Attaining your

MAAA

Bronze/Silver Wings for Fixed Wing Aircraft

Release 1b

Paul A Phibbs

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Dedicated to the many members of the Camden Valley Radio Control Miniature Aviation Sports Club, who through their tireless, selfless efforts, encouraged me to achieve goals I didn't think possible.

In particular I'd like to thank the following:

Bruce Thrift
Ernie Swanson
Ted Oram
Alistair Heathcote
Peter Bons
Don Murray
Felix Nieuwenhuizen

I'd also like to thank my wife for supporting me with this retirement interest.
Love you Katie.

Acknowledgements

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For the important task of proof reading and providing feedback on content, I'd like to thank Ted Oram, Ernie Swanson, Alistair Heathcote, Ronald Hicks, Don Murray, John Clelland and Bruce Thrift.

I'd like to add a special note of thanks to my daughter Rebecca, who is always willing to provide excellent feedback on the written word.

About the author

I have had an interest in aviation from an early age. As a teenager, I built and flew control line and free flight models. I later developed an interest in computing which became my profession for life. During that time I further broadened my interest in aviation with flight simulation software. I began real world flight training and went on to get my GFPT (restricted) license for single engine aircraft. I used this knowledge to enhance the enjoyment of simulated flying on-line and went on to develop flight training, which encouraged some participants to fly real world.

After some health issues which stopped me from flying real world, I decided to refocus my aviation interest towards Radio Control flying. The advent of *ARF*s and improved technology has reduced the cost of this hobby and encouraged many people who don't feel they have the capacity to build models from scratch or *kits* to "have a go".

I joined the Camden Valley club back in 2011 and with the help of this friendly and supportive club, went on to attain my *MAAA* bronze, silver and gold wings. I have also passed the *MAAA* instructor course and look forward to assisting others to develop in this sport.

I'm hoping this book serves to assist you in gaining your bronze/silver wings with the information it provides. Please drop me a line if you have any comments at paphibbs@bigpond.com.

Enjoy and BE SAFE!

Contents

Is this book for you?

This book is intended to support a new flyer that:

1. is interested in learning to fly a fixed wing *R/C* (Radio Control) plane;
2. intends joining a club and using an *MAAA* instructor for the training process;
3. wants to know the necessary foundation information that will support the training process; and
4. intends to make bronze or silver wings the personal goal accreditation that recognizes their abilities as a flyer.

What if I've been flying for years?
Even if you have learnt to fly, you can select the material from the book that will assist you in preparing to take the wings assessment. It is still suggested that an *MAAA* instructor be used to guide you through the maneuvers and assist in determining when you are ready for the assessment.

Disclaimer
This book is intended to be used as a guide only. It is by no means a definitive guide to radio control flying. I have provided it to support the early process of learning to fly along with the eventual goal of being assessed for your bronze or silver *MAAA* wings by an approved *MAAA* Instructor. It is assumed that you will use an *MAAA* instructor to manage your wings training. The information is brief and simplified to suit a new person to the sport. As suggested throughout the book, always be guided by the manufacturer's instructions for your specific equipment. A glossary is provided at the end of the book to explain any terms in *italics*.

The information has been provided in good faith, to help you through the process. You need to use your instructor to expand on any specific areas that are confusing. Hopefully the book will assist in laying the important foundations on which to build your knowledge.

No responsibility will be taken for problems that arise as a result of following the instructions in this book. There are many points of view around areas covered in the book, which can be confusing to the new flyer. All information is based on my experience and the experience of fellow flyers that have kindly assisted me or provided input towards the content in this book.

Following any suggestions made in the book is at your own risk but everything in the book is genuine and much effort has been taken to ensure it is correct and appropriate.

I have written this for the *R/C* flying community as a way of giving back for the wonderful support I have received. I hope it will enhance your enjoyment of this exciting sport.

Getting started

Attaining your *MAAA* Bronze/Silver Wings endorsement for fixed wing aircraft isn't difficult. Both Bronze and Silver wings have the same requirements. The difference is that Bronze Wings are awarded for models under 2kgs (e.g., park flyers) and Silver wings are awarded for models 2kg and over. You will need the guidance of an approved club instructor to ensure you have the appropriate grounding in your training. One of the benefits of joining a club is that you get this support training for free. You must be a member of a Club and hold an *MAAA* card to be eligible for this training.

What is the MAAA?

Model **A**eronautical **A**ssociation of **A**ustralia (*MAAA*) – supports clubs by providing service needs to its members, such as:

- liaising with *CASA* for safe model operation rules;
- providing a framework around safety and activities to enhance the enjoyment of club members;
- providing comprehensive public liability insurance and personal accident insurance for clubs and their members; and
- provides guidelines around certification standards for instructors and levels of proficiency for flying, i.e., bronze, silver and gold wings.

Instructor courses are run in accordance with *MAAA* requirements, to ensure club members that wish to become instructors understand the requirements of the wings endorsements.

The primary objective of the Bronze/Silver Wings proficiency level is to ensure that you as pilot can control the aircraft in a safe manner, in a busy club environment, to the satisfaction of the assessor. In addition, there are some theory areas that are covered in the assessment.

Below are the areas of assessment that need to be satisfied for a Bronze/Silver Wing endorsement:

- **Dexterity**: The pilot must be able to locate all the *transmitter* controls quickly without fumbling.
- **Theory**: The pilot must be able to name all major components of the aircraft and define functions, including effect of controls and have a thorough knowledge of safety rules and regulations.
- **Airframe & pre-flight checks:** The pilot checks the engine mounting, plumbing (for *IC engines*), wiring, *centre of gravity* (CofG) location, security of batteries under-carriage and signs of structural or covering problems that could affect flight, e.g., presence of warps (twists in surfaces) which could affect trim, loose or frayed wires etc. The pilot also performs a safe start up sequence (including arming electric motor if appropriate), checks that controls are neutral and control throws correct, and checks throttle setting, state of battery and performs a range check. Range check every model every day.

- **Take Off:** The pilot demonstrates gradual application of power while keeping the aircraft straight with rudder and using a little *elevator* to lift off, makes a gentle climb out with wings level until a safe altitude is reached.
- **Trimming**: Pilot shows ability to trim the aircraft in flight. Displacement and re-trimming of both the primary roll control and *elevator* should be demonstrated.
- **Procedure Turns (one in each direction)**: The pilot's ability to perform the following steps in the procedure turn will be assessed:
  - level flight segments should be straight and level;
  - aircraft should pass directly over the landing area;
  - turns should be at a constant altitude; and
  - turns should be completed in order that upwind and downwind tracks are superimposed.
- **Figure eight**: Pilot to demonstrate either an inward or outward figure eight, as shown in the diagram in the *MAAA* Trainee Pilot Log Book. This is a flat eight circuit without loss of height and the change of turn directions is directly in front of the pilot.
- **Landing circuits**: Pilot to demonstrate in both directions, as shown in the diagram in the *MAAA* Trainee Pilot Log Book, with all turns of 90 degrees. With high performance aircraft, the power needs to be reduced much sooner than at the turn onto base leg. The upwind and downwind legs are parallel to the landing strip. The first three legs are maintained at a constant height and a gradual approach angle is started at the beginning of the base leg.
- **Approach & Landing**: Pilot demonstrates an engine assisted landing, using a suitable power setting that allows the model to descend, controlling nose *attitude* with *elevators* (airspeed), and using the throttle to stabilise the rate of descent. The aircraft should be flown over the threshold at an altitude of about 1.5 metres, the throttle closed gradually, and the round out or *flare* initiated. The "hold off" period is then commenced where the aircraft is gradually allowed to sink and settle on the ground in a slightly nose high *attitude*.
- **Simulated dead stick landing**: At a safe and high position, the pilot will reduce the throttle to idle and perform a descending circuit to show his/her ability to safely glide the model without power to a position where a landing can be executed.

Details of the maneuvers are outlined in the *MAAA* Trainee Pilot Log Book, which can be obtained from your Instructor. They are discussed in detail later in this book.

The instructor isn't looking for precise maneuvers but an indication that the pilot understands the maneuver, carries out the maneuver in accordance with the requirement and keeps safe control of the aircraft throughout.

If possible, keep with the one instructor throughout your training. Different instructors have different approaches to the training and this can be confusing and add to the time it takes to complete your training.

Attaining your MAAA Bronze/Silver Wings

Many clubs require that new members can’t fly solo unless they have attained their bronze/silver wings. Regardless, this endorsement is a foundation that all pilots should attain before pursuing more advanced forms of flying.

Selecting a suitable plane

It is better to begin with a *high wing* "trainer" style aircraft and leave the Spitfire, Mustang (or whatever) for down the track. You will find the trainer more forgiving and is more suited to the introductory manoeuvres outlined in this book.

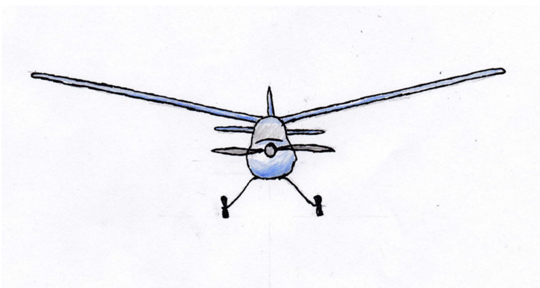
These days, you are spoilt for choice for your first trainer aircraft because there are many options available, model aircraft can be acquired in the following ways:

Recommendations for a beginner.	
• Purchased ready to fly.	Recommended for a beginner.
• Purchased almost ready to fly.	Recommended for a beginner.
• Build it yourself from a *kit*.	Recommended but you should regularly ask an experienced builder to review your work.
• Build it yourself from a plan.	Not recommended for a beginner but it can be done with assistance from an experienced builder.
• Purchase a second-hand aircraft.	Not recommended for a beginner. Unless the particular aircraft is known to your instructor.
• Design and build it yourself.	Definitely not recommended for a beginner.

Be careful with these options. Not all pre-built aircraft are equal in every respect. Some can be more difficult for a beginner to repair than others.

Whatever you choose, your aircraft should have the following characteristics:

- be a recognised "trainer" type;
- have a *high wing* layout;
- have *dihedral* in the wings - adds stability to the way the plane flies; and
- ideally be designed for and be powered by a *40 size* (or 46 size) engine. (See "The Engine" section below, for information about electric powered model aircraft.)



Dihedral – Note the way the wings tilt up, i.e., are not parallel to the ground.

Low Wing

High Wing

Other non-critical factors to consider:

- aircraft with a *tricycle undercarriage* can be easier to handle on the ground than a *taildragger*; and
- *four channel* aircraft are recommended as they cover all the typical *control surfaces.*

Taildragger

Tricycle

Above is a good example of a *high wing* trainer aircraft with *dihedral* wings and a taildragger undercarriage.

Basic aeronautical knowledge

For the purposes of this book, Basic Aeronautical Knowledge will cover the following areas:

- calls – communication to other pilots;
- aircraft controls and balance;
- aerodynamic forces;
- generation of *lift;*
- flying basics;
- engines (IC and electric);
- fuel and battery systems; and
- rules and regulations

Calls

Communication is a critical part of any group activity and radio controlled flying relies on clear communication and cooperation for safe and enjoyable flight with groups of flyers.

Typical calls that need to be made are:

- Is it ok to enter the runway for take off?
- Announce take off on <name> of runway, towards <direction>.
- While in the air, if you plan to perform any maneuvers that might conflict with other pilot's flying, announce the maneuver so other pilots know what to expect.
- If you experience a "*dead stick*" (engine failure) and need priority to land, announce *dead stick* and land on whatever runway is convenient. Announcing a *dead stick*, gives a pilot priority to land.
- Once you are ready to land, announce landing and the runway of choice along with the direction you are landing from.
- If necessary, announce a "go around" if the landing is aborted and remember to announce that you are landing again.
- If you have to collect your plane from the field, announce "on the field" so that pilots understand someone is on the field and they don't attempt a landing.
- Once clear of the field, announce, "clear of field" so that other pilots know that they can land if required.

The success of any of these calls is dependent upon the acknowledgement and understanding of other pilots.

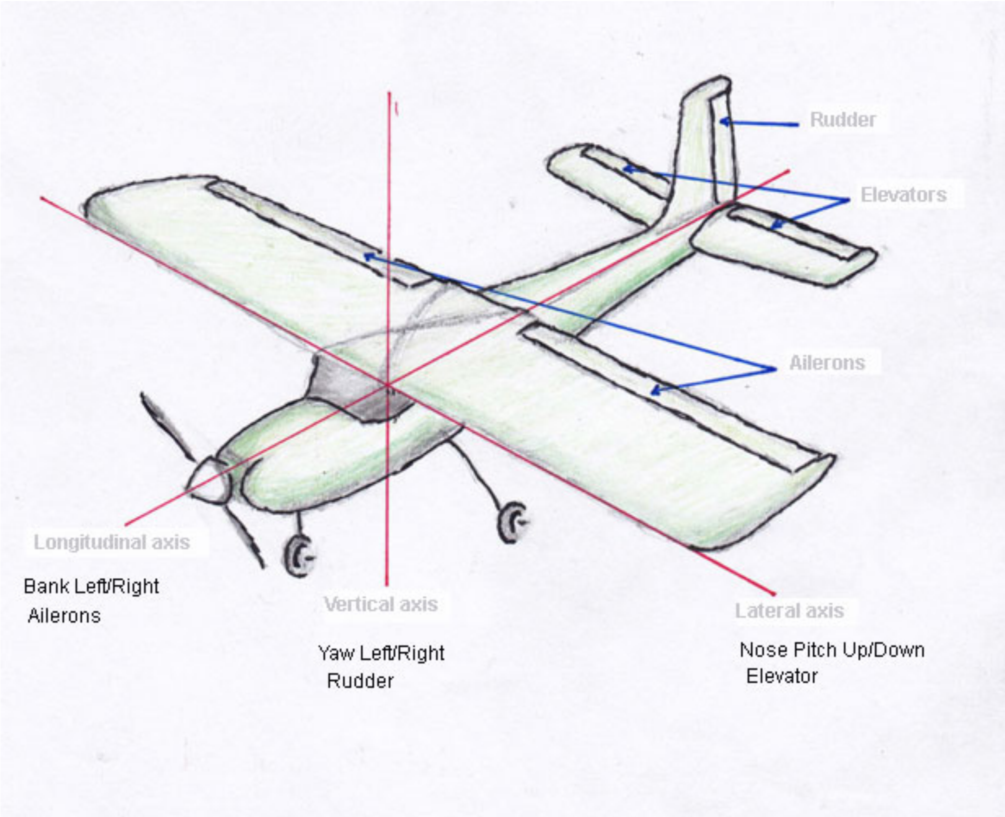
If you need to communicate to pilots from a position outside the pilot's box, use a "spotter" to relay any calls and confirm that you can proceed.

Aircraft controls and balance

Aircraft Controls

The following are the primary *control surfaces* of a typical aircraft:

- aileron;
- rudder; and
- elevator



Aircraft motion

<u>Pitching about the lateral axis</u> is done via the ***elevator***. Push on the stick and the *elevator* goes down pushing the tail up and the nose down. Pull on the stick and the *elevator* goes up pushing the tail down and the nose up.

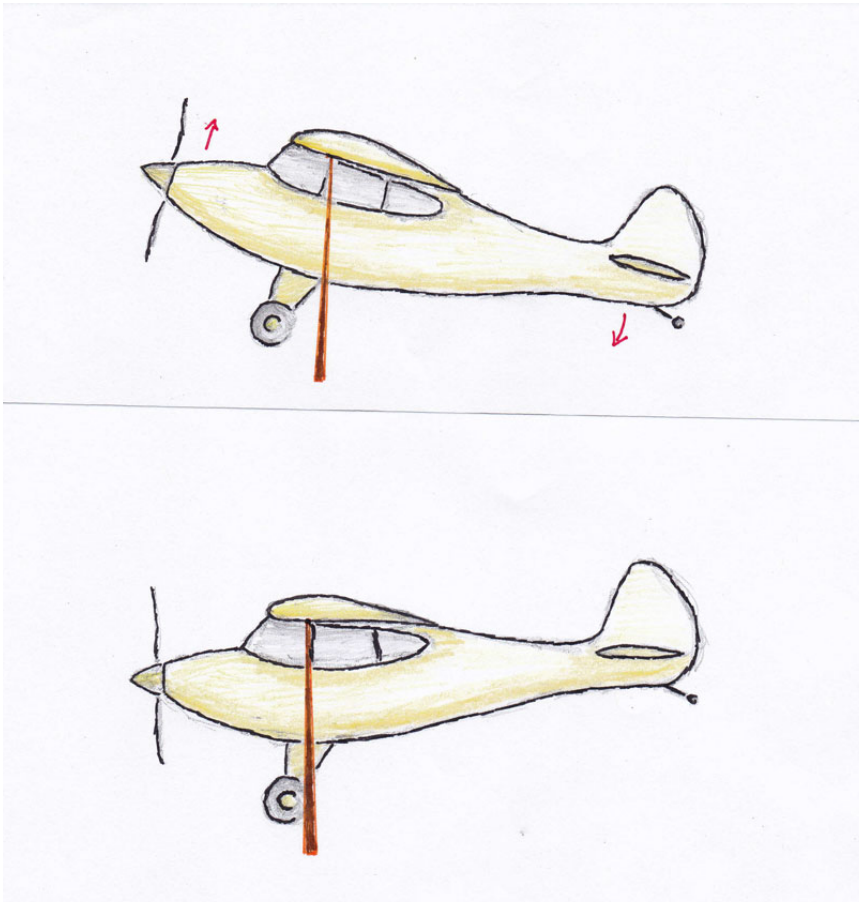
<u>Rolling about the longitudinal axis</u> is done via the **ailerons**. Move the stick to the left (to make a left turn) the left aileron goes up and the right aileron goes down. *Lift* is created on the right aileron causing the right wing to raise and the left wing to drop. This creates a bank that causes a turn. Conversely, move the stick to the right (to make a right turn) the left aileron goes down and the right aileron goes up.

<u>Yaw about the vertical axis</u> is done via the ***rudder***. Move the *rudder* left and the *rudder* deflects to the left causing a *yaw* to the left. Move the *rudder* to the right and the *rudder* deflects to the right causing a *yaw* to the right.

Roll and yaw together: In a *roll*, the upward wing causes *drag* and has the effect of pushing the nose in the opposite direction of the *roll*. This is referred to as a skid. To counteract this skid, a small amount of *rudder* is used in the direction of the turn to *yaw* the nose into the turn. This is referred to as a **coordinated turn**.

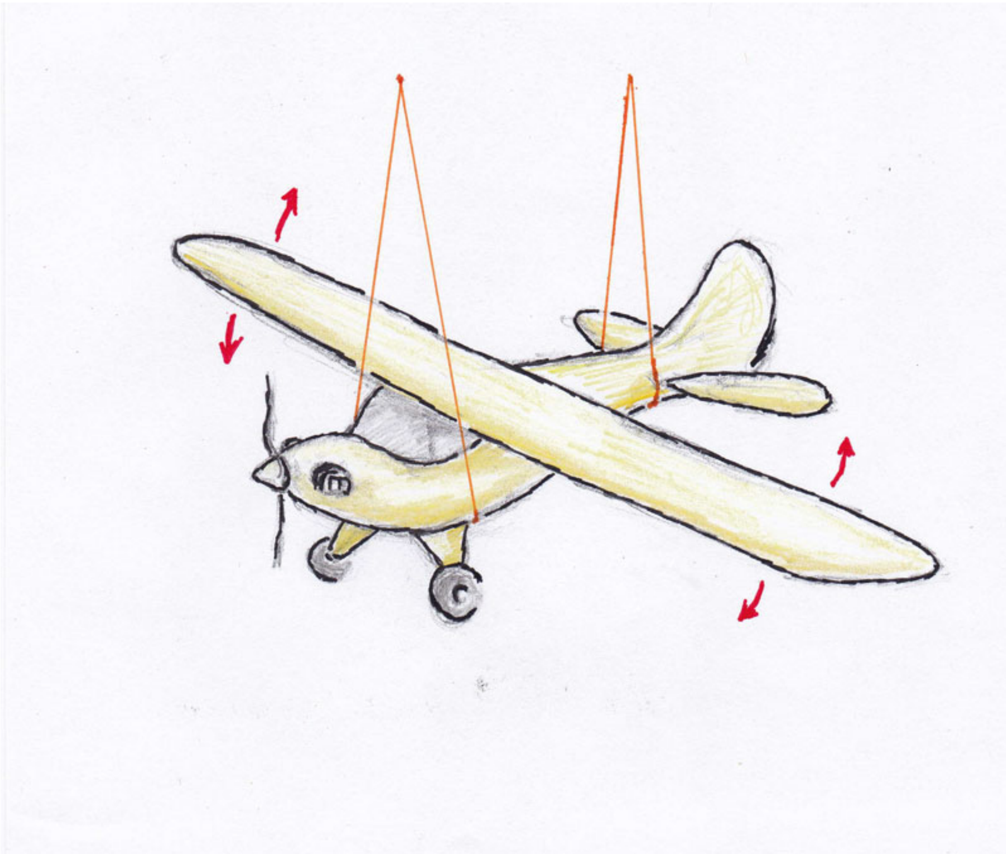
Balance

Centre of gravity (COG) is the point of balance around the lateral axis (nose to tail). The plans or manual for the aircraft will generally specify where the COG is located and can be an area as opposed to a fixed point. Balance outside this area can make the plane difficult to fly or control.



Place the tip of your finger at the suggested point for correct balance under each wing. If the planes tail tilts down, you need more *weight* on the nose. If the nose tilts sharply, you need *weight* in the tail. Ideally the correct balance will be either level or slightly nose heavy.

You can also balance the longitudinal axis (wing tip to wing tip) to determine if one wing is heavier than the other. Placing small stick-on weights on the underside of the wing will correct the issue.



Models with *IC engines* would determine their balance with an empty tank of fuel. This is so the balance doesn't become tail heavy as the fuel is exhausted, making it difficult to land.

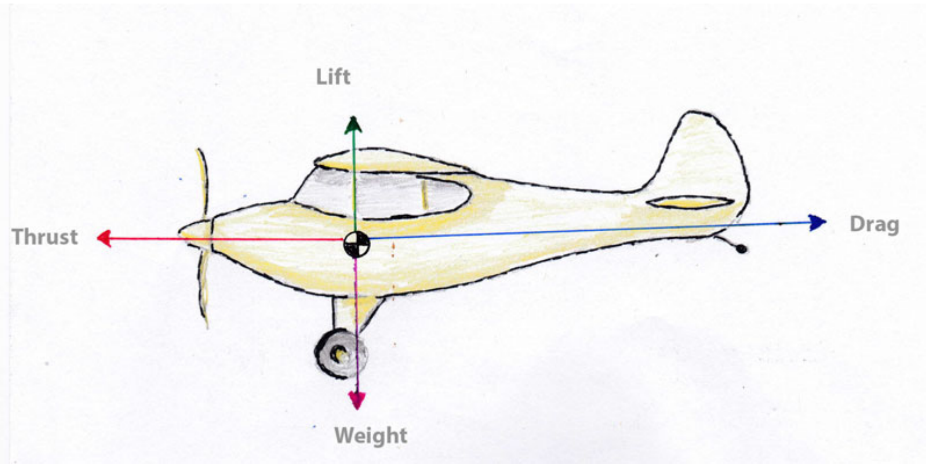
Similarly, electric models would determine their balance with the *lipo* battery installed.

Ensuring the plane if properly balanced is **CRITICAL**.

Aerodynamic forces

The four forces acting on an airplane in flight are as follows:

- lift;
- weight;
- thrust; and
- drag



Thrust: An airplane is pulled forward by the *thrust* of the *propeller*. This forward movement generates airflow over the surface of the wings. If flown into wind, a lower speed across the ground is required to provide the necessary airflow over the wings to provide *lift*. This aids with take offs and landings.

Drag: Forward *thrust* is opposed by the rearward retarding force called *drag*. This can be **profile *drag*** or **induced *drag***. Profile *Drag* is caused by parts of the plane that interfere with the flow of air, e.g., non-aerodynamic areas such as aerials, landing gear etc. Profile *drag* causes a higher *drag* when the plane flies slowly. Induced *drag* is a result of flight. Induced *drag* causes higher *drag* when the plane flies fast.

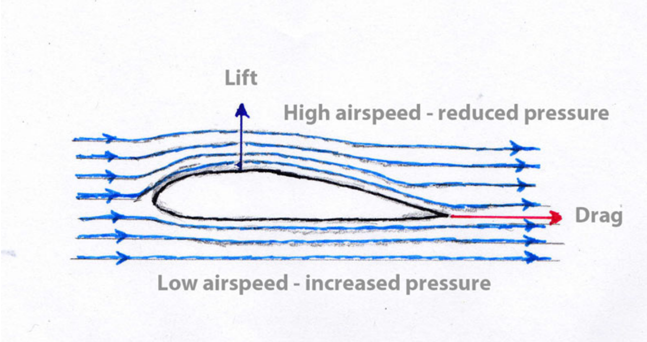
Lift: When sufficient air is passing over the wings, *lift* is generated as a result of the *aerofoil* cross section of the wings. As the airflow passes over the *aerofoil* a variation in air pressure is created, i.e., lower on the upper wing and higher on the lower wing surface. This differential of air pressure allows the wing to generate *lift*. If the airflow is disrupted, the wings *stall* and no *lift* is generated.

Weight: The force of *lift* is opposed by the ***weight*** of the plane and gravity. It is critical that *weight* be balanced around the *centre of gravity* (see comments about balance earlier).

When all four forces are equal, the plane will fly straight and level.

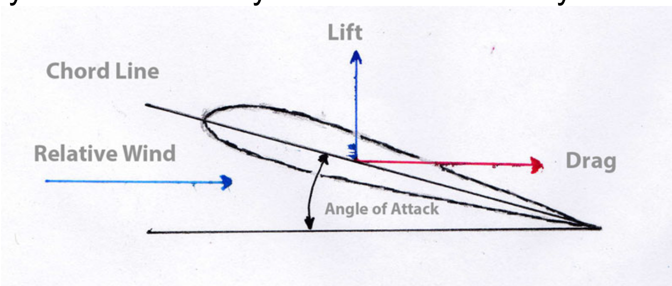
Generation of lift

Let's talk about the generation of *lift*. When you are flying straight and level, i.e., wings parallel to the ground, all the earlier mentioned forces are in balance. Air passes over the top and bottom of the wings and *lift* is generated due to the *aerofoil* cross section shape of the wings. The air has to travel further and faster over the top of the wing as opposed to the lower wing. This causes a difference in pressure, which provides *lift* on the upper wing.

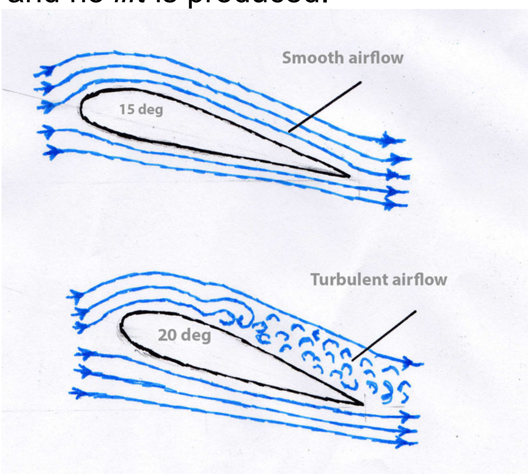


The chord line, is the imaginary straight line joining the leading and trailing edges of an *aerofoil*. The *angle of attack* is the angle between the airflow that meets the wing as it flies (relative wind) and the *pitch* of the chord line. Relative wind doesn't need to be parallel with the ground, e.g., in a vertical dive the relative wind is opposed to the direction of flight.

The important thing to take away from this is if you increase your *angle of attack*, you will increase your *lift* and increase your *drag*.



This will only work up to a certain *angle of attack*, e.g., 15 – 20 degees depending on the wing type, after which airflow across the top of the wing breaks up and *lift* is reduced. Once no air can flow over the wing the wing is *stalled* and no *lift* is produced.



Flying basics

We will now discuss the things you need to consider when performing basic operation of an *R/C* plane.

Taxiing
Taxiing is the ability to steer the plane to maneuver on the ground, e.g., taxi to the runway for takeoff. With *tricycle undercarriage* (*nose wheel*) taxiing is fairly easy with throttle and *rudder* to steer the *nose wheel*. For *tail draggers* (*tail wheel*) applying full up *elevator* while taxiing will keep the tail down. Accurate taxiing is a very important skill. In fact, a prerequisite for a straight take off.

Take off
Firstly we need to get that airflow over the wings. This is achieved by starting our takeoff roll along the ground into wind. Gradually increase throttle to achieve your speed along the ground. Remember to use the rudder to steer a straight path down the runway (your plane may want to drift to the left). Once we believe the plane is travelling fast enough we add a small amount of up *elevator* (backpressure on the stick), which will force the plane to *pitch* up (*rotate*) and climb out from the ground. Too steep a climb risks a stall. Too shallow takes too long to achieve a safe height. A 30 degree climb out is a safe compromise.

Tricycle undercarriage aircraft present the chord of the wing directly into the airflow. Once sufficient speed is reached, you can simply apply backpressure on the *elevator* to take off (*rotate*).

Tail draggers need to allow the tail to rise, so that the chord of the wing is pointing directly into the airflow. Then the *elevator* can be used to *pitch* the plane up to *rotate*. For *tail draggers*, during the takeoff roll, start with up *elevator* to keep the tail down. Then as the plane builds up speed during the takeoff roll, relax the backpressure on the *elevator* to allow the tail to rise with speed.

It is critical that you don’t exceed your *angle of attack* or a *stall* will result. Refer below for the recovery of a *stall*.

Level flight
Once you climb out to the required altitude, level off by easing backpressure on the *elevator* and reducing the throttle. If the plane is trimmed out correctly, the plane will fly straight and level. Note the slower you fly the plane, the more backpressure you will need on the *elevator* to maintain altitude. As the plane continues to slow and too much backpressure is added increasing the *angle of attack* beyond it’s limits, the plane will *stall* as *lift* is destroyed.

Bank left or right
When you fly straight and level, all the forces are in balance. If you bank the wings, *lift* is reduced so you need to add backpressure to the *elevator* to maintain altitude in the turn. In addition, the *stalling* speed goes up in a bank, so you need to be conscious of not over banking in slow flight, particularly if you are close to the ground. If in doubt, add some throttle in the turn. During a bank, *drag* on the outside wing forces the nose in the opposite direction of the turn. This is called a skid. To keep the nose pointed into the turn, use a small amount of *rudder* in the direction of the turn. This assistance creates a coordinated turn.

Climb
The ability to climb is important when required. In the early days of your flight training, it is recommended to fly on the higher side, so you have time to respond if something goes wrong. This is referred to as flying a couple of mistakes high. Keep in mind that you need to be able to clearly see the plane to effectively control it, so never let it get out of sight. To initiate a climb to a higher altitude, simply increase throttle then apply *elevator* backpressure. It is important to increase throttle, otherwise airspeed will decrease as you climb due to increased *drag* and the plane will eventually *stall* if it gets slow enough.

Stall recovery
It is important to look for signs of an imminent *stall*, so that it can be remedied. Typical signs are sloppy controls, i.e., have little impact due to low airflow. Wing drops are common as the plane enters the *stall*. It is a good practice to try *stalls* out at a suitable recovery altitude, so you can observe how the plane reacts and take the required action. Not all planes behave the same in a *stall*.

To recover from a *stall*, apply full power and reduce the nose *attitude* by slight forward pressure on the *elevator*. If the plane goes into a spin, the usual additional step is to use opposite *rudder* to the direction of the spin to recover from the spin.

Descend
Descents are required for landing approaches as well as maneuvers performed at a lower altitude. Maybe you have been flying at a high altitude to allow for errors and now wish to descend to a suitable altitude to perform a landing circuit.

To descend, simply reduce power. This will reduce the altitude of the plane. You can add forward pressure on the *elevator* to speed up the descent if required. Be aware that a dive produces high airspeed, which isn’t wanted in an approach for landing.

Land
Like takeoff, landings are done into wind. You may need to fly with a cross wind if the runway doesn't match the wind direction. It is still important to be flying into the wind where possible. If the wind is 90degees to the runway, it doesn't matter which approach direction you choose, you'll need to crab into wind (point the nose of the aircraft into wind) while you descend on your final approach to land. You also need to allow for drift as you descend and straighten up once you are close to the runway. It's a lot like swimming across a river to a point on the opposite bank with a current trying to sweep you off course. Planes will only handle a certain strength *crosswind* so don't fly if the wind is beyond the plane or your ability to fly it safely.

To land, perform a minimum of downwind and base prior to your final approach to the runway. Get the plane down to a suitable altitude for the circuit and begin to slow the plane down towards the end of the downwind leg. Be careful making turns, i.e., don't over bank as you are generally slower than usual and close to the ground. Reduce height with throttle and use *elevator* and throttle to control the approach path of the plane down to the runway. You may need to use *rudder* to assist with lining up with the runway as required. **Note:** on final approach the ailerons are used to keep the wings level and the RUDDER is used to steer the plane.

As you approach the ground, apply a little backpressure on the *elevator* to raise the nose in the *flare*. Maintain this raised position and reduce throttle so the plane runs out of airspeed and settles on the runway. It is desirable to land on the main wheels first, so as to not overstress nose or *tail wheels*. Once settled on the ground, use the *rudder* to keep the rollout straight until the plane comes to a complete stop.

Author with his Swift trainer

Engines

Together with a *propeller*, engines are used to provide the *thrust* component of the four aerodynamic forces supporting flight (discussed earlier).

Types of Engines

Engines can be Internal combustion (IC) or electric motors (EP). These types can then come in a range of sizes, which indicate the power output. They can be 2 stoke or 4 stroke and can use Methanol or Petrol.

IC Engines

2 Stroke IC engine

Engines that run on methanol based fuel require the *glow plug* mounted at the top of they cylinder to be connected to a battery powered glow starter. This causes the filament in the *glow plug* to glow and ignite the fuel in the cylinder chamber. Once the ignition starts the engine, the glow starter can be disconnected and the combustion process continues.

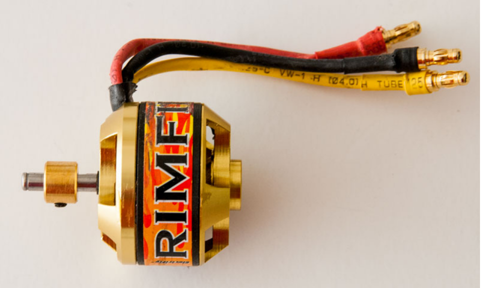
Glow plug

Engines that run on a petrol based fuel require a battery powered ignition system that keeps the spark plug igniting the fuel. It is required that this ignition system be managed by the radio so it can be shut down remotely if required. Note there are some Petrol engines that use a *glow plug* and don't support an ignition system.

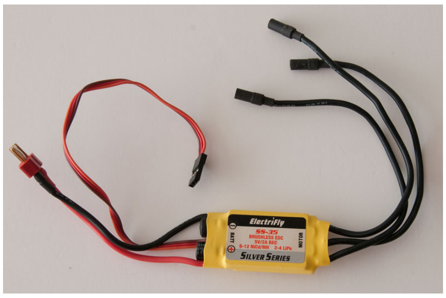
Engines come in various sizes to suit the aircraft that is to be flown. A typical size for a Trainer is .40 or .46.

Electric motors

Electric motors require the addition of an Electronic Speed Controller (*ESC*) to manage the speed of the motor. Motors come in various sizes to suit the aircraft that is to be flown.



Brushless outrunner



Electronic speed controller (ESC)

Electric motors have many benefits over *IC engines*, i.e., quiet running, reliable and consistent power, clean (no messy residue from fuels). *Lipo* batteries are a more cost effective power source over time when compared to fuel, if they are managed properly.

Engine/motor capacities

IC engines come in various capacities and are measured in either cc's (cubic centimetres) or cubic inches. As a guide, 1 cubic inch equals 16.38 cc's.

.40 cubic inches	6.55 cc
.60 cubic inches	10 cc
1.8 cubic inches	30 cc

Electric motors are measured in power by watts. As a guide, 746 watts is equal to 16 cc or 1 hp (horse power).

Unfortunately there is no simple chart to compare electric motors with *IC engines*. There are too many variables at work, i.e., model type, model *weight*, flying style, scale effect, *pitch*, speed etc. Manufacturers also use different methods to size their motors, e.g., kv (in this context kv refers to the R.P.M. per volt), some use a proprietary metric rating or in the case of E-flite, they use a label to match the ic engine equivalent.

There are on-line calculators to assist in determining size and combination of motor, *ESC* and battery. If in doubt, be guided by the manufacture of the plane you are building or experts in hobby stores and at your flying field. It is CRITICAL that the motor, *ESC* and battery (*Lipo*) combination is correctly matched.

Operating your engine

The following steps are typically performed when operating your engine:

Running in new IC engines
Before any flight with a new engine, the engine needs to be run in. Refer to the instructions supplied by the manufacturer for details. This assists to bed in the working parts of the engine and will support the future operation of the engine.

Important: The below steps are a guide only. Please refer to the Manufacturer's suggested approach for starting the engine as some engines differ.

Operating a 2 stroke glow engine (methanol based)

- Ensure the plane is secure behind stays or has a tail tie. This is to ensure the plane doesn't propel forward when the engine starts.
- Fill the fuel tank with fuel.
- Turn on radio and ensure correct plane is selected.
- Turn on plane via the receiver switch and confirm that controls work as expected.
- Do your range checks for the radio to *receiver* signal.
- Open throttle fully, choke engine by clamping or blocking muffler exhaust and turning over engine with the *propeller*. You may use a *chicken stick* or *electric starter* to turn over engine. You can also choke by covering the carburetor with your finger while cranking the engine a few turns by turning the prop. This will suck fuel into the engine chamber. If the fuel lines are visible, you should see fuel being sucked into the engine. Alternatively, you may see fuel being sprayed out of the carburetor. Don't over choke, as you will end up with a flooded engine and can get a hydraulic lock that prevents the piston from moving. If this occurs, invert the model to allow the excess fuel to pour out of the engine.
- Close throttle and open the throttle a small amount.
- Test for hydraulic locks by turning the prop by hand to ensure there is no restriction (ensure you do this before connecting the *glow plug* starter). Using an *electric starter* on an engine with a hydraulic lock can cause damage to the engine.
- Connect glow starter to *glow plug*.

Important: Always treat the *propeller* with respect. It has the potential to cause serious damage if you or others come into contact with it.

- Turn over engine with the *propeller*. You may use a *chicken stick* or *electric starter* to turn over engine.
- Once engine fires, disconnect glow starter and confirm smooth transition of engine power using the throttle through the entire range. Always

disconnect the glow starter from behind the prop. Never reach over the prop to disconnect the starter.

- Once landed, taxi off the field and stop the engine with the engine cut switch on your radio (this needs to be programmed).
- Turn off the *receiver battery* and your radio.

Operating a petrol engine

- Ensure the plane is secure behind stays or has a tail tie. This is to ensure the plane doesn't propel forward when the engine starts.
- Fill the fuel tank with fuel.
- Turn on radio and ensure correct plane is selected.
- Turn on plane via the *receiver* switch and confirm that controls work as expected.
- Do your range checks for the radio to *receiver* signal.

Important: Before the next step, ensure the electronic ignition is off. However, in any event, be careful turning over the prop, as a previously stored charge can be sufficient to turn over the engine even if the electronic ignition switch is off.

- Open throttle fully, choke engine by turning over engine with the *propeller*. Use an *electric starter* to turn over engine. This will suck fuel into the engine chamber. Don't over choke, as you will end up with a flooded engine and can get a hydraulic lock that prevents the piston from moving.
- Close throttle and open the throttle a small amount.
- Test for hydraulic locks by turning the prop by hand to ensure there is no restriction (ensure you do this before turning on the electronic ignition). Using an *electric starter* on an engine with a hydraulic lock can cause damage to the engine.
- Turn on the engine choke.
- Turn on the electronic ignition for the engine.

Important: Always treat the *propeller* with respect. It has the potential to cause serious damage if you or others come into contact with it.

- Turn over engine with the *propeller* using an *electric starter*.
- Once engine fires, if it continues to run, stop it using the electronic ignition cut off switch on your radio then turn off the engine choke.
- With the electronic ignition set to on.
- Turn over engine with the *propeller*. The engine should start and continue to run.
- Confirm smooth transition of engine power using the throttle through the entire range.
- Once landed, taxi off the field and stop the engine with the remote ignition cut.
- Turn off the *receiver battery*, Ignition battery and your radio.

Tuning an IC engine

Important: The below steps are a guide only. Please refer to the Manufacturer's suggested approach for tuning the engine as some engines differ.

- Set the mixture needle by fully closing (turn clockwise) then opening two to two and a half turns anti-clockwise.
- Start the engine (as specified above).
- Slowly turn the mixture needle to adjust the fuel mixture – clockwise will lean the mixture (less fuel to air mixture) and anti-clockwise will richen the mixture (more fuel to air mixture). As you turn anti-clockwise the note of the engine should drop. Once this point is reached, turn the needle clockwise until the note of the engine reaches its peak. At this point, turn the needle anti-clockwise about a quarter turn to richen up the fuel mixture.
  Note: A tachometer can be used to find the peak running point. Once the peak is found, come back about three hundred RPM on the rich side of peak.
- Check how the engine transitions from low to high throttle. You are looking for a smooth transition. Minor changes to the needle valve will be sufficient to correct any rough running.

Note: Avoid constantly changing the needle valve once you find a suitable mixture. New fuel or extremes in weather may require a minor change but this should be no more than a couple of clicks either way.

Operating an electric motor

- Ensure the *lipo* battery is fully charged. Some pilots use battery testers to confirm the charge.
- Ensure the plane is secure behind stays or has a tail tie. This is to ensure the plane doesn't propel forward when the engine starts.
- Turn on radio and ensure correct plane is selected.
- Set throttle cut off on your radio (if available). This needs to be enabled in your radio (if supported) and will protect against accidental use of the throttle. Otherwise, simply don't connect your battery until you are ready to fly. Ensure the throttle is closed when connecting the battery.
- Arm the plane by connecting the battery.
  SAFETY NOTE: most clubs require arming to be done in a designated area and definitely NOT in the pits. Always treat a propeller as potentially live whenever the battery is connected (armed).
- Do your range checks for the radio to *receiver* signal.
- Confirm the *control surfaces* work as expected.
- Disable the throttle cut (if set) and fly.
- After flying enable throttle cut or ensure the throttle is closed and disarm the plane by disconnecting the battery.
- Turn off your radio.

Care for your engine

The following are care and maintenance areas to consider:

IC engines
- Always run an engine on the rich side of peak. Avoid running your engines too lean, as the engine will overheat and damage will occur.
- Learn to read a glow plug, i.e., shiny and flat filament as opposed to matt and rough – lean vs rich running.
- Run the cylinder dry at the end of the flying day.
- Place about five drops of after run oil in the carburetor (glow engines only).
- Periodically inspect the engine to ensure nothing has come loose through vibration.
- Inspect fuel tubing to ensure it isn't perished. Particularly with petrol based engines, the tubing can become hard and need to be replaced.

Electric motors
- Virtually no maintenance required.
- Ensure motor is secure.
- Ensure you always use a recommended propeller and it is tight.
- Ensure wires are in good condition
- Match the motor with a suitable *ESC* and Battery.

Propeller size

It is critical that the correct *propeller* is chosen for your engine or motor to get the optimum performance. The wrong size prop can cause serious damage to engines or motors (particularly for electric motors).

Props come in a range of sizes. Props are defined by:
- the size (in inches/cm) of the spinning arc the prop makes; and
- the pitch of the prop blades. This pitch designates how far in inches/cm the prop will theoretically move through the air per single revolution. Therefore the higher the pitch the faster your plane will go.

IMPORTANT: Props are specifically designed to run on *IC engines* and others on electric motors. Ensure you select the correct prop.

As a guide, below is a chart that lists typical *propeller* size for a given engine size:

IC engine size	Prop range
.10	7x4 to 8x4
.25	8x4 to 9x6
.32	9x4 to 10x5
.40	10x5 to 11x6
.60	11x6 to 12x8
.90	13x6 to 15x8
1.2	14x6 to 16x6
2.8	18x6 to 20x10
4.2	20x8 to 24x10

Fuel and battery systems

There are a number of fuel systems available, i.e., glow, gas and electric. In this book we will focus on the typical types, i.e., methanol based for glow engines, petrol based for gas engines and *lipo* batteries for electric motors. The typical trainer that you would use to learn to fly and attain your bronze/silver wings would support these fuel types.

Methanol based fuels

Fuel is easily available pre mixed from your Hobby store and typically sells for around $40 for four litres. Some pilots prefer to mix their own fuel which usually comprises: 10% nitro, 20% oil and 70% methanol. Some prefer to leave out the Nitro and others like to include either castor or synthetic oil or a mixture of both. Most of the constituents are available from you Hobby store but methanol is sold from some specialised outlets. From experience you can save around 50% of the cost by mixing your own fuel.

Petrol based fuels

Petrol based fuels are based on a two stroke oil/petrol mixture.

Refer to the manufacturer's guide for recommendations on petrol/oil mixtures but a typical guide is:

30 to 1 (petrol for oil) for the first 3 Litres, then
45 to 1 thereafter.

The higher oil content initially required is associated with the running in of the engine.

Lipo batteries

Batteries for electric motors are usually *lipos* (**Li**thium **Po**lymer). They can last for years if they are cared for correctly. Pattern flyers in particular prefer *lipos* to fuel because they typically need to practice often for competitions and batteries work out to be a cheaper power source than fuel.

Care of lipo batteries

If looked after well, you should get a few years out of your *lipo* battery. *Lipos* are safe if handled correctly but can be very volatile if mismanaged. Below are some handling tips for *lipo* batteries:

- ensure you store your *lipos* in a fire safe bag or container;
- use the "Store" program on your charger if the batteries are to be left for any period of time;
- don't use *lipos* when the packaging looks "puffed" or the battery looks damaged;
- only use batteries with specs advised by the manufacturer of the plane;
- keep them in a clean and dry place, out of contact with metal objects;
- occasionally wipe the contacts with an alcohol swab, to keep them clean;
- time your flights and don't let the battery run until it is flat. Over time, this will ruin a *lipo* battery;
- periodically use the discharge/charge cycle on an approved charger to prolong the life of the battery. This is different from flattening a battery while flying. This process will condition the battery for maximum efficiency;
- new *lipos* should be charged a couple of times initially to help recover the capacity they lost while in storage. Never leave charging *lipos* unattended;
- always charge using the balancing lead and using the balanced charge method on your charger. Periodically test the cells to ensure they hold the same voltage. Cells with a variance of 0.1v are in danger of exploding; and
- avoid overcharging *lipos*. However most modern *lipo* chargers avoid this issue. Check that yours does.

Fuel vs batteries

As already mentioned, combustion or electric engines are available for model aircraft. The below table lists some of the pros and cons associated with using fuel vs batteries.

IC engines + fuel	Electric motors + batteries
More realistic sound	Quieter operation
Messy oil residue on planes	Clean – no mess
Longer flight time	Typically 8 to 10 mins
Need to allow for vibration, more stress on airframe and radio gear	Less vibration, causing less stress on radio gear and airframe
Dead sticks possible even though fuel not exhausted	Less likelihood of *dead sticks* (unless battery exhausted)
Variable engine performance	Reliable performance

Rules and Regulations

There are some important rules and regulations associated with model flying. Two bodies that regulate our flying are CASA and MAAA.

CASA

Civil Aviation Safety Authority (*CASA*) is an independent statutory authority, which has the primary function of regulating safety for civil air operations in Australia and Australian aircraft overseas.

CASR 1998 Part 101 regulation includes:

- 400' height restriction in Controlled Airspace.
- Can't fly within 3nm of an airport.
- 25kg and up to 150kg certification is required.
- Requesting permission for flying in restricted areas.
- 30m rule – operation near people and buildings.

MAAA

Model Aeronautical Association of Australia (*MAAA*) supports clubs by providing service needs to its members. Providing a framework around safety and activities to enhance the enjoyment of club members. *MAAA* also provides comprehensive public liability insurance along with personal accident insurance for Clubs and their members. They also provide Manuals of Procedures (MOPs) which are guidelines for all aspects of aeromodelling including: certification standards for Instructors, levels of proficiency for flying, i.e., bronze, silver and gold wings, that must be followed to meet the MAAA insurance requirements.

General rules (provided each year on your membership card. Read them to ensure you are aware of any revisions):

- I shall make myself aware of and abide by the requirements of the *MAAA* Manual of Procedures (MOP), *CASA* regulations and *MAAA* and club rules. The MOP is on the *MAAA* web site at www.maaa.asn.au.
- I will not fly my model higher than 400 feet unless allowed under Civil Aviation regulations.
- I will give right-of-way and avoid flying in the proximity of full-scale aircraft. Where necessary, an observer shall be utilised to supervise flying to avoid having models fly in the proximity of full-scale aircraft.
- In addition, where established, I will abide by the safety rules for the flying site I use, and I will not willfully and deliberately fly my models in a careless, reckless and/or dangerous manner.
- Flying over the pits, spectator areas or buildings is prohibited, unless beyond the control of the pilot(s).
- I will only operate radio controlled model aircraft on frequencies that have been approved by the *MAAA*.

- I will not fly my model aircraft in events, displays, air shows, or model flying demonstrations until it has been proven to be airworthy by having been previously and successfully flight-tested.
- I will not operate a model aircraft with a mass greater than 7kg without a valid Permit to Fly. In any case, the maximum permissible mass of a model, without fuel, allowed to operate under *MAAA* rules is 150kg.
- I will not operate any gas turbine powered model aircraft unless I have obtained a Permit to Fly and complied with the MAAA GT Rules. (**Note:** This does not apply to ducted fan models using piston engines or electric motors).
- I will not operate models with metal-bladed *propeller*s or with gaseous boosts, in which gasses other than air enter their internal combustion engines(s): nor will I operate models with extremely hazardous fuels such as those containing tetranitro-methane or hydrazine.
- I will not operate models carrying pyrotechnics (any device that explodes, burns or propels a projectile of any kind) including, but not limited to, rockets, explosive bombs dropped from models, smoke bombs, all explosive gases (such as hydrogen-filled balloons) and ground mounted devices launching a projectile.
- I will be aware of and follow the *MAAA* Alcohol, Drugs & Illness Policy. Therefore I will not consume alcoholic beverages or illegal drugs prior to, or during, participation in any model operations.
- I will not taxi my aircraft without restraint close to or where it may be a danger to other people.
- I will not fly my model any nearer to power lines than 15 metres or any greater distance if specified in State Legislation.

Radio control

- I will have completed a successful radio equipment ground range check before the first flight of a new or repaired model.
- I will perform my initial turn after takeoff away from the pit and spectator areas.
- I will not knowingly operate an *R/C* system within 4 kilometres of a pre-existing model club flying site unless in accordance with the *MAAA* Manual of Procedures.

Electric

- I will make sure the *receiver* is switched off or if it is on, make sure the *transmitter* is also on with the throttle set low, before connecting the main flight batteries to the speed controller.
- I will always check the direction of rotation of the *propeller* before launching an electric glider.

Free flight

- I will not launch my model aircraft unless at least 30 metres downwind of spectators and automobile parking.
- I will not fly my model unless the launch area is clear of all persons except my mechanic, timekeepers and officials.
- Use of fuse De-Thermalisers is not permitted in Australia.

Control line

- I will subject my complete control system (including safety thong, where applicable) to an inspection and pull test prior to flying. Pull test will be in accordance with the current Competition Regulations for the applicable model category. Models not fitting a specific category, as detailed, shall use those pull test requirements for Control Line Precision Aerobatics.
- I will ensure that my flying area is safely clear of all utility wires or poles.
- I will ensure that my flying area is safely clear of all non-essential participants and spectators before permitting my engine to be started.

Club rules

In addition to the above rules, clubs will have their own local rules. When you join a club, you should be provided with a rule book to be guided by, while you are a member. If not, request a list of the rules from the club officials.

What you need to know about your radio

Frequencies

Megahertz frequencies
Frequencies approved by the *MAAA* in Australia are:

26.957 – 27.282MHz (27MHz)
29.720 – 30.000MHz (29MHz)
36.000 – 36.600MHz (36MHz)

Pilots flying these frequencies needed to use a “key or peg board” to identify what *frequency* and channel they were using so that other pilots with the same *frequency* and channel know to wait until it is available before flying. Some clubs use a plastic key or tag that slots into a similar board to indicate the *frequency*/channel in use. This board is referred to as a “*frequency keyboard*”. If two planes used the same *frequency* and channel the interference will cause both of the planes to crash.

Gigahertz frequencies
With the advent of the 2.4GHz spread spectrum system, several people can fly together safely without any concern about interference between radios. Most modern radios use the 2.4GHz *frequency*.

If you are purchasing a radio (new or second hand), ensure it uses 2.4GHz as the old MHz frequencies aren’t worth the disadvantages associated with using those frequencies.

Example of a key board used to determine channels for a given frequency in use

Making the decision – Mode 1 or Mode 2

Radio *transmitters* (TX) come in a number of modes as follows:

Mode 1: Left stick controls *rudder* and *elevator*. Right stick controls *aileron* and throttle.

Mode 2: Left stick controls throttle and *rudder*. Right stick controls *aileron* and *elevator*.

Mode 3: Left stick controls *elevator* and *aileron*. Right stick controls throttle and *rudder*.

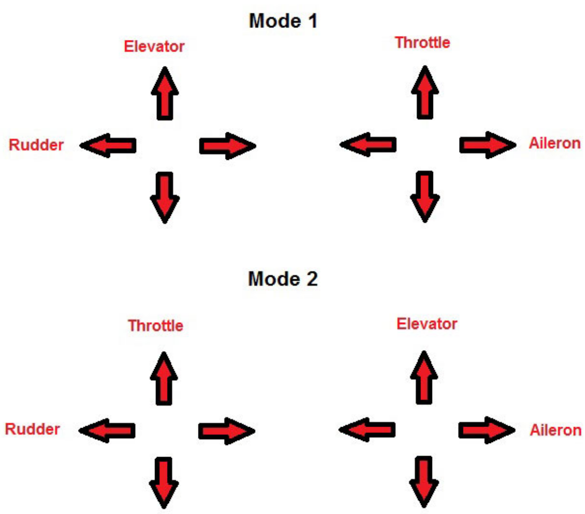
Mode 4: Left stick controls *aileron* and throttle. Right stick controls *elevator* and *rudder*.

Most *transmitters* are sold as either *Mode 1* or *Mode 2*. Mode 3 and 4 are rare but available.

It basically comes down to what you begin to learn on. This might be based on the mode your instructor uses. Either mode is ok but you should keep with whatever mode you choose, so your reactions become quick memory responses.

Aerobatic pilots often prefer *Mode 1*, as stick movement of *ailerons* doesn't mix with another *control surface*, i.e., *rudder* or *elevator*. This allows for more precise control during maneuvers that demand inputs from various *control surfaces*.

Pilots used to game consoles often prefer *Mode 2*, as the stick movements have a closer relationship to a game controller.



Stick movement for Mode 1 and 2

Using the sticks

Using the sticks is all about your preference for thumbs or fingers. Many people are comfortable using their thumbs, resting on the tops of the sticks to move them. Others, feel they have better control by holding the sticks using the thumb and index finger. The latter option requires the radio to be supported either by a neck strap or a support platform.

The choice is up to you and either way is ok. As a comment though, when I went for my bronze wings, I was so nervous that my thumbs were shaking. You can imagine what that translated to in my control of the plane. I suspect that using thumb and index fingers to hold the sticks as opposed to thumb pressure on the tops of the sticks may have been less of a problem at the time.

Using trim

The first time you fly your plane, you may need to apply trim to one of more of the *control surfaces*. Ideally you want to get the plane up high enough to recover if the plane decides to move erratically towards the ground. Next, fly a straight line either into wind or with wind, to rule out any influence of the wind (great if you can do this on a calm day). Watch the plane to see if it wants to roll in a particular direction. If so, apply *aileron* trim in the opposite direction to counteract the *roll*. Also note if the plane tends to climb or descend. Apply up or down *elevator* trim to counteract that behaviour. After a successful trim, the plane should keep straight and level with no pressure on the sticks (hands off). Trim buttons are located near the sticks and trimming is made in the direction of stick movement.

Important: It is a good practice to adjust your *control surfaces* once the plane is back on the bench, so that the radio trims can be returned to neutral.

Range check and aerials

Most computer radio *transmitters* have a built in function to perform range checks with your model. This is to ensure that from about thirty metres, you can still communicate with the model to move all *control surfaces* smoothly and effectively using a reduced signal strength that is part of the range check functionality.

Refer to the radio's manual for details on using the range check function.

In addition, refer to the radio's manual to ensure:

- the aerial is oriented correctly before flight. Some more modern sets have a fixed aerial that doesn't move; and
- the aerial of the *receiver* is oriented correctly. If a satellite unit is included, it must be oriented ninety degrees to the main unit's aerial. Refer to the *receiver*'s manual for details. Aerials should be clear of any object that might cause interference or obstruct the radio signal.

Safety Tip: Range check every model, every day.

Binding and failsafe

Note: Check your transmitter instructions for details as this is a critical step. If you are still unsure, check with an Instructor or your supplier.

Binding: For your radio *transmitter* (2.4GHz only), you need to *bind* it to the *receiver* in your plane, to ensure they communicate.
Example – Spektrum radio: inserting a "*bind*" plug into the "*bind*" channel on the *receiver* (with the *receiver* off), turn on the *receiver* in the plane (it will usually flash), then hold down the "*bind*" switch/button on the radio *transmitter* while turning on the radio. The LED in the *receiver* will stop flashing and you will get an indication on the radio that it is bound to the *receiver*. If you need to reverse channels, e.g., throttle goes the wrong way, it is important to rebind once reversing the channels. This is to support *failsafe* mode in the event that the transmitter/receiver link is interrupted.

Failsafe: If your *transmitter* stops talking to the *receiver*, i.e., the link is lost, the *servos* connected to the *receiver* are set to the position when they were bound. Ideally you want the plane to return to idle, so that it will descend along with a slight turn and will stay in the area. This is so it doesn't fly away and be difficult to recover. Not to mention the safety to people and property.

Example Spektrum: move the *control surfaces* to the desired position during the *bind* process. If the *transmitter/receiver* is interrupted, the *servos* will return to those positions.

Example Futaba: set the fail safe positions on the transmitter. If the transmitter/receiver link is interrupted, the servos will either hold their last position or go to the pre-programmed positions.

The effect of exponential

Exponential is the ability to soften the effect of stick movement, so inputs are initially not as strong. Control response is milder below half stick but quickly catches up as the stick moves through its range. This can be useful for learners so that their inputs are smoother than if no exponential was applied.

Exponential can be added to *aileron*, *rudder* and *elevator* movements.

Refer to your radio's manual to determine the process for applying exponential to your *control surfaces*.

Dual rates

Dual rates allow you to setup two profiles of movement of a *control surface*, such as *elevator*, *rudder* or *aileron*. The extent of movement is assigned to a dual rate switch which can exist for each control surface. The plane can utilise either profile even during flight by flicking the switch to either position.

A student pilot might restrict the movement of *control surfaces* like *elevator* and *aileron* using *dual rates* and as they become more proficient, utilise the full extent of *control surface* deflection simply by using the *dual rates* switch.

Take care to know what you have set up.

Refer to your radio's manual to determine the process for setting *dual rates*.

The effect of differential

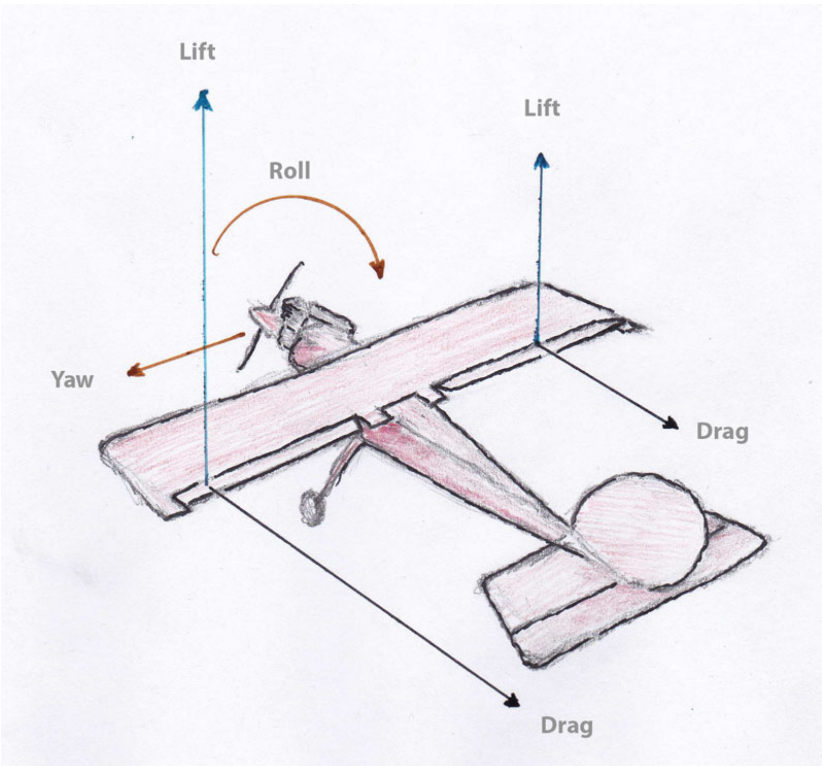
The purpose of using differential is the ability to move the *ailerons* more in one direction than the other, i.e., more upward movement.

The purpose for this is to rectify *adverse yaw* during turns. *Adverse yaw* occurs because a downward deflected *aileron* (*i.e.* the *aileron* on the outer wing during the turn) causes more *drag* than the upward deflected *aileron*, and this *drag* tries to pull the airplane in the opposite direction of the turn. For example, if the plane is in a banked turn to the right, there's increased *drag* on the left hand wing (because of the down *aileron*) and this causes an unwanted *yaw* to the left, even though the plane is turning to the right. Reducing the downward extent of the aileron reduces this drag.

The more appropriate response to this is to apply a small amount of *rudder* in the direction of the turn, which assists the nose to follow the turn. This type of turn is called a coordinated turn. In real world airplanes, a “turn indicator” gauge allows the pilot to determine the amount of *rudder* deflection is needed to keep the turn coordinated. With R/C flying, you need to guess and observe the aircraft in the turn.

In addition to using *aileron* and *rudder*, you need to remember to add some up *elevator*, to compensate for the reduced *lift* that a turn produces.

Refer to your radio manual for details of how to apply differential.



Plane turning to the right with a yaw to the left

Timing your flights

A full tank of fuel typically lasts around ten minutes. Most *lipos* also last around seven to ten minutes of flying time. Often you can squeeze additional time at the risk of a *dead stick*, which isn't desirable and totally exhausting a *lipo* battery isn't a good practice either.

Therefore, it is a good idea to time your flights. You might use a timer, e.g., most smart phones have timers as pre-installed apps. You could also make use of the timer that is available on most computer radios. Refer to the manual for the radio for instructions on using and setting the timer. Some timers are started by pressing a button or by flicking a switch, while some radios will automatically start the timer once a percentage of the throttle is used.

Get into the habit of setting your timer once you have started the engine, so you lessen the possibility of having to land the plane without power.

Buddy box configuration

A popular technique that has been around for a while now is to use a *buddy box* system. This allows the student flyer to develop confidence with flying, with the knowledge that the instructor is there to take control if they get into trouble.

What is a buddy box?
Two radio *transmitters* tethered together, i.e., master and slave. Some newer radios use a wireless method of linking the transmitters. The student uses the slave to fly and the instructor can instantly take control via the master if required.

Buddy Box configuration – Master and Slave radio.

Most computer radios support *buddy box* pairing. Refer to the manual for details. One of the benefits is that you can pair *mode1* and *mode 2*, allowing an instructor that uses *mode 2* to manage a student learning on *mode 1* (or vise versa).

HIGHLY RECOMMENDED as a teaching aid.

R/C simulators

Taking your first model out to the park or flying field and hoping for the best usually ended up in tears. These days you can purchase a simulator to run on your home computer, connect your radio (or one supplied with the simulator) and fly any number of aircraft types without having to worry about flights that end in disaster.

There are a number of simulators available. Some are free while others can cost up to three hundred and sixty dollars.

Two standout simulators are “Phoenix” flight simulator and Great Planes “Real Flight” simulator.

Real Flight comes with a handset that is only designed to work with the simulation software, although you can connect your radio to it via a supplied cable. You can purchase a wireless version that will work with an *SLT* (secure link technology) wireless compatible radio. A six channel tactic TTX610 radio is offered if required.

Phoenix is sold software only, so you can connect your own radio, or it can be purchased with a *four channel* DX4e or six channel DX6i radio that you can use with your models at the flying field.

Simulators are recommended for learning to use the sticks and developing quick responses to recovery situations. *Mode 1* and *Mode 2* are available depending on your preferences. The simulator develops your reactions and provides the confidence to fly with skills learned on the simulator. This reduces the instance of crashes occurring as a result of inexperience.
TIP: remember to practice flying – not crashing.

HIGHLY RECOMMENDED as a teaching aid.

Real Flight 6.0 with Interlink Controller

Checks to perform

Prior to sending your aircraft skyward, it is critical that some checks are followed to ensure the flight doesn't end in tears.

Below are some typical areas that need to be considered:

Before going to the airfield

Fuselage
☑ Check *servos* mounted securely and all *servo* arms secure.
☑ Check all pushrods secured to *servos*.
☑ Check that the *receiver*, battery and all connections are secure.
☑ Check that *receiver battery* is charged (*IC engine*).
☑ Check that *lipo* battery is charged (electric motor).

Wing
☑ Check for breaks, cracks, loose covering, etc.
☑ Check linkages to *ailerons*, i.e., hinges and *servo* linkages, clevises etc.
☑ Check linkages to flaps (if applicable), i.e., hinges and *servo* linkages, clevises etc.
☑ Check throws for *ailerons* are correct and *ailerons* operate as expected, i.e., roll left – right *aileron* goes down left *aileron* goes up.

Tail
☑ Check linkages to *rudder* and *elevator*, i.e., hinges and *servo* linkages, clevises etc.
☑ Check operation of *rudder* and *elevator* are as expected.

Undercarriage
☑ Check main wheels are secure and turn freely. Ensure spats if fitted are secure.
☑ Check *tail wheel* (if equipped) is secure, straight and turns as expected.
☑ Check *nose wheel* (if equipped) is secure, straight and turns as expected.
☑ Check that undercarriage is secured to *fuselage*.

Engine
☑ Check to ensure engine is mounted securely.
☑ Check that muffler (*IC engine*) is mounted securely.
☑ Check prop for nicks and other damage.
☑ Check prop and spinner (if applicable) is secured.
☑ Check the cowl (if fitted) is secured.
☑ Check linkages to throttle (*IC engine*) are secure.
☑ Check operation of the throttle is correct and that any cut-off (if configured) is operating correctly.
☑ Check the *ESC* (electronic speed controller) is secured and all connections are secure.

Radio
☑ Check that radio is fully charged.
☑ Check that your radio is bound to support *failsafe* if communication is lost.
☑ Check that any special settings such as exponential etc., are appropriate for the model and type of flying you are performing.

Balance
☑ Check the *centre of gravity* is correct for the plane (if not already confirmed). This must be done with an empty tank (*IC Engine*) or with the *lipo* battery installed (electric motor).
☑ Check the balance of the prop (if not already confirmed).

Field Equipment
☑ Check that field box battery (if applicable) is fully charged.
☑ Check that *glow plug* starter (if applicable) is fully charged.
☑ Check you have fuel pump, *chicken stick*, *glow plug* starter, *electric starter* (as required).
☑ Check that there is sufficient fuel for the day.
☑ Check you have all necessary tools or spares.
☑ Check you have stays or restraints for plane,
☑ Check you have spare batteries and a charger (electric motors).

Other Considerations
☑ Check you have sufficient food and water for the day.
☑ Check you have a hat, sunscreen, sunglasses and suitable clothing for the weather conditions.
☑ Check that the plane is sufficiently protected from damage when transporting to and from the airfield.

At the airfield

☑ Check connections for *ailerons* and flaps (if applicable) are secure, when assembling the aircraft.
☑ Check that wing bolts are secure, when fitting the wing to the *fuselage* or if elastic bands are used, ensure there are sufficient (usually six) and they aren't perished.
☑ Check that wing struts (if fitted) are secure.
☑ Check that no one else is flying with the same *frequency* as your radio, if you are flying with a *frequency* other than 2.4Ghz.
☑ Check that a peg has been placed on the board for the *frequency* you are flying, if you use a radio other than 2.4Ghz.
☑ Check that the correct aircraft is selected in the radio.
☑ Check that all *control surfaces*, i.e., *rudder*, *elevator*, *ailerons* and flaps (if applicable) are working in the correct manner and direction.
☑ Check the communications between the transmitter (radio) and the *receiver* (in the plane) with a range check. Remember, every model every day.
☑ Check that the fuel tank is full prior to flight (IC engines).
☑ Check that the plane is restrained prior to starting the engine. Note: in the event of an electric motor, the engine must not be armed until it is moved to the runway.

☑ Check that it is safe before starting the engine.
☑ Check the performance of the engine through the throttle range. Hold engine nose up to determine if it cuts out.
☑ Check the direction of the wind to take off into wind.
☑ Check with all pilots currently flying, that it is safe to enter or place the aircraft on the runway.
☑ Check that you communicate effectively to all pilots currently flying about any specific maneuvers you intend to perform, announce landing intentions and announce once clear of the field.
☑ Check that the peg is removed from the board once you have completed your flight and your radio is stored in the pound (only for radios using frequencies other then 2.4Ghz.

Note: a useful post flight check would be to check your model for any damage as a result of the day's flying.

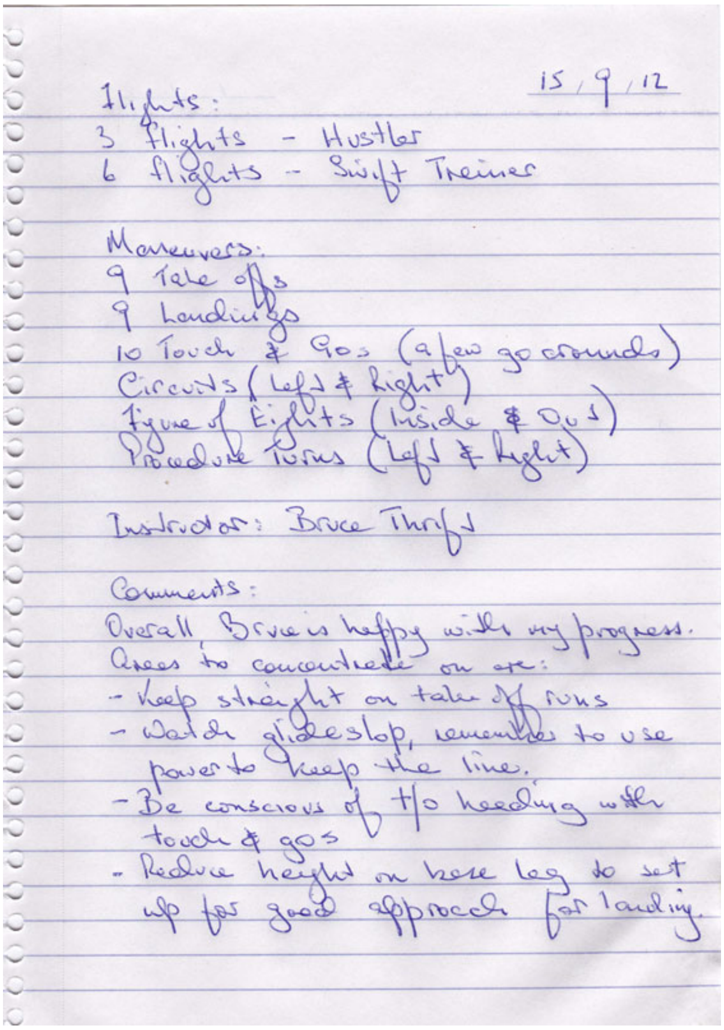
Using a logbook to review your flights

Once you are an *MAAA* member, you can receive a Trainee Pilot Log Book for Fixed Wing Power Aircraft. This logbook is designed to be used in conjunction with a pilot training program.

It allows your progress to be recorded as you work through the requirements of your Bronze/Silver wings endorsement. However, I personally feel there is insufficient room to record sufficient detail around what was covered in the day's training along with comments from your instructor about your efforts and where you need to improve etc. Therefore, I suggest a small notebook with ruled lines that allow you to record each day's training in sufficient detail for later review.

Some pilots keep a record of each flight they perform with specific planes and engines, as a record of the flying history of the equipment. Details may be kept when plugs are changed etc.

Below is a page out of my logbook that clearly shows the sort of detail that proves useful for ongoing improvement.



15/9/12

Flights:
3 Flights - Hustler
6 Flights - Swift Trainer

Maneuvers:
9 Take offs
9 Landings
10 Touch & Gos (a few go arounds)
Circuits (Left & Right)
Figure of Eights (Inside & Out)
Procedure Turns (Left & Right)

Instructor: Bruce Thrift

Comments:
Overall, Bruce is happy with my progress.
Areas to concentrate on are:
- Keep straight on take off runs
- Watch glideslop, remember to use power to keep the line.
- Be conscious of t/o heading with touch & gos
- Reduce height on base leg to set up for good approach for landing.

The maneuvers in detail

The following maneuvers are required for an accreditation for bronze/silver wings. The maneuvers aren't difficult to perform and with some practice, you will be wearing those wings with pride in no time.

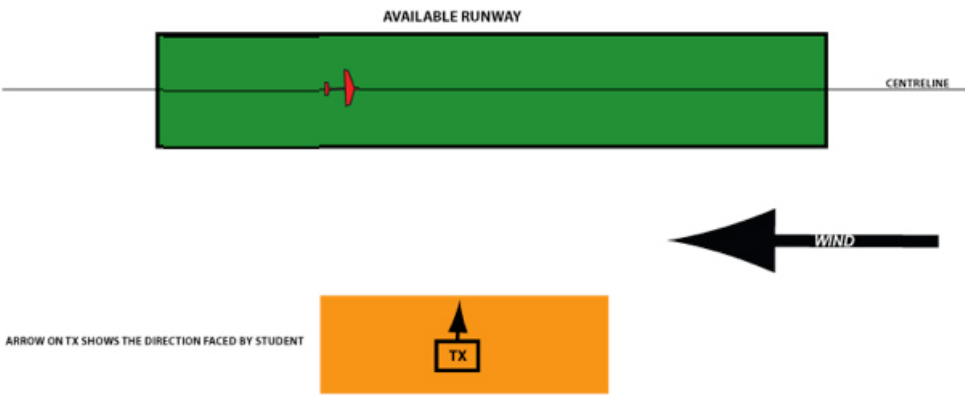
Let's look at each of the maneuvers in turn.

Takeoff

Takeoff: The pilot demonstrates gradual application of power while keeping the aircraft straight and using a little elevator to lift off, makes a gentle climb out with wings level until safe altitude is reached.

Your flights will begin with a takeoff but while you are learning, the takeoff will be delayed until you were comfortable controlling the plane in the air.

The takeoff can be performed safely from the pilot box at all times. Developing the skill of accurate straight taxiing is a pre-requisite for straight take offs.



TAKEOFF PRACTICE

The aim of a successful takeoff is to show a gradual application of power in the takeoff run (into wind), using the rudder to keep straight and using a little *elevator* to lift off (or *rotate*), make a gentle climb with wings level, maintaining runway direction until a safe altitude is reached for your turn onto cross wind. Always turn away from the pilot's box.

Tips:

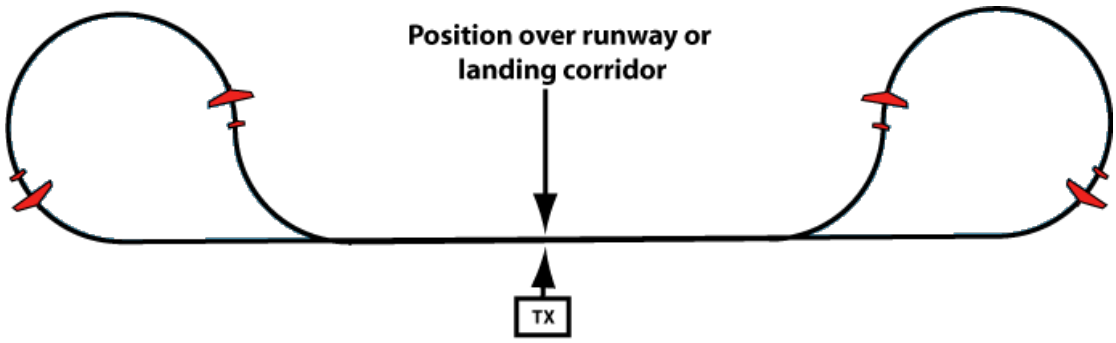
- don't apply too much power at once, which can cause the plane to act un-expectantly. You may need to add some right *rudder* to allow for the torque of the *propeller* (some aircraft offset the engine to allow for this);
- don't pull too much *elevator* into the climb, as this not only produces an unrealistic climb but also exposes the plane to an early *stall* if the *angle of attack* is too steep to keep the wings flying. Wait until you are at a safe height before turning onto cross wind;
- 30 degrees is a good climb angle and
- don't turn onto cross wind too steeply, as steep turns close to the ground can end up in a stall if the *airspeed* is low.

Procedure turn

Procedure turns (one in each direction): The pilot's ability to perform the procedure turn using the following criteria will be assessed:
- level flight segments should be straight and level;
- aircraft should pass directly over the landing area.;
- turns should be at a constant altitude.; and
- turns should be completed in order that upwind and downwind tracks are superimposed.

The procedure turn is a very important maneuver for changing the direction of the circuit so that maneuvers can be conducted from different directions, fitting in with existing traffic at the field or preparation for landing that supports the wind direction.

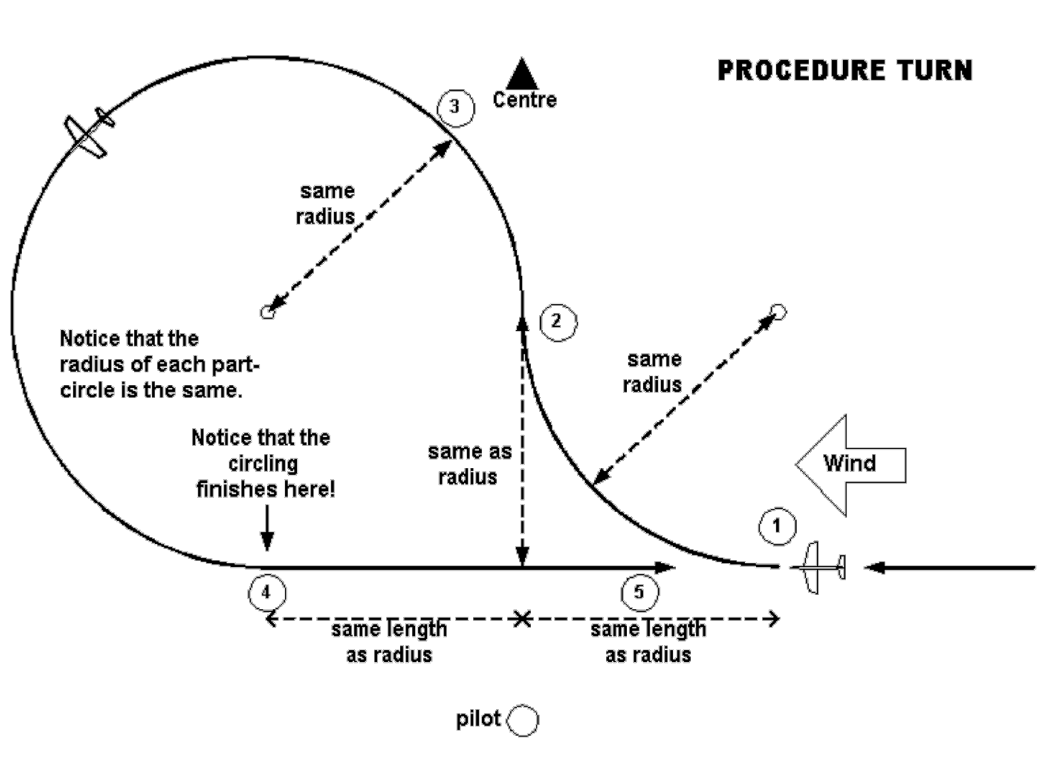
For the bronze or silver wings endorsement, you need to perform the maneuver in both directions.



PROCEDURE TURNS

To fly a procedure turn, proceed as follows:
1. over fly the runway;
2. fly past yourself towards the end of the runway;
3. before the runway threshold, turn away with an arc that points the direction of the plane 90deg from the runway; and
4. *roll* the wings level and immediately begin a gradual turn that will bring the plane through 270 degrees and back down the runway in the opposite direction from the start of the procedure turn (see above diagram).

The procedure turn can be done in either direction, to change the circuit direction or the direction for performing maneuvers.



The procedure turn can be done at either end of the runway to allow a change of circuit direction. The above illustration shows a competition version, where the turn is centered on the pilot's position as opposed to the runway thresholds.

Procedure turns prepare the pilot for approaches and landings.

Tips:
When you fly towards yourself, some of the controls for the rudder and ailerons appear reversed from the pilot's perspective. While you are getting used to this situation, move the stick towards the wing that is down, to level the wings.

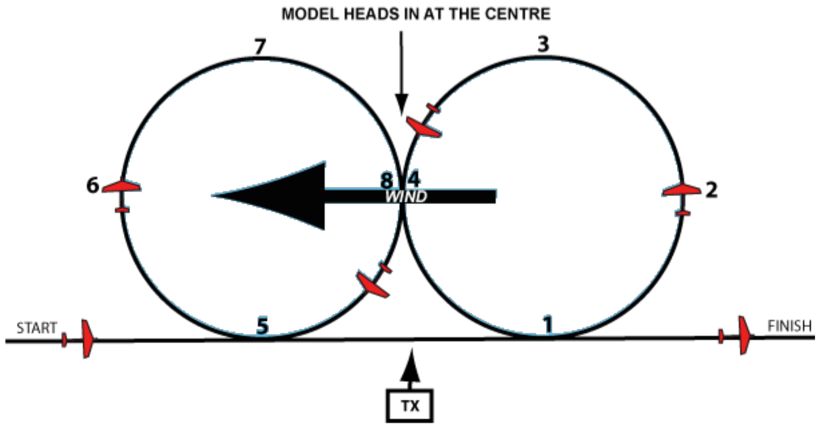
Figure eight

Figure eight: Pilot to demonstrate either an inward or outward figure eight, as shown in the diagram in the MAAA Trainee Pilot Log Book. This is a flat eight circuit without loss of height and the change of turn occurs directly in front of the pilot.

The figure eight maneuver comes in two forms:
- inward; and
- outward

For the bronze or silver wings endorsement, you only need to perform one of the above maneuvers in one direction only.

Inward figure eight
Of the two maneuvers, the inward figure eight is more difficult. This is because you need to gauge your distances well for the circular tracks and fly towards yourself as you complete each of the circles.



INWARD FIGURE EIGHT

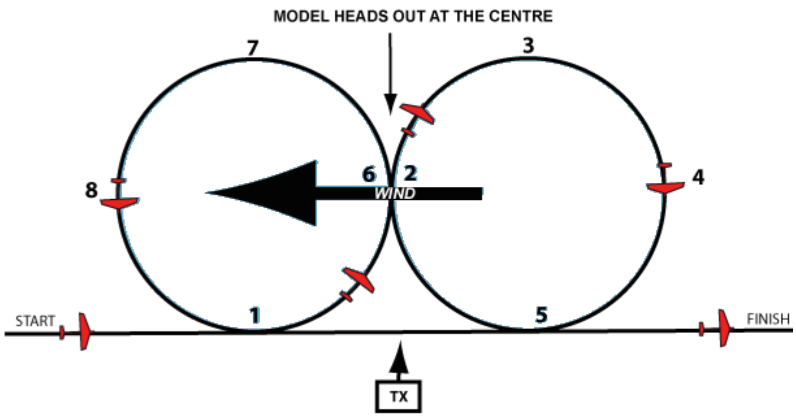
To fly the inward figure eight maneuver, proceed as follows:

1. fly the approach over the runway centre line and after passing the pilot's position (TX above) begin your turn through 90 degrees away from the runway direction;
2. continue the arc of the first circle until you are now pointing in the opposite direction from the runway;
3. continue the arc of the first circle so that you are pointing directly at the pilot's position;
4. level the wings and begin the opposite direction bank to commence the arc of the second circle, so you are positioned over the runway facing the opposite direction to your approach at the start of the maneuver;
5. continue your turn through 90 degrees away from the runway direction;

6. continue the arc of the second circle until you are now pointing in the opposite direction from the runway;
7. continue the arc of the second circle so that you are pointing directly at the pilot's position; and
8. level the wings and begin the opposite direction bank to commence the arc for the exit of the maneuver, so you are positioned over the runway and fly along the runway centre line to complete the maneuver.

Outward figure eight

The outward figure eight maneuver is a little easier, as you are flying away from yourself for each of the arcs of the circle.



To fly the outward figure eight maneuver, proceed as follows:

1. fly the approach over the runway centre line and begin your turn through 90 degrees away from the runway direction so that the plane is positioned in front of the pilot's position (TX above). You should be looking directly at the tail of the plane. This is the first circle crossover point;
2. level the wings and begin the opposite direction bank to commence the arc of the first circle, so you are facing the same direction to your approach at the start of the maneuver;
3. continue the arc of the first circle so that you are pointing directly at the runway;
4. continue your turn through 90 degrees so that you are over the runway and facing the opposite direction from the approach for the maneuver;
5. complete the arc of the first circle until you are now pointing away from the pilot's position identical to the start of the first circle crossover point;
6. continue the arc of the second circle so that you are pointing in the opposite runway direction from the approach to the maneuver;
7. continue the arc of the second circle so that you are pointing at the runway;
8. complete the arc of the second circle so that you are pointing in the same runway direction from the approach to the maneuver; and

9. level the wings and fly along the runway centre line to complete the maneuver.

Tips for performing inward and outward figure eights:

- try to keep both circles the same size;
- you may need to allow for wind strength when determining circle size;
- the crossover should be immediately in front of the pilot, plane nose pointing away from pilot for outward figure eights or towards pilot for inward figure eights;
- the crossover point should be the same for both circles; and
- these maneuvers are two circles joined together. Not an X crossover in the centre.

Simulated dead stick landing

Simulated dead stick landing: At a safe and high position, the pilot will reduce the throttle to idle and perform a descending circuit to show their ability to safely glide the model without power to a position where a landing approach can be executed.

There are a number of issues that can demand a non-powered glide back to the runway (or any suitable surface as available). *IC engines* can run out of fuel, or simply stop for some reason to do with the fuel mixture. Electric motors can stop due to battery consumption.

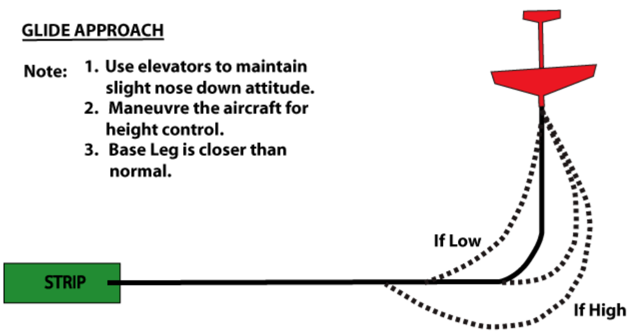
It is important to be able to act quickly and safely in these situations, as they will invariably occur when not expected.

When asked to perform the maneuver for your bronze or silver wings, the examiner will get you to position the plane at a high enough position to perform a glide approach.

To fly the simulated *dead stick* landing, proceed as follows:

1. reduce power to idle to simulate the cut in power;
2. immediately lower the nose to keep sufficient *airspeed* and avoid a *stall*;
3. determine your position, the direction of wind, aim to land into wind and plan your descent so that you can glide back onto the runway;
4. gentle turns will avoid a large loss of height. Only lower the nose sufficiently to maintain the glide. Dives will build up speed and reduce the glide distance;
5. if still too high near approach, extend your base leg and do some gentle snake turns to extend the approach while you loose height; and
6. if low head directly for the field and land where possible.

Tip:
Your instructor will suggest you go around by applying power once he is satisfied that you would have made it in. For *IC engines*, gradually apply power, so the engine doesn't quit if you apply too much fuel after the engine has been idling for a while during the descent.



GLIDE APPROACH

Landing circuits

> **Landing circuits**: Pilot to demonstrate in both directions, as shown in the diagram in the MAAA Trainee Pilot Log Book, with all turns of 90 degrees. With high performance aircraft, the power needs to be reduced much sooner than at the turn onto base leg. The upwind and downwind legs are parallel to the landing strip. The first three legs are maintained at a constant height and a gradual approach angle is started at the beginning of the base leg.

Landing circuits as the name implies, are all about setting up for a landing approach. Circuits can be left or right. Circuits have 5 possible legs:

- upwind;
- crosswind;
- downwind;
- base; and
- final

Upwind: Overflying the runway into wind is referred as the upwind leg.

Crosswind: Turning 90 degrees from the runway direction from the upwind leg is referred to as the *crosswind* leg.

Downwind: Turning 90 degrees from the *crosswind*, i.e., parallel to the runway and in the same direction as the wind, is referred to as the downwind leg.

Base: Turning 90 degrees from the downwind leg roughly 45 deg from the runway threshold is referred as the base leg. If landing, height is reduced during this leg. If no landing is planned, the same altitude is flown as from downwind.

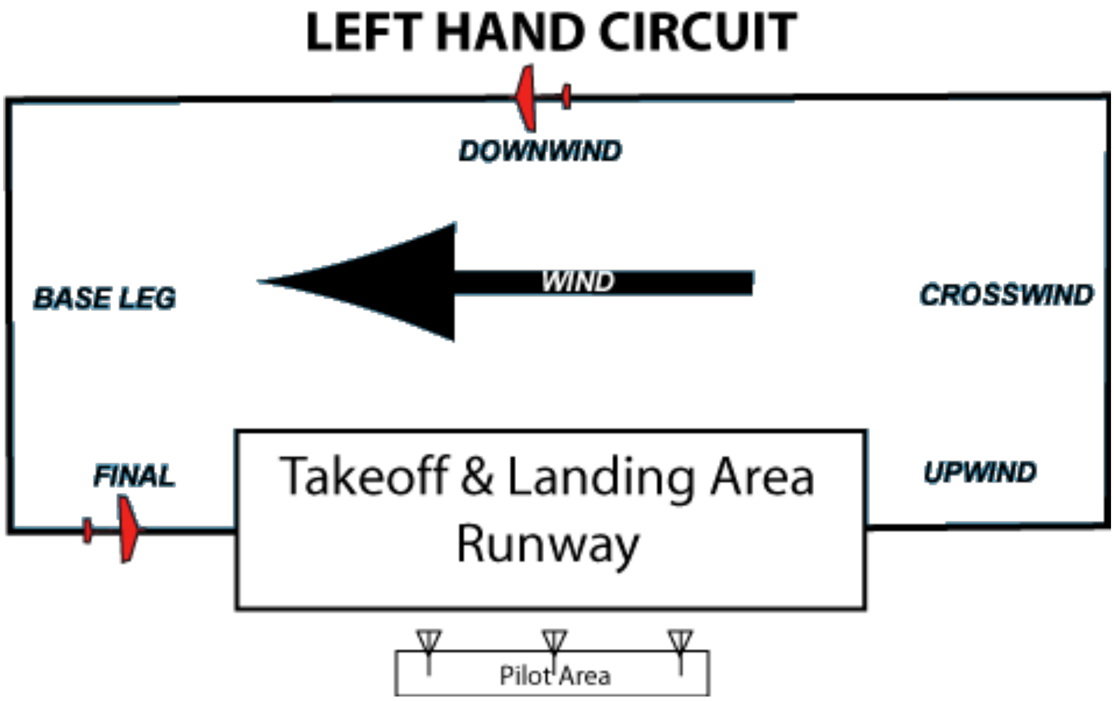
Final: Turning 90 degrees from the base leg, to line up with the runway centre line, with a continued descent that suits the glide path for a landing on the runway (into wind) is referred as the final leg. If no landing is planned, the same altitude is flown from the base leg and this leg is referred to as the upwind leg. Another possibility on this leg is that an attempt at landing had failed and the decision to go around was made. This would become the upwind leg for this action, once the decision to go around was made.
As discussed earlier, the circuit direction can be either left or right. To change circuit direction, perform a procedure turn while overflying the runway in the direction of the new circuit.

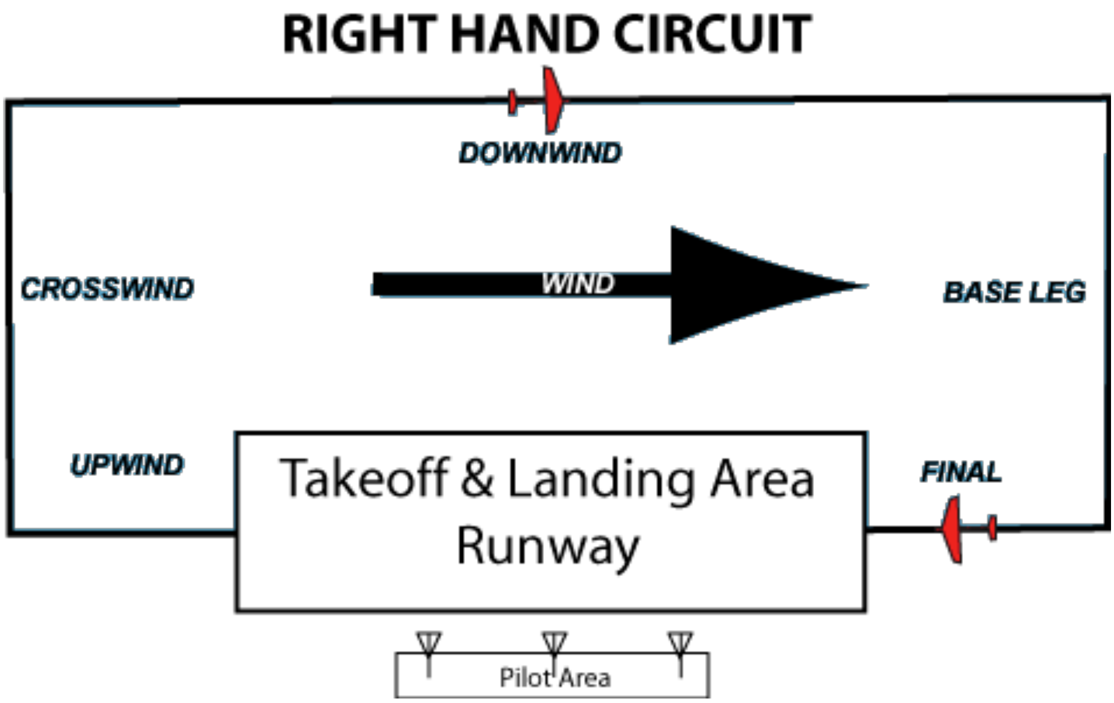
Tips:

- ensure you square off on each of the legs, i.e., 90 deg turns;
- ensure the downwind and upwind legs are parallel to the runway;
- ensure you maintain the same height throughout the legs (where required);

- ensure the upwind and final (if landing) is lined up with the runway centre line; and
- try to keep the *crosswind* and base legs equal.

Examples of left and right hand circuits.



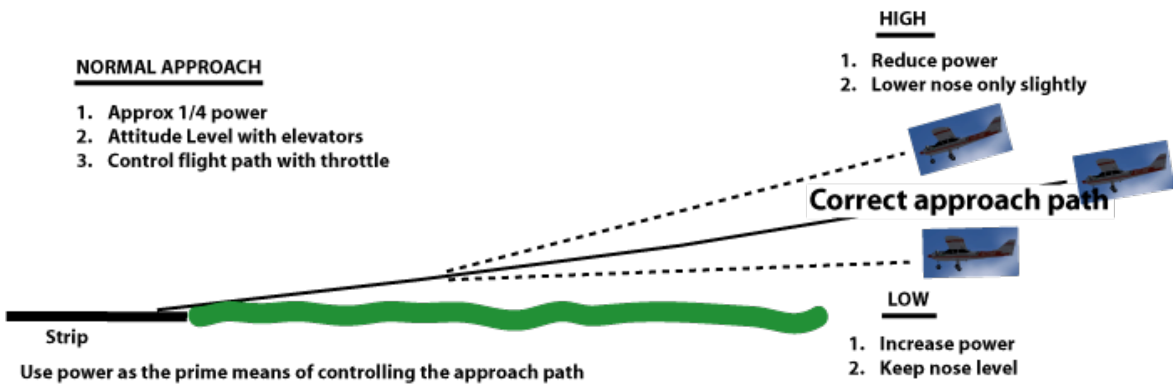


Approach and landing

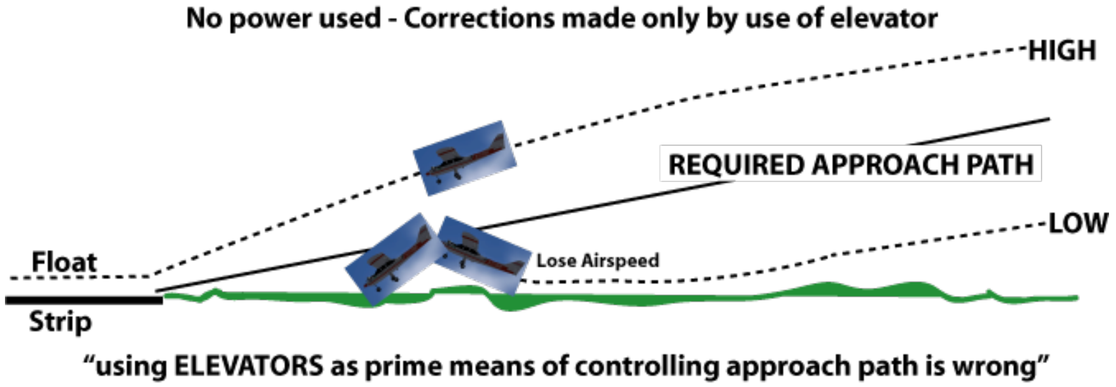
Approach and landing: Pilot demonstrates and engine assisted landing, using a suitable power setting that allows the model to descend, controlling nose attitude with *elevators* (*airspeed*), and using the throttle to stabilise the rate of descent. The aircraft should be flown over the threshold at an altitude of about 1.5 metres, the throttle closed gradually, and the round-out or flare initiated. The "hold-off" period is then commenced where the aircraft is gradually allowed to sink and settle on the ground in a slightly nose high attitude.

A good landing is supported by a good approach.

Approach: The approach involves slowing the plane down on the downwind leg, reducing height with *elevators* to manage *airspeed* and throttle to manage descent on the base leg, turning at the correct point to line up on the runway centre line for the final leg and continuing the approach assisted by power to maintain the glideslope to the touchdown point on the runway.

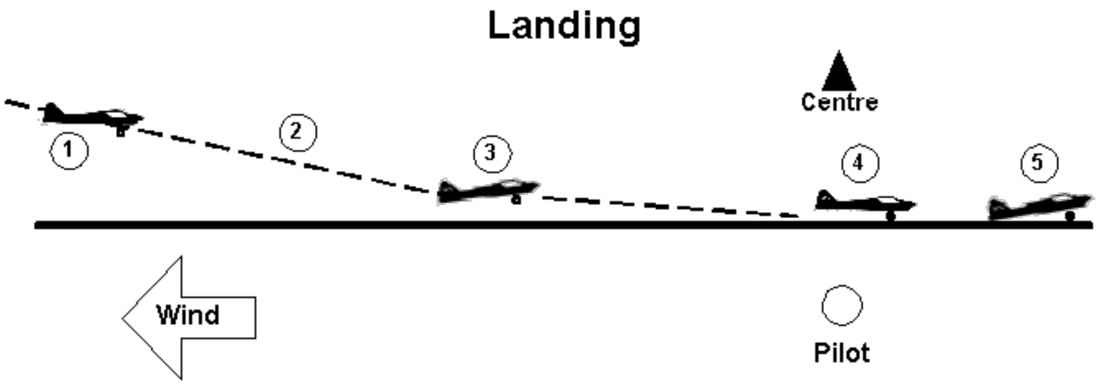


NORMAL APPROACH



ELEVATOR APPROACH

Landing: Once you near the ground, level off and *flare* (slight nose up *attitude*), to further slow the plane down and *stall* the main wheels onto the runway. Avoid touching down with *nose wheel* or *tail wheels* first, as they are usually more susceptible to damage.



Once the plane has settled on the runway, allow it to continue along the runway until it comes to a stop. Keep the track straight using the *rudder*.

Tips:
- always land into wind, to maintain *airspeed* but reduce the ground speed for landing;
- a good landing is usually assisted by a good approach. Ensure you perform at least a downwind and base leg prior to an approach to land. This allows you to plan your approach and manage your height and speed;
- remember to manage your approach descent with *elevator* and throttle. Use the throttle to maintain your approach angle to the runway. Don’t simply use *elevator*;
- always remember to *flare* when close to the ground and touch down on the main gear first; and
- maintain a straight roll out until the plane comes to a complete stop.

Taking the assessment

The following are some tips to prepare you for your flight test:

- leading up to the assessment, practice with the plane you intend to fly for the test. Don't keep swapping between planes as they all have different flight characteristics;
- leading up to the assessment, practice the assessment maneuvers. Each flight, focus on a particular maneuver that you wish to perfect, until you can run through all the maneuvers in a flight;
- if you are uncertain of your readiness or you wish to ensure you are performing the maneuvers correctly, get the assessor to observe your maneuvers;
  Note: the assessors aren't looking for perfection. They are looking for the ability to control the plane by completing the maneuvers and flying safely in a busy club environment;
- book the assessment in advance, to avoid disappointment. Suggest that the assessment be conducted only if the weather is favorable. This is to reduce the stress of flying in difficult circumstances;
- complete the paperwork for the assessor to tick off the requirements and sign off if you are successful;
- fly before the assessment to get comfortable with the plane and your sticks on the day;
- study the rules of the club along with safety requirements etc;
- take the time to review the operation of your radio and some of its primary functions. You may be asked about its operation;
- take your time responding with the theory. Think about your answers;
- be organized. Organize your field equipment for use. The assessor will favorably view this;
- remember to be SAFE throughout your assessment. Be mindful of care around props, arming batteries, restraining aircraft and communication with other flyers; and
- relax and enjoy the experience. It isn't rocket science and if you are prepared you will probably be presented with a new set of wings to wear proudly.

Good luck and safe flying.

Glossary of terms

40 size engine
An engine that has a swept capacity of 0.4 cubic inches (about 6.5 cubic centimetres). Common model aircraft engines range in size from about 0.1 cubic inches to about 1.0 cubic inches; the most popular size for beginners being engines in the range 0.4 to 0.46 cubic inches. There are bigger and smaller engines but they are less common

Adverse yaw
During a turn, if no *rudder* is used, *drag* from the downward *aileron* on the outside wing pulls the nose in the opposite direction of the turn.

Aerofoil
The cross section shape of the wings, designed to provide *lift*.

Aileron
Movable *control surfaces* on the wings of an aircraft that cause it to roll about its axis along the *fuselage*.

Airspeed
The speed of the wind directly hitting the plane (not to be confused with Ground Speed, which is the speed passing over the ground.

Angle of attack
The angle of the chord line of the wing, relative to the airflow over the wing.

ARF
Almost **R**eady to **F**ly – indicates that some building although mainly assembly of built parts with the need to install engine, radio gear etc.

Attitude
The position of the nose of the aircraft relative to the horizon, i.e., up or down.

Binding
The process (for 2.4Ghz only) to establish communication between the *transmitter* (*TX*) and the *receiver* (*RX*). This usually only needs to be done once, after which the plane can be selected on the radio and the connection is established.

BNF/BiNd and **F**ly – indicates the plane simply needs to be bound to your radio and it is ready to fly.

Buddy box
Two radio transmitters tethered together or linked wirelessly, i.e., Master and Slave. The student uses the slave to fly and the Instructor can instantly take control via the Master if required.

CASA
Civil Aviation Safety Authority (*CASA*) is an independent statutory authority, which has the primary function of regulating safety for civil air operations in Australia and Australian aircraft overseas.

Centre of gravity
This is the point of balance nose to tail, where the plane should be balanced. Out of balance planes can be uncontrollable, hence this is a critical consideration with any plane.

Chicken stick
This is a stick that is used to turn over the prop because you are too chicken to use your hand. Highly recommended that you use the *chicken stick* as opposed to starting by hand.

Control reversal
A phenomena you experience when controlling an aircraft from the ground. Your R/C system is set up to cause the aircraft to behave the way you would expect if you were sitting in it or observing it from behind but if the aircraft is coming towards you, it will appear to react opposite to your *aileron* or *rudder* control inputs.
Control surface
These are the movable parts of the wing and tail components, that assist with the direction and speed of flight.
Crosswind
This refers to the direction of the wind relative to the direction of the runway. Any wind that isn't straight up and down the runway is said to have a *crosswind* component.
Dead stick
This is what we call a plane that has lost all engine power and needs to land immediately.
Dihedral
Dihedral is the upward angle from horizontal of the wings or tailplane of a fixed wing aircraft. A trainer with *dihedral* wings is more stable than one without *dihedral*.
Drag
Drag is the opposing force to *thrust*. It can occur due to objects that the airflow hits, e.g., aerials or non streamline shapes on the airplane. It can be influenced by the deflection of *control surfaces*. It can also be present through normal flight.
Dual rates
Dual rates support two settings on your radio that dictate the range of movement of *control surfaces*. One rate might have modest movement, where the other rate might support full deflection.
Electric starter
This is a battery-powered device for turning over the prop. Recommended over the *chicken stick* and for larger engines.
Elevator
A movable horizontal surface, usually at the tail of the aircraft, that causes the aircraft to *pitch* up and down.
EP
Electric Power, i.e., a plane powered by an electronic motor as opposed to an *IC engine*.
ESC
Electronic Speed Controller for an electric motor manages the speed of the motor.
Failsafe
This is the mode the *receiver* goes into if communication fails with the *transmitter*. It is the state of *control surfaces* and throttle at the time the *receiver* was bound to the *transmitter*. The purpose of *failsafe* is to bring the plane down as safely as possible (free flight) if communication is lost.
Flare
Flare is the nose high transition that is made close to the ground, to slow the plane down and *stall* it onto the runway – main gear first.

Four channel
Normally *four channels* are required to control a *Four Function* aircraft.
Four function
A model aircraft that uses all four *primary controls* (*ailerons*, *elevator*, *rudder* & throttle).
Frequency
Frequencies used for *R/C* flight can be megahertz or gigahertz based. The megahertz frequencies, e.g., 27 Mhz require a crystal that supports only one plane that can fly on a given channel, where the gigahertz, e.g., 2.4 Ghz frequencies allow several planes to fly without any interference.
Fuselage
The body of the aircraft. That is: Excluding wings and tail.
Glow plug
This is the plug (like a spark plug) that sits in the top of the cylinder and is activated by a battery powered glow starter, which causes the filament in the *glow plug* to ignite the fuel.
Groundspeed
This is the speed the plane flies in relation to the ground.
High wing
An arrangement where the wings of the aircraft are mounted on top of the *fuselage*. This arrangement offers the most natural stability which is a desirable characteristic of a beginner's model aircraft. Closely allied arrangements are a "parasol" wing and a "shoulder" wing.
IC engine
Internal Combustion Engine, can be glow or gas and 2 stroke or 4 stroke.
Keyboard
For radio frequencies other than 2.4GHz, a *keyboard* is used to identify who is flying with what *frequency* at any time. Pilots place a key on the board for the channel they are flying for MHz frequencies. This is to avoid more than one pilot flying with the same channel causing interference between aircraft in flight. Radios with 2.4GHz don’t suffer from this issue.
Kit
Kit built – indicates that it needs to be built from balsa parts that are sometimes stamped and partially cut or laser cut. Usually includes instructions and plans to assist with the build.
Lift
This is the upward force generated by air passing over the wings, causing a pressure difference that forces the wing to create *lift*.
Lipo
Lithium Polymer battery usually used to power electric engines along with all the radio gear and *ESC* for the engine.
MAAA
Model Aeronautical Association of Australia – supports clubs by providing service needs to its members. *MAAA* liaises with *CASA* for safe model operation rules. Provides a framework around safety and activities to enhance the enjoyment of club members. Provides comprehensive public liability insurance along with personal accident insurance for Clubs and their members. It also provides guidelines around certification standards for Instructors, levels of proficiency for flying, i.e., bronze, silver and gold wings.

Mode 1, Mode 2
These are labels that refer to the way the four *primary controls* of the aircraft are shared between the control sticks on an R/C *transmitter*. *Mode 1* refers to the situation where the *aileron* and *throttle* are controlled through the right stick and, the elevator and *rudder* are controlled through the left stick. *Mode 2* usually refers to the situation where the *aileron* and elevator are controlled through the right stick and, the *throttle* and *rudder* are controlled through the left stick. Other arrangements are possible but these two are the most common.
Nose wheel
A wheel, usually steerable, that supports the forward end of an aircraft on the ground.
Pitch
Movement around the lateral axis of a plane. Primarily effected by the *elevator*.
Pre-flight checks
Pre-flight checks are the checks that are performed before committing your plane into the air. These are CRITICAL and shouldn't be omitted.
Primary controls
Most model aircraft utilise two, three or four *primary controls* (*rudder*, *elevator*, *aileron* and *throttle*). If three are used, they are usually *rudder*, *elevator* and *throttle*. If only two are used, they are usually *rudder* and *elevator* (also see: *two function*).
Propeller (prop)
The spinning surface that pulls or pushes the aircraft through the air. These can be two, three or four blade surfaces. Care should always be exercised around them as they can cause injury.
Pusher
An arrangement where the *propeller* pushes the aircraft through the air.
R/C
Radio Control
Receiver (RX)
Component housed in the plane that accepts inputs from the transmitter (*TX*) to cause the applicable *servos* to move *control surfaces* of the plane.
Receiver battery
Typically NiMH (Nickel Metal Hydride). Usually four to five cells and used to power the *receiver* and *servos*.
Roll
Movement around the longitudinal axis of the plane. Primarily effected by the *ailerons*.
∫**Rotate**
Rotation is the point when a plane leaves the ground during the take off manoeuvre.
RTF
Ready **T**o **F**ly – indicates that the plane may need to be assembled and it is ready to fly.
Rudder
A movable vertical surface, usually at the tail of the aircraft, that causes the aircraft to turn in the horizontal plane, essentially similar to the way a car or boat is steered.

Scratch built
Built from Scratch – indicates that the builder needs to use plans to create and cut out all parts according to the plans. This is the most difficult type of build. Generally the builder only has the plans as a guide, i.e., no instructions to follow.
Servo
Mechanical device used to control the movement of *control surfaces* like *rudder*, *elevator* and *ailerons*. It is connected to the appropriate channel in the *receiver* for the *control surface* being managed. *Servo* movements are received by the *receiver* from inputs made with the Radio *Transmitter* sticks.
Skid
A stick or other structure projecting from the underside of the aircraft to support it on the ground.
SLT Radio
Wireless radio using SLT (Secure Link Technology).
Stall
A *stall* results when airflow is completely disrupted as it flows over the wings. The wing no longer produces *lift* and *stalls*. *Stalls* can occur with slow or fast flight and can be affected by *angle of attack* of the wings and bank angle of the wings.
Tail dragger
An arrangement of the wheels of an aircraft where the main wheels are towards the front and the rear of the aircraft is supported by a *tail wheel* or *skid*.
Tail wheel
A small wheel that supports the rear end of an aircraft on the ground.
Three function
When the model aircraft is controlled by *rudder*, *elevator* and *throttle* (also see: *two function*).
Thrust
Thrust is the force generated by the prop pulling or pushing the plane forward.
Transmitter (TX)
Radio *Transmitter* used by the RC Pilot to send control inputs to the plane.
Tricycle undercarriage
An arrangement of the wheels of an aircraft which is essentially similar to the arrangement of a child's tricycle.
Two channel
Normally the minimum number of channels required to control a *two function* aircraft.
Two function
When the model aircraft is controlled by *rudder* and *elevator.*
Weight
Weight is the opposing force to *lift,* which is impacted by the *weight* of the plane and gravity.
Yaw
Movement around the vertical axis of a plane. Primarily effected by the *rudder*.

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