elements should include Airmanship considerations, weight and balance, aircraft operating envelope, appropriate operating height for recovery, the HASELL and weather assessment. The student should recognise and recover stalls confidently and with little prompting or corrective action.

Initially revise power off stalls and ask student to demonstrate. They should remember the pre-stall checks and don't forget to praise correct responses and correct poor actions promptly.

Now you demonstrate the effect of power on the stall, resulting in slower speed reduction, more sensitive elevator and rudder due to slipstream effect, and less effective ailerons as they are outside the slipstream. A slightly higher nose attitude at stall will be evident and a reduced airspeed at stall due to power application. The aircraft may show an increased tendency for uncommanded yaw.

Ensure the student completes the correct recovery actions, pitching the nose down to just below horizon while applying full power. The resulting pitching up and yaw due to power application should be controlled and finally wings leveled if roll occurs.

Demonstrate the effect of flaps on the stall, commencing with half flap and then full flap. Expected outcomes include a faster speed reduction, slightly lower nose attitude and reduced airspeed at stall. Demonstrate the recovery action including raising flaps at safe speed and in stages. The student should then practice these with the Instructor monitoring.

Now demonstrate the effect of power and flaps and provide reference to an approach configuration, resulting in slightly higher nose attitude, increased tendency for a wing to drop, reduced airspeed and the need for prompt recovery action.

It is essential that the student becomes highly proficient with recognition and recovery from this type of stall and does not allow the nose to pitch too high, and context is provided relative to the approach configuration and the conduct of go-around manoeuvres.

Note
Instructors are cautioned that due to typical power to weight ratios of RAAus aircraft, during power on stall exercises the aircraft may be positioned in an unusual attitude that could result in the aircraft operating outside the manufacturers' prescribed flight envelope.

The Student should practice with Instructor monitoring.

Finally, demonstrate stalls in a turn at bank angles to 30°. You should have referenced the Flight Manual for the expected increased stall speed with angle of bank. The student should be aware of the same speed reduction but a higher stall speed with a bank angle of about 30° and the importance of first recovery actions followed by leveling the wings promptly.

RECREATIONAL
AVIATION AUSTRALIA

The Flight
Circuits

CIRCUITS - 3 AXIS AND WEIGHTSHIFT (B)

RECREATIONAL AVIATION AUSTRALIA

1. AIM

To combine all practiced phases of flight in a standard format including take off, approach and landing in accordance with recognised circuit procedures.

2. APPLICATION

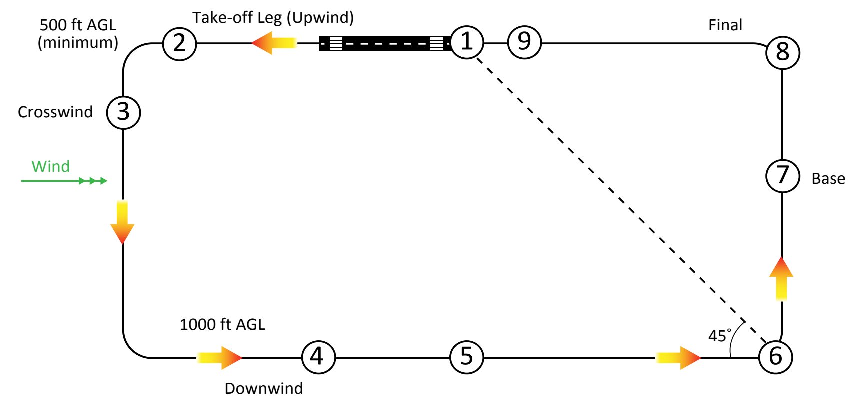
For use when operating at aerodromes for arrival, departure and standard traffic flow around a preselected runway.

3. UNDERPINNING THEORY

- Circuit conventions based on ICAO standards and outlined in CAR 166C
- Use of standard traffic pattern within the manoeuvring area of a landing area
- Circuits should be conducted on the most into wind runway unless conducting cross wind operations
- CAR 166C and CAAP 166-1(X) provide requirements and guidance for operations at non-controlled aerodromes including use of radio for “alerted see and avoid”
- Reference RAAus Syllabus of Flight Training 1.02 Circuits

4. FLIGHT EXERCISE

1. Takeoff	• Reference points and line up checks	• Keep straight
2. Climb out	• Separation • After takeoff checks	• T.O.S.S. • Turn at 500'ft AGL
3. Crosswind	• Tracking and lookout	
4. Downwind	• Positioning	• Checks
5. Aircraft configuration	• Possible to reconfigure aircraft depending on performance	
6. Base turn	• Lookout • Reference point • Carb heat as required	• Positioning • Flap set as required • Turn
7. Base leg	• Track • Attitude controls airspeed	• Flap set as required • Power controls descent rate
8. Final	• Anticipate turn 500' ft AGL • Short final alignment • Power to control aim point	• Attitude controls airspeed • Reference aiming point • Carb heat as required
9. Landing	• Glide approach OR powered approach (power as required) • Touch down on main wheels • Let nosewheel settle • After landing checks - clear of runway	• Look ahead towards end of runway • Progressively increase back pressure to control sink • Keep straight



- Lookout - ALWAYS prior to conducting manoeuvres in vicinity of aerodrome
- Assessment of appropriate runway and taxiing/holding points
- Take-off considerations: performance and emergencies
- Circuits broken down into basic flight manoeuvres
- Demonstration of full standard circuit
- Progressive introduction of all circuit tasks relative to workload
- Aircraft configurations and pre-landing checks
- Descent profile management and the landing phase
- Modification of circuit for conditions/ traffic

5. AIRMANSHIP AND HUMAN FACTORS

- Lookout and situational awareness SA
- Appropriate climb/descent profiles for each leg of circuit
- Management of flight sequences while multi-tasking SA, CRM
- Reference attitudes, and runway positioning SA
- Monitoring and management of circuit and aircraft operation TEM
- Right of way and circuit rules

6. OUTCOMES AND EXPECTATIONS

- Correct application of controls and decisions through the range of sequences in the circuit
- Recognition of errors and appropriate corrections applied
- Awareness and appropriate actions for corrections required in circuit
- Reference RAAus Radio Operator Syllabus 2.04 and CAR 166C for radio use
- Required standards: Heading +/- 5 degrees, Nominated Height +/- 50 ft, Airspeed +/- 5 kt, aircraft balanced for all manoeuvres

Introduction

Accurate circuit flying is a complex exercise, to brief and to fly. This complexity is not diminished by the wide range of interpretations by flying Instructors. There have been many attempts to standardise circuit procedures with limited success. Military, civil airlines, general aviation and recreational pilots all have differing needs, aircraft operating requirements and procedures.

For RAAus purposes the intent of a successful circuit for recreational pilots is to ensure the greatest possible options for a safe return to the aerodrome in the event of an engine failure and to integrate with other circuit operations in a professional manner. This is the basis for the information provided in this section. As a result, there may be some controversial points or objections however the procedures discussed are the result of thousands of hours of practicable application and the reader should note these procedures with an open mind.

It should be noted that this element cannot be covered in one session but requires many sessions.

Time to solo. This subject is so important and so often discussed due to the mythical aspects attributed to the student who solos quickly as a badge of hour and the mark of an exceptional pilot. Over the years this myth has led Instructors to rush through preliminary exercises and circuit flying in order to give themselves and their students some sort of legendary status. When boasting of their prowess and ability these Instructors may not have considered they have in fact, let the student down by not ensuring competency in all sequences.

As mentioned in earlier chapters, rushing through the upper air exercises to enter the circuit can also be a response to boredom by the Instructor, and again reflects poorly on the Instructor rather than making them a legend.

The time to solo generally has little to do with either the ability of the Instructor or of the student. In times past solo could be achieved in 1-2 hours, however pre and post WW2 averages time to solo had increased 7-10 hours. In today's environment and considering the average RAAus member's demographic, age and social background, it is more common to take between 10-20 hours. Different types of aircraft, different learning environments, changes to Instructors, weather and family, work and competing leisure activities can extend these hours, however the bottom line is what does it really matter?

If an average recreational pilot has 10-20 years of flying and averages 50 hours per year, an additional 5 or even 10 hours prior to solo will make very little difference to their overall years, and it could be argued that additional time with the experience of an Instructor in the right seat can deliver other intangible benefits.

BRIEFING CONSIDERATIONS - CIRCUITS

- Reasons for conducting circuits.
- How runways numbers are derived.
- Circuit size. Aiming to ensure the success of an engine out forced landing from the downwind leg, the glide ratio of a typical aircraft is 12:1, the aircraft can glide 12,000 horizontal ft or 2 nm. To achieve the runway with allowances for the effect of wind and turns, etc., we should conduct the downwind leg at a distance of 1.5 nm from the runway.
- Factors affecting this ideal distance include ATC requirements, preceding aircraft patterns, high drag versus low drag aircraft.
- The aircraft climb rate and power to weight ratio also has relevance to the distance maintained for downwind and a turn onto downwind may be required while still climbing to circuit height.
- When briefing circuits consider the orientation of circuit diagrams to actual compass points to assist student comprehension.
- Ensure when drawing the circuit diagram with specific orientation that any associated runways match the appropriate bearing.
- Circuit leg identification and consistent use of terms. Upwind, crosswind, downwind, base and final should all be referenced to the expected wind direction to create context for the student.
- Active or live side versus inactive or dead side of the circuit.

Circuit training sequence. During previous exercises, the student should have been following with the Instructor through take-off, circuit departures, circuit entry, circuit procedures and landings and taxiing. Most of the time, it is assumed, that the student has actually been flying many of these sequences under instruction. It follows then, that all remains is for the Instructor to formalise the circuit procedures and flight practice.

While there can be altruistic intent in allowing the student to fly as much as possible, there is benefit to letting the student sit back and observe correct and accurate circuit exit, conduct and entry by the Instructor without the pressure of actually conducting the flying themselves.

Students can gain great benefit particularly from observing a number of landings and having the Instructor begin to patter them through without the student flying.

Accordingly, the professional Instructor must and will conduct all aspects of circuit flying accurately and with the same procedures and processes expected of the student.

When we consider the workload involved for a successful circuit, including radio, taxiing, take-off, climbing, flap configuration changes, climbing turns, straight and level flight with reference to a landmark (the runway), level turns, pre-landing checks, lookout and control of the aircraft, descents with and without flap, descending turns, judgement of the approach, the landing and maintaining control of the aircraft through the landing roll, is it any wonder students may struggle?

Instructors must therefore not short cut circuit procedures for expediency or any other reason.

Circuit orientation. The correct technique when briefing circuits includes visually orienting the pattern to the runway in use. This will assist the student to understand laying off drift, what to reference on the runway to turn for each leg, distance out, etc. While reference can be made to geographical features there is a danger the student will become reliant on 'turning over the house with the red roof' or 'level out when alongside this hill'. Far better to reference the runway, and a geographical point ahead to ensure tracking remains constant, compass references, angles relative to the runway and aircraft references like 'halfway along the wing strut' for a high wing, or 'two thirds of the way along the leading edge' for a low wing aircraft.

If the Instructor teaches the student to orient their circuit pattern to local geographical or ground features these students cannot easily conduct an accurate circuit in a different location.

Radio calls. Standard radio calls and phrases are outlined in the AIP, however some Instructors insist on teaching radio calls relevant to their aerodrome, or insist radio calls are not required at rural airfields. This results in student inconsistency and lack of awareness of required procedures. Student either do not learn radio calls or omit them when they should be made.

Checks. Students must be aware that checklists must be used. Professional pilots, not limited to those being paid to fly, use checklists due to known limitations of the memory. Generic checklists may be safely used to ensure correct configuration of the aircraft, although manufacturers generally provide recommended checklists for their type. While variations in standard checklists exist, the most well-known are provided in the Definitions, Abbreviations and Checklists section.

Circuit etiquette

- Maintain position in the circuit, do not short cut or overtake.
- Maintain awareness of other pilots. If they act in what you believe is an improper manner, do not use the radio inappropriately. Note the aircraft call sign and report this to your CFI or RAAus directly.
- Use correct radio phrases and correct circuit positions. While you may not be aware of other traffic in the area, continue to make a minimum of appropriate radio calls to keep other airspace users informed.
- Avoid irrelevant chit-chat.
- Never direct another pilot to conduct a specific action.
- Listen carefully to all calls from other circuit traffic even if not directed to you. There could be implications affecting your circuit.
- Never allow radio operations to be a higher priority than controlling the aircraft and maintaining “see & avoid” awareness.

Ground operations

- Aircraft must not be taxiied faster than can be safely managed, with consideration of factors such as environmental, pilot expertise and aircraft braking effectiveness. Instructors must lead by example.
- Ensure a good lookout before starting the aircraft taxiing and especially before and after making entering runway call.
- Do not dawdle on the runway.
- Enter and line-up promptly.
- Vacate the runway as soon as feasible after landing.

Pre-Take-off Safety Brief. This basic exercise in ensuring the student has a plan to easily be enacted in the event of an issue during the take-off ground roll and subsequent climb is not as common as it should be.

This simple exercise provides preplanned essential safety actions in the event of an emergency. This should be provided as part of the school handout information and again should be generic in nature. This brief should be spoken aloud prior to takeoff, usually at the holding point. The brief reinforces and predetermines the actions that the pilot will take should the engine fail during or after the take-off. An example is provided below.

If an emergency occurs while on the ground, I will close the throttle and maintain directional control with rudder, bring the aircraft safely to a halt using brake.

If an emergency occurs on this take-off upwind, I will set best glide attitude to maintain XX knots and if insufficient runway remains land straight ahead. If runway doesn't remain, I will select an area to land within 30 degrees either side of the aircraft.

If the engine fails on crosswind, I will set best glide attitude to maintain XX knots, and select an area within safe gliding distance ahead. If I have time I will do emergency checks and make a MAYDAY call.

Some elaboration. In an emergency the throttle should be closed on the take-off roll in case the engine returns to life again and creates a problem stopping the aircraft. The student must be made aware of the impossibility of turning back to the runway below 1000 ft. A controlled touchdown, even on unsuitable terrain is preferable than stalling in the turn and losing control of the aircraft.

If possible, with consideration for traffic, a demonstration of a turn back from upwind should be provided by the Instructor, to visually confirm the practical impossibility of managing a turn back.

If time permits, the fuel should be turned off to reduce the possibility of post-impact fire. Full flap should be used if the aim point is achievable to ensure that the lowest possible touchdown speed is achieved.

Finally, the best possible management of emergencies is via practice so reactions become instinctive. If an engine failure occurs, vital time is wasted if the pilot actively has to process the required actions, while processing the fact the emergency has actually occurred. It is not recommended to practice a simulated emergency just after take-off as it is inherently dangerous.

During training and once the Pilot Certificate is achieved the best practice can occur at home while carrying out normal day to day routines. Decide an engine failure or other emergency has occurred and practice the drills and actions. This is a known technique of visualisation and has been practiced by pilots and athletes for years.

Flaps. The use of flaps is commonly misunderstood. Instructors must reference the aircraft POH rather than create their own procedures.

POH procedures are developed by test pilots to establish safe flying practices for the particular aircraft. Take-off and landing distances are predicated by the use of flaps, so use of the recommended flap setting in the POH will ensure the best possible outcome.

Crosswind considerations. Controversy can exist about the use of flaps in a crosswind. A manufacturer will specify the maximum flap to be used. Full flap enables the aircraft to have a lower landing speed and a shorter float distance reducing the effect of the cross wind.

Full flap should only be extended when the aim point for landing is assured, ensuring the pilot can conduct a safe go-round if required.

The student pilot must be entirely familiar with managing and controlling pitching as a result of raising and lowering flap.

Circuit practice. Consideration should be given to conducting full stop landings in addition to only practicing 'touch and go' landings.

Benefits of Full Stop landings

- The student experiences controlling the aircraft to a full stop safely, maintaining directional control, managing brakes, and manage the aircraft.
- During the back track the student can receive feedback and consider how to improve.
- Provides the benefit of more practice with radio calls.
- Ensures the student sets the aircraft up again for the next take-off.
- The student practices controlling the take-off from a full stop.
- Prior to first solo, the Instructor can vacate the aircraft knowing the student will correctly configure the aircraft and manage the full take-off and landing process.

Negatives of Full Stop landings

- The time between take-offs is increased, reducing the number of possible practices.
- The aerodrome may be too busy to permit full stop, back track and take-off.

Benefits of Touch and Go

- Excellent practice for 'Go-arounds.'
- More circuits per hour.

Ideally, the first few circuits could be full stop and touch and go landings can be introduced. If first solo is imminent, the student should be given practice at landing to a full stop and a subsequent take-off from full stop.

Cross wind circuits

Take-off technique Hold into wind aileron and commence the take-off run. Use sufficient back pressure to keep the nose wheel lightly loaded and when the rudder becoming effective, raise the nose to the normal take-off attitude. As the airspeed increases and ailerons become more effective the amount of aileron required is reduced, but they must be used to maintain wings level.

Use sufficient rudder and nose wheel steering to keep the aircraft straight against the tendency to weathercock into wind.

It is important to not raise the nose too early or too high as the aircraft may lift off prematurely and could then touch down again without being straight.

Once airborne, the aircraft is turned (not yawed) into the wind to counteract drift. During the circuit keep the aircraft track parallel to the runway by laying off drift.

Approach using the crab method. Use flap as per POH recommendations to manage the aim point. The aircraft should be tracked down the extended centre line by laying off drift. This is achieved by turning the aircraft into the wind, not using the rudder. The wings are kept level and the aircraft is flown in balance, no slip or skid.

The aircraft is flared as normal and just prior to touch down rudder is used to yaw the aircraft to align with the runway. The secondary roll effect from yaw is corrected by the ailerons to lower the into wind wing.

At touch down, the main wheels should touch down into wind wheel first, then the other. The nose wheel must be maintained in alignment with the runway and allowed to contact the ground as speed decreases. As the weight of the aircraft tends to move forward with the decreasing speed, light back pressure is used to keep the nose wheel lightly loaded. As the rudder becomes less effective with decreasing speed, directional control is maintained with nose wheel steering. Into wind aileron is maintained to ensure the into-wind wing does not lift.

Approach using the slip method This may be easier for the student to manage initially, and if using the crab method, can be transitioned to earlier on the approach (at say 200 ft AGL), to assist the student to visualise the appropriate control inputs.

The disadvantage of using this method is the higher rate of decent, and careful use of power may be required to slow the rate of descent.

The student should align the aircraft with the runway using rudder and control the resulting secondary roll with into wind aileron. The advantage of this method is the aircraft is directionally aligned and managed and a normal round out, hold off and flare can then be conducted. The student workload is therefore reduced.

To assist the student to understand the appropriate control inputs, the Instructor may nominate that the student will only manage one specific control at a time. Starting with rudder, the student can concentrate on ensuring the aircraft is aligned with the runway centreline leaving the other inputs for the Instructor.

Next the Instructor can nominate the student only manage the aileron, to understand and manage the correct into wind positioning to prevent drift.

Finally, the student can practice using all control inputs, and gradually bring the corrections closer to the runway round-out moment. Crosswind circuits should be understood and practiced prior to first solo.

A student successfully managing the crosswind corrections is one of the most satisfying moments for an Instructor, topped only by sending the student for their first solo.