The Complete Beginners Guide to Flying Radio Control I.C. Powered Model Aircraft

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About the Author

As a very young school boy I spent many happy hours at our local common watching a group of guys from the nearby town hand launching flimsy, oily free flight models over the heather and long grass. My friend and I were fascinated by these models that more often than not ended up with some cosmetic damage from hard landings in gorse bushes and the like.

Living as I did in the country, I had little opportunity to visit the outlets where these models could be purchased and there was no-one locally who new anything about them. As a consequence my childhood passed into youth without ever having a chance to indulge in this fascinating hobby.

During my early thirties, having got married and produced a family, we took a trip to a country show at Wicksteed Park in Northamptonshire. There in a large field a group of enthusiasts were entertaining the crowds with a variety of model aircraft but not just going where the prevailing breezes took them, these aeroplanes were going where the modelers wanted them to go!

I was intrigued by this new aspect of the hobby and while my wife and children went off to explore the rest of the show, I spent the whole day watching in awe.

This was it, I had to have one of these machines and of course the control equipment that would make it go where I wanted it to go.

The rest really is history. Thirty odd years on I have tried most types of fixed wing flying including gliders, both flat field thermal soaring and slope soaring, club 20 racers, pylon racers and scale competition flying. I confess to never having tried helicopters. These flying machines without wings never grabbed me so I couldn’t justify spending my hard earned money on something I couldn’t relate to.

I became a keen member of my local model club to the extent of becoming their events and competition secretary for a number of years in succession. I also qualified through the BMFA as an instructor and was responsible for training a good number of new members over the years.

Through this experience and the guidance I felt students required, I saw a need for a dedicated training manual to help them progress with greater confidence. Generally speaking instructors do a magnificent job and their patience is commendable.

Obviously there is no substitute for actual supervised training and flying practice plus the ‘hands on’ help and support of an instructor. This manual aims to give the student a valuable resource of detailed information to supplement this training.

Radio Control Model Flying is a wonderful sport and if this book helps some of our novice fliers learn to become proficient, then my aim will have been accomplished.

Colin Bedson
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Part 1

Introduction

Welcome to the world of Radio Control Model Flight. So what got you interested in this fascinating but almost masochistic hobby!? A hobby where, if you take the wrong approach, you will almost certainly enter and leave (in fairly rapid succession) a disillusioned and much poorer individual.

You've probably encountered some model fliers enjoying themselves at the club field wringing all sorts of manoeuvres out of their models. You've watched in awe as these miniature flying machines defy all the rules of gravity and appear to be capable of doing things even full size aircraft can't do. You're thinking to yourself “Oh to be able to do what these guys can do”. Well strange as it may seem, YOU CAN!

What you must appreciate is that these wizards of model flight have probably been flying planes like these for several years and at one time were standing just like you wondering at the skills of some other fliers. Flying these aircraft is not impossible for you; it just takes time, practice, patience and money to get where these guys are.

The actual amount of time, practice, patience and money will all depend on your aptitude, willingness to listen and learn and the acceptance that it will cost you. This is not a cheap hobby although it can be relatively inexpensive compared to some hobbies we humans follow.

If you want to learn to fly a radio control fixed wing model aircraft and you are prepared to TAKE ADVICE, then this book will help you succeed with the minimum of pain and disappointment.

Essential Considerations

We are going to work only with fixed wing model aeroplanes powered by two stroke fuel engines. The basic advice is also relevant to helicopters, as far as engines, radio and starting kit is concerned.

There are some basic fundamental factors you must accept and appreciate before you even start.

1) Where you are going to fly your model.

2) The necessity for you to be protected by third party indemnity insurance.

Both of these essentials can be fulfilled by approaching and joining your local model flying club. Such organizations will, in most instances, have negotiated flying rights with a local landowner, council, etc. or even own their own flying field.
Most established clubs will be affiliated to the national governing body that controls model flying in your country. As part of that affiliation they will have inclusive membership insurance at a fraction if the price it would cost you to insure yourself.

Not only does club membership carry these most useful benefits, there will almost certainly be a pilot training scheme for you to take advantage of. Many clubs today even provide a suitable club trainer and control setup for you to ‘cut your teeth on’, so to speak.

If you haven’t already been put off your initial enthusiasm by the above reality check, then let’s move on to some further considerations.

a) Where are you going to learn to fly your model?
b) Who’s going to teach you?
c) What sort of model will you choose?
d) How are you going to power it?
e) What radio equipment will you choose to control it?

Let’s take each of these basic considerations in turn.

**Where to Fly**

Unless you happen to own a large tract of open land with short cropped grass or an ex military airfield with an old runway, you will need to join a club or arrange to fly on someone else’s land. Whatever you do, you will have to abide by the regulations that control model flying in your country. The civil aviation authority that controls aircraft movement within your home country’s airspace will usually have a set of strict guidelines for the operation of airborne models.

If you intend to go it alone, then it is your responsibility to ensure that you don’t contravene these regulations.

Join your local model aircraft club and none of the above will concern you. The club will have taken all necessary precautions and responsibilities to ensure these regulations are satisfied. All you have to do is abide by the club rules and enjoy your flying and the camaraderie of the other members.

As a general rule model club members are a very mixed bunch of characters and you are sure to find a few that you can relate to. You’ll share enjoyable times with them and not only that, you will learn a great deal from the experience and expertise they will be happy to share with you.
**The Instructor**

It’s not completely unknown for individuals to teach themselves to fly model aircraft but more fail miserably than actually succeed. Without the help and support of an experienced flyer, you are almost certain to destroy your pride and joy at the first attempt.

Gravity is a very unforgiving adversary in this battle and unless you are very lucky, you will loose the initial confrontations. Even if you have a very commendable attitude and a determination to not be defeated, the encounters will empty your financial coffers quite rapidly. Repairs or replacement aircraft, engines and radio equipment can be a major drain on finances.

Why make life difficult for yourself when, for the price of a meal out for two, you can have a full year’s club membership and the help of a qualified tutor at your disposal? Most clubs provide free tuition for novice members.

A proficient instructor can be the best aid to your success in this adventure. Most club instructors have been through a process of selection and special training to provide them with the skills they need to teach others.

Talk to each of the appointed instructors to find one you can relate to. Bear in mind also that your instructor has to have your respect. This relationship is very much a two way exercise and requires you to be receptive and prepared to obey instructions as required. If the club appoints an instructor that you feel uncomfortable with, don’t be afraid to explain this to the training officer and find one you are happy with. It is very important that you and your instructor have a strong measure of both trust and understanding.

Once you are happy with your instructor, take some time to sit down and have them explain the programme you will follow (they will probably do this anyhow). This is important so that you know exactly what will be expected of you. Not only this, but you will have some idea of the time frames required to fulfill the various stages of the programme.

**Choice of Model**

There are mixed opinions as to the choice of first model. Some suggest the choice of a fully built up model, starting with a box of wood, glues, accessories and a plan. The theory here is that the construction process will teach the builder a great deal about the way the model works and how it will fly. This knowledge helps the student understand the laws of physics that apply to flight, the way the model travels through the air and the forces that work on the control surfaces.

The downside of this approach is the time it takes to get to the flying stage. A rookie builder can take quite a long time to finish a model and the lack of experience can lead to building errors that could make the model unflyable or at best a real handful and difficult to trim for stable flight.

Most modern Almost Ready To Fly (ARTF) model kits come with a high level of pre-fabrication and are designed to have the owner airborne in a matter of hours rather than
weeks. The designers have done all the hard work and the prototypes have been fully tested and checked for their suitability as training models. In the hands of a competent instructor most of these models will fly straight from the building board, be easy to trim for stable flight and the student will be learning quickly on a plane that is relatively easy to fly.

The choice of model is almost endless. There are numerous ARTF kits on the market. A visit to your nearest model shop will reveal a good choice. You can rest assured that the range they keep will represent the most popular models purchased from them. This is usually a good indicator that they are finding favour with both instructors and students alike.

Recent designs have greatly improved and the standards of construction and finish are very good. Most of the models available look something like real aeroplanes and with care and attention, will reward the owner with a model they can be proud of.

If you have joined your local club, take a look at the trainers being used and discuss their choice with both owners and instructors. Instructor’s opinions are particularly relevant as they will have experience of flying many different types. They will recommend types they prefer and you can guarantee if they are happy with a particular model, they will be comfortable training you on it.

A model having a wing span of 1.4metres (55 inches) to 1.8metres (72 inches) will be suitable. Most kits feature models with a span of around 1.52metres (60 inches). These are designed to fly on a 40 – 50 size engine and are ideal (more about engine sizes later). Choose a high wing type for stability. You can progress to shoulder, mid or low wing types when you are proficient on your trainer type.

There are also some practical considerations to take account of. These include:

- Ease of repair - Availability of Spare Parts – Stability - Control Setup - Accessories & Equipment

Let’s look at these in turn.
Ease of Repair
You have to accept that your first—and maybe your second—model could well be damaged in the course of your learning how to fly. With this in mind, you should look for a trainer that has relatively few parts that can be easily repaired if they are broken.

Wood and foam are high on the easy-to-fix list; molded plastic, fibreglass or epoxy resins are more difficult to repair. Cyanoacrylate (CA) glue (sometimes called 'superglue' or 'cyano') and epoxy are the most common adhesives used for gluing wood parts together. Aliphatic resin or special white glues available from your model shop are excellent for gluing foam pieces back together.

Parts availability
Often it is easier to replace damaged parts than to repair them. Try to select a model that has replacement parts readily available via your model shop from the manufacturer. Some model kits have extra wings supplied in case you damage one beyond repair.

Motors, batteries and servos can get damaged or worn out, but understand that you can simply replace these parts as necessary. You don't have to buy a new model if any of these need to be replaced.

Bear in mind that should any of these components fail in flight, they could result in the need to replace the airframe!

Stability
Some trainers are easier to fly than others. Talk to your instructor and people who have different kinds of models and find out how stable they are.

A good indicator of how stable and easily a model will fly is how much wing dihedral it has and how long the tail moment is. As a general rule a model with a fair amount of dihedral angle (5 or more degrees) and a fairly long tail moment will fly with more stability and smoothly for ease of control. See overhead and side aspect diagrams of typical trainer model on page 10. (Moment - nose moment or tail moment - refers to a distance on a model forward or aft of the balance point).

Control setup
Before you buy a model, check its control setup. There are normally two setup options available.

1) Basic standard primary control setup - Rudder, throttle and elevator control.

2) Four function control – Rudder, throttle, elevator and aileron control.

Although you can learn quite satisfactorily on the first of these setups, it does mean that you will have to progress to the second configuration eventually. If you can afford the extra function initially, you may just as well master all four controls from the outset.

Accessories & Equipment
Finally, check to see whether the model you like comes with all the equipment you'll need to complete the airframe. In the long run, it is less expensive to get everything in one package.
Your kit should include all the materials needed to completely assemble the model with the possible exception of glues. It's sometimes worth paying a bit more for your model if it comes with everything included. Buying the extras separately can add considerably more to the overall cost.
The Power Plant

The most suitable engine size for almost all trainers is a 6.5cc. (0.40cu.in. or "forty") size.

When it comes to choosing an engine for your trainer, the choice is almost mind boggling. So many manufacturers, each one offering several engines in the same capacity range. So which do you choose?

You can buy cheap or you can buy reliable. "Reliable" means it starts, ticks over, runs and stops when it's meant to and will probably cost an extra £10 to £15 more than a cheap offering. If you enjoy the challenge of getting an engine to run properly when it doesn't want to - buy cheap. If you want to learn to fly - buy reliable.

A good engine isn't necessarily a powerful one. What you need in a suitable trainer engine is one that starts easily, is easy to set up and runs consistently. When you're learning, most of the time you are unlikely to have the engine running at much more than half throttle. Ask around at the club and watch anyone else learning to fly. Notice how easy it is to get the engine started. Does the engine run consistently throughout the flight - full throttle on take off then back to about half throttle? Does it falter just after take-off or die in the air unexpectedly?

As a fairly rough guide, a trainer should be airborne about five minutes after the decision to have a flight and should fly around for about ten minutes before landing. Starting difficulties, head-scratching, frustrations and bad language are indicators of possible poor engine performance and/or poor setup.

Talk to your instructor, as a seasoned modeler he or she will be familiar with a wide range of engine types. Showing pupils how to start engines of all types is just a part of their designated tuition programme. They will have learned to differentiate between those engines that start and run easily and those that can be generally tiresome. Select your engine carefully and look after it and you will be rewarded with hours of flying pleasure.
You will also need a set of accessories appropriate to your engine:

**Two propellers** - one on the model and a spare, which for a 6.5cc. (0.40cu") engine will probably be 10"x6".

**Two glow plugs** – one fitted to the engine and a spare.

**A spinner.**

You may also want to consider a silicon exhaust deflector that will help to keep your model clean by deflecting the exhaust away from the fuselage.

As a final comment on this section, please remember to treat your engine with the respect it deserves. Far too many model fliers have suffered damage to various parts of their and other persons’ anatomies directly as a result of failing to appreciate the awesome power of a model engine propeller spinning at a few thousand rpm. These miniature power plants carry a seriously damaging ‘sting in the tail’ if treated lightly.

**YOU HAVE BEEN WARNED!**

**The Radio Control System**

There are many modern radio systems to choose from. Each manufacturer offers a wide range of options from simple 2 - channel to computer assisted 8 - channel systems (and more!). The choice is limited only by your financial budget. As a beginner you should discuss the choice of system with your intended instructor. There are several good reasons for doing this, the primary reason being that the student's systems must be compatible with the instructor's system if a buddy box link is proposed. This option will be covered in more detail later.
All standard radio systems consist of four (4) basic components.

Transmitter - The unit that takes the control input from the pilot through the gimbal mounted sticks, encodes this input and sends it to the aircraft as a radio signal.

Receiver - The unit that receives the signal from the transmitter, decodes it and routes it to the appropriate servo.

Servos - These devices convert the decoded signals into a mechanical force that is directed via a linkage to the appropriate control surface.

Batteries - The component that provides the electrical supply enabling the other components to function.

Radio Control Transmission Frequencies
The atmosphere surrounding the earth is filled with a myriad of radio signals providing information for thousands of different communication systems along with naturally occurring radio waves such as solar radiation. When you switch on your radio control transmitter you merely add to this information blitz. It is therefore essential that the signals you transmit do not coincide with other transmitted signals or are, at the very least, stronger than any other similar signal within the vicinity of your flying field. Your airborne receiver would otherwise have great difficulty deciding which signal to obey.

Specific frequencies are assigned for use with airborne R/C models. A beginner must ensure that the system he chooses is tuned to one of these frequencies. Radio control system manufacturers usually place a sticker on the outside of the carton that says, "For airborne use only". There is a frequency reference chart available that lists the purposes of all of the frequencies that are assigned for R/C use.

The radio system that is chosen must meet the 1991 specifications for narrow band receivers. It is the responsibility of the manufacturer to ensure the equipment is certified to this standard. The owner's manual for the system will note that the requirements are met and many of the transmitters and receivers will have a gold sticker to signify this fact.
Radio control systems may transmit and receive on either an Amplitude Modulated (AM) signal or a Frequency Modulated (FM) signal. Most modern aircraft control systems use FM frequencies as they are less prone to interference than the AM frequencies. Having said that, AM systems seldom have problems with interference. Some radio systems use an internal system, called PPM, to help to nullify interference.

**Typical Transmitter layout**

![Typical Transmitter layout diagram]

- **Antenna**: The telescoping tube that transmits the signal
- **Batteries**: The device that provides power to the transmitter
- **Battery Meter**: The device used to monitor the strength of the transmitter batteries
- **Crystal**: The device that sets the radio frequency of the transmission
- **Gimbals (Stick)**: The device that allows the user to input desired control movements into the transmitter
- **Handle**: The device for carrying the transmitter
- **Power Switch**: The switch used to apply battery power to the internal components of the transmitter
- **Trainer Switch**: The switch used to allow an instructor to give control of a model to the student
- **Trim Lever**: Slides used to adjust control surfaces during flight
Transmitter Control Modes
There are two (2) primary modes of operation, meaning the way the gimbals are set up for operation.

Mode 1
Most early radio control fliers adopted this mode and it became the accepted configuration particularly in the United Kingdom. Mode 1 has Rudder and Elevator on the left hand gimbal (stick) and Ailerons and Throttle on the right hand gimbal (stick).

Mode 2
In more recent times, the thinking changed to the Mode 2 configuration. Most modelers believed that it was easier to control the primary surfaces effectively with the same hand. Mode 2 grew in popularity and is used almost exclusively in the USA. A beginner does not have to be concerned about which mode he should select since most manufacturers install the gimbals according the most widely used mode for the nation to which the radio system is being shipped.

When choosing your equipment it is important to consider the mode your tutor uses and the availability of your chosen mode from the supplier. All modern transmitters have the facility to change over the stick designations if necessary. Your user manual will provide instructions on how to do this.

Buddy Box
This facility was briefly mentioned earlier. Many instructors now use a ‘buddy box’ system where there is a cable link between your transmitter and that of your instructor. This gives the instructor total control over the model in flight and the ability to transfer control to your transmitter at the flick of a switch.
In the event you are experiencing a problem, this setup enables your instructor to take control of your plane just by releasing this switch. In essence your transmitter becomes the slave to your instructor’s master transmitter. The main advantage is the increased speed of transfer of control between student and instructor in the event of difficulty.

**The Receiver**

This is the small rectangular sealed box with a length of thin wire protruding from one end and a set of sockets and exposed pins at the other end. These sockets are provided to receive the plugs attached to the servos. Normally the sockets are marked with the appropriate designated function. The number of functions available will normally range from 4 up to 7 or 8 depending on the model purchased. There will also be another input socket designated for the battery lead.

There will also be a socket to take a receiver crystal. The crystal will normally be fitted in situ when a new system is purchased. Crystals are usually supplied in matched pairs designated Tx (Transmitter) & Rx (Receiver), the frequency value in MHz and/or the channel number. Never interchange the Tx and the Rx crystals.

**Servos**

These are the brut force of the system. The servos convert an electronic signal from the receiver into mechanical output. Most modern servos have a central output shaft to which can be attached a variety of output arm types. If you purchase a new system the servos will usually arrive ready fitted with a matching set of output arms. Alternatives will be provided along with other accessories in a plastic bag.

The direction of rotation of the output shaft can usually be reversed via a facility within the transmitter. Refer to your owners manual should this be necessary.

**The Battery**

Most modern outfits are supplied with a four cell 4.8 volt 600ma/h nicad rechargeable battery to power the airborne system. Treat this battery with extreme caution and respect. You ignore the manufacturer’s guidelines as to its charging and discharging methods at your peril!

What you must understand is that a battery failure during flight usually means major expense and lost flight and training time whilst the resulting damage is repaired or replaced. This is equally important in respect of the transmitter batteries which again are usually rechargeable.

We’ve quantified all the essential components of your flight training kit and what they all do. We’ve discussed the best way to get started and your responsibilities, so now its time to look at how everything works, especially your model. A little understanding of the physics of flight will prove invaluable for you when things start to happen. Knowing why your model is moving in a particular way will help you appreciate the actions you need to take to retain complete control over its direction and attitude.
Part 2

The Basics of Flight

Unfortunate as it may seem it is almost impossible to learn to fly without having the most basic of understanding of how and why aircraft stay in the air. Your impatience may tempt you to bypass this section but you will eventually need to come back and read it. So, sit back and let us try to teach you the rudimentaries of flight, it’s not too difficult to grasp and your understanding of what’s happening to your model will become more clear.

There are different and sometimes conflicting theories and arguments as to how airplanes fly, but the one accepted principle is that lift is generated as a result of the air pressure on the bottom of the wing being higher than the air pressure on the top of the wing.

Lift Diagram

Four (4) primary forces act on an aircraft in flight; thrust, lift, drag, and weight.

Thrust is the force applied by the combination of engine and propeller pulling the aircraft forward.

Drag is the resistance to forward motion of the aircraft by the pressure of the air against the forward facing surfaces.

Weight is caused by the earth’s gravitational forces acting on the mass of the aircraft.

In order for a constant speed to be maintained, thrust and drag must be equal.

In order for a constant altitude to be maintained, lift and weight must be equal.

In order for forward speed to increase, thrust must be greater than drag whilst lift remains equal to weight.

To gain altitude, lift must become greater than weight.

Lift increases as the velocity of the air passing over the wing increases or as the angle of attack increases as long as the flow of air over the wing remains smooth. Flight is achieved when the force of the lift equals the weight of the aircraft.
An aircraft pivots about three axes;

The **yaw** or vertical axis controlled by the rudder.

The **pitch** or lateral axis controlled by the elevator.

The **roll** or longitudinal axis controlled by the ailerons.

It can pivot about any one of these individually or in any combination depending on the control surfaces that are moved and the direction of this movement.

Moving the rudder to the right causes the aircraft to rotate to the right about the yaw axis. Moving it to the left has the opposite effect and the plane rotates to the left of the yaw axis.

When the elevator is moved up, the aircraft will pitch its nose upwards whereas moving the elevator down raises the rear of the aircraft and the nose pitches down.

The ailerons move in opposite directions. When the left aileron is moved up and right one down, the aircraft rotates to the left. Conversely, moving the left aileron down and the right one up causes the aircraft to rotate to the right.

At all times the combination of these three control inputs determine the movement of the plane in relation to the surrounding air. Learning to fly your model depends on your ability to recognize these effects and to use them correctly.
**How the Controls Work**

Modern Radio Control Systems operate on a principle of 'Proportional Control'. This means that varying movement of the Gimbal or Stick will cause the control surface on the model to move in sympathy. If, for example, a control stick on the transmitter is moved half its full travel then the appropriate control surface on the model will move half its maximum travel also. Maximum movement of the stick will result in maximum movement of the same control surface.

The result is that the pilot has full 'proportional' control over the model at all times and can decide how gently of violently the model will react to the control inputs. During normal level flight the model is behaving in equilibrium with all forces acting on it being equal. This is achieved by setting the throttle to a position where forward speed is constant and lift is equal to the weight of the model. Now we can start to look at what effects the movement of the transmitter control sticks will have on the model.

**Elevator Control**

For the purpose of describing the control actions **Mode 2** has been assumed as this is the most popular setup for modern systems.

Pulling back toward oneself on the right stick, as shown in the diagram above, will cause the elevator to move up. This has the effect of pushing the tail of the model down, increasing the angle of attack of the wing and causing the nose to pitch upward. This also has the effect of increasing drag. To prevent the model stalling increased power is required. Stalling occurs when the air passing over the wing becomes turbulent and lift decreases until weight exceeds lift and the model begins to drop.
Pushing forward on the right stick causes the elevator to move down. The tail lifts reducing the angle of attack on the wing, reducing lift and drag so that the model nose pitches downward. As the model descends its speed increases until drag and thrust are again in balance.

Aileron Control

Right Stick - Push Forward

Right stick - Move Right

Left aileron moves down, Left wing moves up
When the right stick is moved right (see above), the left aileron deflects down and the right aileron deflects up. This causes the airplane to roll to the right. Lift is increased on the left wing and on the right wing it is reduced. It will continue to roll as long as the stick is held in the same position. As the model rolls, the lift area of the wing effectively reduces so the effective lift decreases. As the angle of the roll increases, effective lift continues to decrease and the model will begin to drop.

**Rudder Control**

When the right stick is moved left (see above), the opposite movements occur. The left aileron is deflected up and the right aileron down. By the same reasoning as before, the model rolls to the left. The right wing lifts up and the left wing drops. The roll will continue for as long as the stick is held in the same position. Once again, as the angle of the roll increases, effective lift continues to decrease and the airplane will start to drop.

Now we move over to left stick in mode 2. Moving this stick to the right (below) causes the rudder to move right. This causes the model to swing or yaw to the right, trying to rotate about its central axis. The left wing moves slightly faster through the air increasing lift, whilst the right wing slows down reducing lift. The combination of the yaw and the lift imbalance results in a gentle turn to the right as long as the stick is held in position.

Conversely, when the left stick is moved left, the rudder moves to the left. The rear of the model is pushed to the left again trying to rotate about its central axis. The right wing increases its forward speed through the air causing an increase in lift and this time the left wing looses speed and lift. The combination of the yaw and the lift increase on the right wing results in a gentle turn to the left as long as the stick and rudder are held in position.
Throttle Control
The fourth stick function, forward and back on the left stick, controls the setting of the engine throttle. When this left stick is moved forward, the throttle is opened resulting in an increase in engine RPM and consequently the speed of the model. Greater forward speed causes an increase in lift and results in a tendency for the aircraft to climb. Pulling back on the left stick
closes the throttle down, resulting in decreased speed. Lift decreases and the model starts to descend.

It is important to appreciate that the effects of stick movement can adversely affect the flight of a model. These adverse effects are overcome by using a combination of control surfaces to achieve the desired positive results. When the right stick is moved to the left and at the same time pulled back, the resulting model response would be a banked turn without loss of altitude. The increased lift from raising the nose of the model compensates for the loss of lift in the left hand roll component.

Learning how to fly your model and to maintain total control of it at all times is the application of these principles. Mastering the combinations of stick inputs to position the model where you want it to be in the sky in relation to your position on the ground is the object of the exercise.

**NB**
You will have noticed that all discussions so far have been based around a four function system with aileron, elevator, rudder and engine controls.

If you are starting out with a more basic three function system of rudder, elevator and engine then wherever we mention aileron control, substitute rudder.

Most training models using just three function control compensate for the lack of roll control by having more dihedral. This causes the model not only to rotate about the yaw axis but also to rotate about the roll axis. Pushing the model sideways on to the air flow with the rudder changes the lift distribution in favour of the wing on the outside of the turn, causing the model to roll.
Part 3  

Model Preparation

Construction

Construction of a trainer model is far too involved and lengthy to be covered in depth here. Ensure that the trainer you choose has a good set of plans and step by step instructions that guide you through the complete assembly including the installation of the radio system.

A beginner with no experience in building or assembling flying models would be advised to seek help from an experienced modeler to avoid mistakes that can have disastrous effects. Another good reason to join your local club before you invest money in your chosen model and equipment. There is no substitute for experience when deciding what to buy and what not to buy.

Consider using a strong, slow curing adhesive if you are building your model from a kit. This allows time to correct mistakes during construction. Aliphatic resins cure slowly but yield an exceptionally strong joint and sand easily after curing. All joints that are subjected to high stresses such as the firewall and centre wing joints should be joined with a slow cure epoxy.

Wing alignment is critical in the flight performance and stability of the trainer. The building manual provided with the kit should give detailed instructions as to how this is accomplished and special care should be taken to follow these instructions.

Installing the Engine

Most trainer style models have engines mounted upright for ease of installation and operation. Usually they are not surrounded by close cowls and so are simple to access and adjust.

Most kits suitable for the “40” size of engine come with Nylon filled engine mounts. These are easy to drill for the mounting bolt holes both for the bulkhead position and for the engine lugs.

In some kits Screws are provided to fasten the mount to the bulkhead and/or to fix the engine to the mount. It is advisable to replace such fasteners with bolts and lock nuts to avoid loosening due to vibration. Nyloc™ nuts are highly recommended for this purpose. You can buy these in the appropriate sizes from most engineers’ supplies outlets.

Ensure that the linkage between the throttle adjustment horn on the engine and the servo inside the fuselage is as straight and as friction free as possible. It is also recommended to use a nylon clevis to connect the linkage to the horn. This eliminates any risk of metal to metal vibration that could potentially result in radio interference.

The fuel tank should be firmly positioned inside the fuselage behind the front bulkhead so that it cannot move. Wrapping it in foam will help prevent the fuel foaming through vibration. Although the manufacturer will have normally provided a measure of fuel-proofing for the engine compartment, it is well worthwhile coating the area with an epoxy resin to ensure the wood cannot be soaked with fuel and oil residue. This also helps to seal down the covering that overlaps into the engine bay.
Make sure all plumbing between the tank and engine is of the correct fit and does not have any kinks or tight corners likely to restrict fuel flow. Examine your installation carefully for small nicks or pinholes in the fuel lines. Nothing is more frustrating than to spend hours trying to get your engine running at the field, only to find there is a damaged fuel line allowing air to bleed into the fuel system. This also applies to the length of tube carrying the clunk to the bottom of the tank.
Most trainer models will incorporate some down thrust and side thrust for the engine. This helps to overcome the effects of turn due to excessive engine torque or climb due to high lift coefficient of the wings. If you are in any doubt as to how this is achieved, consult your instructor or someone with experience who knows how to engineer it. Most modern ARTF kits have the appropriate offsets built into the fuselage. All the builder has to do is mount the engine bearers and the engine. The necessary angles will be automatically achieved.

1. To increase down thrust, add washers to the top of the engine mount.
2. To decrease down thrust, add washers to the bottom of the engine mount.
3. To increase right thrust, add washers to the left of the engine mount (when viewed from above).
4. To decrease right thrust, add washers to the right of the engine mount (when viewed from above).

Fuel pipe connections should be as follows:

- The fuel line from the "clunk" inside the tank should be connected to the engine's carburetor.
- The overflow pipe should go to the top of the tank and be connected to the pressure nipple on the engine's exhaust.
- A third line is often provided for re-fuelling. This should be plugged after re-fueling to prevent air being drawn in during operation.

If you decide to fit a filter, this should be installed between the tank clunk outlet and the carburetor. This filter should be checked regularly for blockages to eliminate starting and running problems.

Make sure that the carburetor is securely fastened to the spigot on the engine and that the rubber seal ring is installed to eliminate air bleed. With the throttle fully closed, check the air inlet on the carburetor fully closes. If it doesn’t adjust the throttle stop screw until it does. This will ensure the throttle servo doesn’t stall when you close the throttle totally.

Check that the exhaust is securely attached and properly tightened to the engine cylinder using the gasket supplied with the silencer to minimize the escape of exhaust gases and oil from the exhaust manifold.

The propellor must be properly tightened. If possible, fit two nuts to the crankshaft or replace the supplied propellor nut with a suitable Nyloc™ version. In the event of a "kick back" from the engine, the propellor may slacken but it won’t come flying off. Set the propellor in a suitable position for starting the engine. This is entirely dependent on who is going to start the engine and how. If you propose to use an electric starter (and this is strongly advised for a beginner) the position of the propellor isn’t critical. If you’re going to flick start the engine, get a "chicken stick". In this case the propellor should be between vertical and “ten past the hour” when the engine is at "top dead centre".

If a spinner is fitted, the cut outs in the spinner for the propellor blades should not make contact with the propellor blades. Check that the spinner does not come into contact with the cowling or fuselage front. This can be done by hand turning the propellor and checking for adequate clearance behind the spinner (about 3mm or 1/8").
Radio Installation

If you are a complete beginner, the single most important step you can take is to get competent help with the installation of the control system in your model. Having hopefully joined your local club, there will be a number of fliers who are willing - and more importantly - able to help you get this right.

The brightest beginner is the one who visits the flying field while they’re building their model and gets step-by-step advice! Your chosen instructor/test pilot is going to go through all the necessary steps of inspecting everything anyway. Just think how competent you will look if there are only a couple of minor problems to be rectified.

Let’s start with the servos. Each servo must be mounted using the rubber grommets and eyelets supplied with the radio gear. They should be secured using the four supplied screws. Tighten the screws just enough to ensure the servo cannot move under normal operational forces.

Many radio control systems come supplied with a special nylon tray to accommodate your servos. This can make life easier if you mount the servos in the tray and then position the tray on suitable bearers in the fuselage using four servo screws.

Many models have servo cut-outs in a purpose made plywood plate already fitted in the fuselage. Either way, be certain to check your servos are firmly held in place and cannot flex under load.
Servo arms must be retained using the supplied self-tapping screws. Any unused output arms on the servos that might foul another moving part should be removed.

Each servo should be plugged into its appropriate socket in the receiver and pushed fully home. Any servo extension leads must be securely connected. A good method to ensure these connections cannot part during flight is to fold the extension and servo leads back alongside the connectors and wrap some electrical tape around the connection and leads.

The servo leads should not be in tension or stretched and should be neatly secured in the fuselage.

The receiver is one of the most delicate and sensitive components of the system. It needs to be well protected within the fuselage to prevent damage during flight. Check that the operating frequency of the crystal is the same as that of the transmitter and that it is fully inserted into the receiver crystal socket.

Pack the receiver in shock-absorbing foam and securely locate it in the fuselage so that it cannot move around or be damaged by loose objects or the battery in the event of a hard landing (crash!).

Run the receiver aerial loosely away from the receiver to a suitable point for it to exit at the top of the fuselage. It needs to be held firmly at this point. The aerial should run all the way to the tail without "doubling-back" on itself and be secured. You can secure the aerial using a modeling pin pushed into the fin post and a rubber band attached to the aerial as a tensioner looped over the pin.

The battery pack must be packed in shock-absorbing foam and securely located in the fuselage where it cannot damage any other equipment. The battery can often prove a useful aid to obtaining the correct balance point of the aircraft. Apart from the engine, it is the heaviest component of the airborne system. It can usually be re-positioned to facilitate forward or aft balance adjustment, just so long as it doesn't jeopardize any other more delicate equipment.

The battery pack to switch harness connectors must be firmly connected and secured as before. The battery pack and switch harness leads should not be in tension or stretched and should be neatly secured in the fuselage.

Securely locate the switch and harness in a convenient and easily accessible location in or on the side of the fuselage. Many switch harnesses have an integral charging lead for the receiver battery pack. This charging lead usually comes out of the switch through the same hole as the lead that is connected to the battery. Make sure that this lead is easily accessible for re-charging your receiver battery ready for the next flying session.

**Control Linkages**

The choice of linkage and delivery of mechanical motion to the control surfaces will depend to a great extent on what the kit manufacturers have provided. Whether they are snakes or pushrods, take particular care over measuring and cutting to length before you install them.
Where threaded links are fitted (common with snake in tube type push rods and threaded piano wire extensions for rigid pushrods) ensure that the clevises are screwed on sufficiently to allow the threaded portion to protrude through the clevis threaded portion.

Servo Tray Installation  
Aileron Servo Installation

Ensure that the clevises for each servo are clipped into the correct control horn and are secured using the keepers provided to stop accidental opening. Complete these connections for all four functions - throttle, ailerons, elevator and rudder.

Pull firmly on all threaded clevis/rod connections to ensure that the clevises cannot "jump" threads when direct force is applied to them. At the small sizes of thread commonly used for these functions, U.S. and metric threads can be interchanged. It is possible to screw a metric clevis onto a U.S. thread but it will be a loose fit and could slip with catastrophic results.

If screw clamp clevises are supplied, check that the screws are tightened fully and that the clamping mechanisms do not slide on the pushrods.

Fitting Clevis to Rudder Horn  
Push Keeper Over Clevis

Push Rods
Snake type pushrods are normally supplied with threaded wire inserts to which the clevis is attached. Ensure that this threaded insert is screwed at least 5mm (3/16") into the pushrod and that it cannot be pulled out. The snake outer of the pushrod must be securely fixed to a rigid structure so that it cannot flex during operation.

Rigid (balsa or spruce) conventional pushrods usually have metal rod attachments for the clevises that should be glued and bound to the pushrod. No movement is permissible where these components join.

Screw clamp fittings should be fitted so that only about 3mm (1/8") of the pushrod protrudes beyond the clamping mechanism. This ensures that they cannot foul any other controls, leads etc.
Static Trimming

“Static trimming” begins on the workbench. If you're building from a kit, you have total control over the model's final outcome. If the model is an ARTF, all of the components are already built and covered. As you assemble the model, there are steps you can take to ensure that it's properly aligned. The assembly instructions should provide guidelines for ensuring the stabilizer and fin are correctly set in the fuselage before gluing.

Wing Alignment

Most ARTFs are built wing first, and this establishes a good foundation to build from. If your wing is in two panels that need to be joined, it’s most important to make sure that they are aligned with each other; the trailing and leading edges should be even. If they aren’t, the wing will appear to be warped or twisted, and that will cause the model to roll in flight. If your wing is one piece, sight down its trailing edge, and check for warps.

If you know someone who has an incidence meter you can borrow, place it at various points along the wing. If the numbers don’t match at each point then your wing is not straight. Finally, place the meter at each wingtip and take a reading. Again, if the numbers don’t match, you’ll know it’s warped. To remove the warp, twist the wing in the direction opposite to the warp, and apply heat.

After you have attached the wing to the fuselage, check for three things:
1. Is it centered from side to side?
2. Are the wingtips an equal distance from the centreline of the fuselage at the tailpost?
3. When viewed from the rear of the model, is the wing horizontal?

Check the centering by measuring from the side of the fuselage to the wingtips. Use the same reference point on both sides; the distance to each tip should be the same. If it isn’t, slightly enlarge the holes for the wing dowels in the fuselage and the bolt holes in the wing until you can center the wing.

Next, take a length of string or thread (use something that doesn’t stretch under tension) and tie it to a large T-pin. Insert the pin on the fuselage’s centreline at the rear and stretch it to a wingtip. Wrap a piece of masking tape around the string, and mark it where the thread meets the wingtip and trailing edge. Swing the string over to the opposite wingtip. If you’re lucky, the mark will line up on the corner. If it doesn’t, mark it again and measure the distance. If it measures 1/4 inch between the marks, for example, you will need to move the wing by half of that, or 1/8 inch. If you enlarged the dowel or the bolt holes, fill in any excess gaps with scrap wood so the wing will be in the same position each time you mount it.

Now check that the wing is horizontal. With the wing installed in the fuselage, stand several feet behind it and see whether the fuselage leans to one side or the other. If it’s crooked, sand the high side of the wing saddle to raise the low wingtip.

Balancing the model

Before checking the center of gravity (CG), balance the model laterally. To laterally balance your model, make a cradle to support the model by its nose and tail, or have a friend hold one end while you hold the other end by the spinner or the prop. Be sure to remove the glow plug
from the engine so its compression doesn’t prevent the model from tilting. If one wing panel is heavier than the other, it will hang low. Add weight to the lighter wing panel to correct this. You can do this by pushing small nails into the wing tip until balance is achieved.

The model’s CG plays a big role in how it flies. Initially, balance the model according to the manufacturer’s recommendations. This represents a starting point for flight safety during the first few flights.

Finally, before you head to the flying field, seal all of the hinge gaps. Sealing the gaps not only makes the control surfaces more responsive but also makes control-surface flutter less likely. Use clear Magic Tape™ or matching covering material.

The easiest way is to unhook the pushrods from the control surfaces, fold them over toward the top of the flying surface as far as you can and then apply a strip of material along the underside of the hinge line. When the control surface is returned to neutral, the gap seal will hardly be visible. At this point, your model is statically trimmed and ready for flight testing.

**Controls Familiarization**

Now that you have a model that is, to all intents and purposes, ready for its maiden flight, it is a good idea for you to familiarize yourself with its control functions and which sticks do what to those controls.

These functions were discussed earlier during our investigation into flight control but until now you have not been in a position to experience the nature of these functions. So connect up the receiver battery and the transmitter to the charger and give them both a good overnight charge. Your user manual will explain the charging cycle so follow the instructions and make sure that your batteries get a full initial charge.

Disconnect the charger and tuck the charging lead to the receiver battery well away from any control linkages. Connect the Aileron servo lead to the correct input socket on the receiver and assemble the wing to the fuselage. This will depend on the manufacturers chosen method of fixing (wing bolts or rubber bands).

Place the model on a level surface in front of you with the nose pointing away from you, switch on the transmitter first (most important) followed by the receiver switch. You may detect an initial jitter of the control surfaces before the servos centre and the control surfaces should settle at their neutral positions. If they don’t then you need to make adjustments to the appropriate clevises. All control surfaces should be exactly in alignment with the fixed part of the flying surfaces.

Assuming that you have done this and everything is as it should be, spend some time gently moving the transmitter sticks first of all one at a time. Observe the effect this movement has on the designated control surface and how the movement is totally proportional to the amount of movement you make with the stick.

As you make these control inputs, try to imagine the effect they would have on your model in flight. If you are having difficulty with this concept, refer back to Section 2 – Basics of Flight:
How the Controls Work. Make a print of each of the diagrams showing the control inputs and associated movements and use them to help you become familiar with your model’s control.

Once you are happy that you understand these independent functions, try mixing two inputs at a time and again try to visualize the effect on the model in flight.

Let’s take an example. First move the aileron stick a little to the right and at the same time move the same stick back toward your body as you are holding the transmitter. The left aileron will drop, the right aileron will rise and the elevator will also rise.

Now what can we deduce from these movements? Aileron movement causes the model to rotate around its roll axis. The combination of left aileron dropping and the right aileron rising gives more lift on the left side of the model and less lift on the right side, the model rolls to the right.

At the same time the elevator rising causes the tail of the model to be pushed down and the nose rises so the model has a tendency to rotate about the pitch axis. The combined effect of these two reactions is for the model to bank and turn to the right. This combination is the basis of every bank and turn manoeuvre you will make with your model.

Now try every movable surface combination you can and try to work out for yourself the overall effect of these controls on the flight pattern. Don’t worry too much about the throttle control at this stage, just remember that, generally speaking, the more power you apply the more extreme the effective control movement. Work at developing a broad appreciation of the way your model is going to behave when you move your transmitter sticks.

Don’t forget to switch off first the receiver followed by the transmitter once you have finished this exercise. If you intend to visit your flying field the next day, be sure to recharge both the transmitter and receiver batteries again overnight.

**NB.**
Always switch your radio control system on and off in the following sequence:

- **ON**  Transmitter First – Receiver Second
- **OFF**  Receiver First – Transmitter Second
At last the day has arrived. You’re ready to have your model checked out for its first flight. You’re probably feeling a combination of excitement, trepidation, impatience and pure fright! Don’t worry; all of this is totally normal. You’ve invested quite a bit of your hard earned cash and some serious hours getting your model ready for this momentous day.

Even test pilots of full size aircraft get nervous over the first flight of a new prototype, so you’re in good company. It will be a good bet that your instructor will be feeling just a little apprehension over the responsibility of getting this new model airborne. After all it’s a journey into the unknown for both of you.

If you’ve done all your checks and followed all the good advice you’ve been given then everything should go according to plan. Your instructor will have experience of handling some pretty hairy situations and overcoming them. The model will be examined with a fine tooth comb before any attempt is made to fly. Any glaring errors will be noted and rectification must be carried out at the field if possible, otherwise the model goes back home to the workshop to be rectified.

Each piece of equipment should be checked out by the instructor to ensure that it works properly. You can be assured that there will be no test flights if everything is not 100% to the satisfaction of your instructor and/or the club safety officer. The model must be checked for proper balance then test flown and adjusted for proper flight. If the instructor feels that there is a serious problem with the aircraft, it must be corrected before you attempt your first flight.
Only when all of the equipment and the model have been approved by your instructor should the training begin.

Let’s imagine your instructor has checked out your model and installation. It’s received the all clear and everything is ready for the first test flight.

The first lesson will have nothing to do with flying the model. At this stage you need to be made familiar with the site facilities and layout. You will be shown where to park, where to place your model in the pits, and most importantly, how to use the frequency control system.

Make sure you understand the site layout, the Transmitter control procedure and the flying area. Make sure you clearly understand the areas to fly in, if in doubt ask.

**Always Remember**

Your instructor is only human; he can make mistakes like you and me. Don’t blame him for any mishap that might occur during your tuition. He will teach you to the best of his ability. Always remember he is there to enjoy our hobby just like you.

The skill of flying radio controlled models is not easily acquired, and as a beginner you need all the help you can get. Joining a club and getting the help and support of experienced model flyers is the quickest road to success, and the cheapest!!

The following are just a few general tips to help you make those first flights go as smoothly as possible and help you get a feel for the model in flight.

- Be very gentle with the controls. It takes very little movement to get the model to execute a manoeuvre. Remember that the farther the stick is moved, the more the control surface moves and the more the model will respond.

- As long as the stick is held in a control position, the manoeuvre will continue. This is a most important consideration when using the ailerons. When the stick is moved to roll the model, it will continue to roll as long as the stick is held in that position.

- Fly in to a manoeuvre and then fly it out of it. It takes equal and opposite controls to overcome a manoeuvre and return to normal flight. A turn requires the movement of the ailerons in the desired direction of the turn. To recover from the turn, opposite aileron input is required.

- Always remember that when the model is flying toward you the aileron control inputs appear to be reversed. Whereas, when the model flies away from you to correct a dropped wing you push the stick the opposite way, when the model flies toward you a dropped wing is corrected by pushing the stick toward that dropped wing.

- Keep the model high. A Certified Flight Instructor once said, "The two most useless things to a pilot are air above the model and runway behind the model." If you get into trouble you need plenty of air below the model to recover. When landing, the runway that is behind the aeroplane after touchdown is wasted because there is a reduction in length of runway to take off again in case of trouble.
• Keep the model in sight. Do not fly too high or too far away. Although your trainer model may seem fairly large, it is easy to get it far enough away so that it is difficult to see its orientation. Do not fly into the sun. A moment of blindness caused by the sun can be long enough to lose a model.

• Do not become discouraged. There will be times when nothing seems to go right. Each manoeuvre results in a near catastrophe. Everyone who flies R/C models today has been through this situation; it’s all part of the learning curve. Do not give up. The next session will be better.

• **DO NOT PANIC.** When a manoeuvre goes wrong, take all the time necessary to recover from the mistake. Panic will cause you to over-control in an attempt to recover and cause the condition to worsen in the opposite direction. Although your instructor may seem to be a casual observer standing at your side, he will be watching in case you get the model into a dangerous situation.

The first few flights will begin with your instructor doing the take-off and checking out the model. You should watch the model as the instructor explains each control movement being used. This will give you an insight into what is required to execute a take-off. The same will be true for the landing. Learning to land a model correctly is by far the most difficult part of learning to fly. The model is most vulnerable when on the approach to landing because the close proximity to the ground, its slow airspeed, the reduced responsiveness to control input and the disorientation due to reversed control are all challenges.

When your instructor has flown the model and is happy that everything is satisfactory, the time will have come for you to take the controls for the first time. He or she will take the model to sufficient altitude, usually 150 to 200 feet and will ask if you are ready to take control.

**It is normal to be nervous at this point!**

If you are using a buddy box, when he or she is happy that the model is totally stable and airworthy, your instructor will give control to you by pressing and holding the trainer switch. You will be told the manoeuvres to perform and how each one is to be done. You will receive instructions as to how improve each manoeuvre as it is being done.

The first manoeuvres will be gentle turns left and right, flying ovals around the field, flying rectangles and figure of eights. Each manoeuvre serves a purpose in building your skill. You will progress to steeper turns, slow flight and stall recovery, each in itself a manoeuvre required to master a landing.

If at any time, you should get into difficulty; your instructor can take control of the model simply by releasing the training switch. A mishap can be avoided as the instructor takes the model back to a safe altitude. The instructor will not let a situation build to a point that is beyond his ability to recover yet he will allow you time to attempt the recovery on your own.

The buddy box system makes this close control much easier for both you and your instructor. It is not impossible to learn without this facility, however. It just means that there is a greater
delay between your loss of model control and your instructor retrieving the transmitter to rectify the situation. Valuable seconds can be lost during the hand over.

**Final Checks.**
Ok so you are ready for the first test flights. Your instructor will take great pains to check out every last detail of the integrity of your model. He or she wants to have the best possible chance of accomplishing as safe and event free first flight as possible. The following are a sequence of checks they will carry out:

**Position of Centre Of Gravity (CoG).**

- The CoG should be checked "dry" so ensure that the fuel tank is empty.
- The CoG should be within the limits specified by the model manufacturer. On a straight wing trainer, this is about one third of the way back from the leading edge of the wing.

**Tracking.**
A successful take off is greatly aided if the model runs freely in a straight line. Your instructor will place the model on the runway and gently push it forward to see how it tracks over the ground. Any deviation from a straight line should be adjusted by either screwing the nose leg clevis in or out dependant on which way the model swings off track.

Be sure to check the clevis is properly clipped into the control horn after adjustment and that the keeper is refitted correctly.

Your instructor will ensure that you have the sole use of the frequency you will be using by obtaining the appropriate frequency peg. If you are uncertain of the reason for this control, discuss it with the instructor so that you fully understand the frequency control system in operation.

**Radio Checks.**
Switch on the transmitter followed by the receiver (NEVER THE OTHER WAY ROUND).

a. **Fouling.**

- Move all the transmitter controls into all possible positions and combinations, remembering to move all of the trims as well.
- There should be no interference or binding of any of the controls. If the wing is fitted, the chances are that you won’t be able to see what’s going on inside the model, so listen closely! Any audible buzzing means you have a stalled servo(s)

b. **Range Check (Engine not running).**

- With the transmitter aerial extended no more than 50mm (2") (some transmitters put out virtually no signal with the aerial fully inside the transmitter) move at least 10m (30’) or thirty paces away from the model.
• You should have full control of all the control surfaces at all times. This can be verified by moving the control sticks around. (Get your instructor to check all movements are correct and control is maintained).
• There should be no occurrences of the control surfaces not moving when the sticks are moved.
• There should be no occurrences of the control surfaces juddering.

c. Failsafe.

If you have a PCM radio fitted with a failsafe facility, follow the instructions in the manual to set the throttle control to reduce to stop or tick-over as a minimum precaution.

Set the aileron stick to maximum right or left, elevator to maximum up or down, rudder to maximum right or left deflection and throttle to idle.

• Switch off the transmitter only.
• All the controls should go to their preset conditions but most importantly, the throttle must close to either “tick-over” or “stopped”.
• If you are satisfied that the controls are doing what you want of them, switch the transmitter back on. If not, repeat this process until you are.

Operating the Engine
Now that the model is to all intents and purposes ready for its maiden flight, it is time to start up the engine and set it up so that full control is possible during the flight. Ideally you should run at least one tank of fuel through the engine on a rich setting to loosen up the parts and ensure maximum lubrication whilst this is happening.

Some manufacturers will have supplied their engines with the carburetor separate. Get the instructor to check you have fitted it correctly and that it is totally secure in its mounting spigot.

The fuel control needle will need to be set according to the manufacturers recommended setting for the first start up. Once running there will almost certainly be a requirement to re-adjust this setting for satisfactory running. Your instructor will demonstrate how to fuel, prime and start your engine safely and how to adjust it for optimum performance.

After these demonstrations, you should be able to carry out these procedures yourself. They are very straight-forward although starting the engine will take some practice. Remember that the instructor is always there to prompt or assist you.

Taxiing Trials
With the engine running smoothly at tick over and slightly rich your instructor will have you place the model on the runway. Before taking off it is important for the instructor to get a feel for how the model will handle under power on the ground. Some models have a tendency to swerve either left or right and can be quite difficult to control during the take off run.

It is also important to find out how it will steer. How big a turning circle it has; it may be necessary to bring the model back to the take off point again. If you are flying from a concrete or tarmac runway, handling should be much easier and more accurate than from a
grass strip. Grass has quite a drag effect on the model’s wheels and can cause it to steer less accurately than on a smooth surface.

**The First Flight**

That momentous occasion has arrived. Now you will discover whether all the meticulous care and attention you have put into your pride and joy has been well rewarded. Although you won’t be flying the model yourself, seeing it take to the air for the very first time can be one of the most exciting moments of the whole learning to fly process.

Having made all the necessary checks and eliminated any obvious problems your instructor will be ready to fly the model. Just stand back and enjoy the sense of elation as your instructor puts the model through its paces. Don’t worry if you see him making adjustments on the transmitter trims during this flight. Very few brand new models will fly absolutely straight and level without some slight adjustments here and there.

After a few circuits he or she will probably be ready to bring the model in for its first landing. This can be one of the most critical moments for an untried model. No-one knows just how it is going to handle on this first landing approach. Having said that, unless it is dramatically out of trim or overweight, most trainers are relatively simple to land and the event should go without incidence.

Once the model is back in the pits area, engine stopped, transmitter and receiver switched off, you can stand back and congratulate yourself on a job well done. Don’t forget to thank your instructor also for his expert handling of your model. Now you know that it flies, there is nothing to stop you becoming a successful model aircraft pilot.

This is the point at which your instructor will go through a ‘post mortem’ of the flight and will show you how to make any changes to the linkages that may be necessary to incorporate the trim changes made during the flight. This means that the next time the model takes to the air, all the trim levers (apart from the throttle trim) on your transmitter should be centralized with the model flying “hands off” in the straight and level attitude.

Quite literally, it should be possible to set your model flying straight and level into wind, let go of the transmitter sticks and, providing the wind conditions are reasonably light and smooth, the model should continue to fly exactly as it has been set.

Your instructor may well want to give the model several test flights before being ready to hand over the transmitter to you. **BE PATIENT!** There are very good reasons for this zealous approach. Your instructor will want to be absolutely certain that you have the best opportunity to control the model effectively once you take over. If he or she is struggling to control the model, then you can be sure that you will and that’s the last thing you need when you’re learning.

If this is the sum total of achievement during this first visit to the flying field, you will have had a successful day. The model is proven, your instructor is satisfied with its flight characteristics and you go home with your aeroplane intact. Your patience will be rewarded with the opportunity of your first hands on experience the next time out. Also you will have had an
opportunity to discuss the model’s handling traits with your instructor. If you take with you a note pad and pen you can write down any important points to remember.

**Your First Flight**

Whether your first “hands on” experience occurs on the same day as your test flights or not, it’s going to be a memorable event for you. Although you are only likely to have control for a few minutes during this first flight, savour it, it’s a special occasion and you will feel a sense of pride and elation.

You’ll probably be very nervous also and may well give your instructor a few moments of trepidation. Try not to panic, remember your instructor is right there at your side ready to take over if you get yourself into a situation you can’t recover from.

Try to remember that control inputs from the transmitter need not be excessive. Over controlling will lead to problem situations whereas gentle control movements will create wide smoother manoeuvres that will give you time to think about your next control input. Your instructor will be talking to you all the time, giving you advice on how to get the model to fly in a controlled manner and be where you want it to be.

Flying a model aeroplane is all about making it do what you want it to do, not just reacting to the model going where it wants to go and you trying to get it back under control.

Once the model is safely back on the ground after this first hands on experience, it’s time to take a deep breath, relax and enjoy the sense of achievement. Discuss what happened with your instructor and try to learn from any glaring errors you made during your time in control.

As with any acquired skill, the more practice you get, the quicker you will succeed and the more competent you will become.

**Some Basic Manoeuvres**

At this early stage of your tuition programme you will be concentrating on learning to put your model where you want to be in the sky relative to where you are standing on the ground. This will involve straight and level flight, simple banking turns and recovery from these turns back to straight and level again.

You will also learn how to control the climb and sink rate of the model using different throttle settings. Don’t fall into the trap of thinking that your model has to be flying flat out at all times.

A model correctly trimmed for training flight should be set so that at about half throttle it flies straight and level, not gaining altitude nor loosing it. This means that reduced throttle will cause the model to sink (less lift resulting from reduced forward air speed), whereas more throttle will cause it to climb (greater lift due to increased forward air speed).

Most of your training flights will be carried out at about this half throttle setting. This limits the speed of the model and is most appropriate for you to learn. Too much forward speed at these early stages does not give you enough thinking time. Higher speeds can come when
you have learned to respond quickly to the control requirements of your model in any attitude and at any altitude.

As you put the model through different manoeuvres you will come to appreciate the need for changes of throttle input. The added drag and reduced lift created as the model changes its attitude and position in relation to the air passing over its surfaces will need to be compensated for by additional power from the engine.

Once you have mastered these basic skills and your instructor is happy you are ready, you will be shown how to fly accurate and specific manoeuvres that are recognizable as being totally controlled and well positioned in relation to your ground location.

**Circuits**

Let's take a look at some of these manoeuvres:

**Don’t forget – For Ailerons read Rudder with three function systems.**

**The Clockwise (Right Hand) Circuit**

This is the manoeuvre you are most likely to learn first when you fly from a field where the prevailing wind direction is West to East and you stand with your back to the sun. The model will be flying into wind and as it passes directly in front of you the application of a little right aileron followed by a small amount of up elevator will hold the model in a continuous right hand turn.

If the turn has a tendency to tighten, release the aileron control a little and at the same time reduce the amount of up elevator. The natural stability of the model will cause the angle of bank to reduce hence the diameter of the circle will become larger.

The circle is fully controllable and with practice you will be able to keep the model in an almost perfect circle. Once the model comes round to where the circle started, you need to apply a little left aileron and release any up elevator you have been holding to straighten up
its flight path. If you have done things right the model should exit the circle at very near the same altitude that it entered.

Providing you keep the circle large enough it should not be necessary to increase engine speed as the loss of lift due to the angle of bank will be very small. If the turn becomes tight then you will detect the nose beginning to drop. In this case you will need to apply a little more engine speed and slightly more up elevator to compensate for the loss of lift in the turn.

As with every manoeuvre you learn, unless you are very lucky or particularly gifted, the first attempts will be far from perfect. The answer is practice and more practice until you get it right every time.

**The Anti-clockwise (Left Hand) Circuit**

Set the model up flying toward you from left to right and as it draws level with you apply slight left aileron combined with a little up elevator. Hold or adjust these inputs to maintain a constant radius circle at constant altitude. As the model comes round the circle and is almost level with you again apply slight right aileron and release the up elevator control.

You will normally learn this manoeuvre when the wind is coming from your right. Most instructors will teach structured manoeuvres from an approach into wind. This does not mean to say that at some future stage you won’t need to practice these same turns out of a “down wind” approach.

So far we haven’t discussed the effect of the prevailing wind on these turns. In relatively still air this effect will be small and will not have a very noticeable influence on the control inputs at the transmitter.

This cannot be said for days when the breeze is stronger. Flying into wind, the amount of aileron and elevator control input required to initiate the turn will be measurably less than the inputs required to maintain the turn as the model starts to negotiate the second half of the
Learning to handle these changes is paramount in your ability to fly smooth manoeuvres whilst maintaining constant altitude.

**Right Hand Rectangular Circuit**

This type of structured circuit is a pre-cursor to attempting a landing approach. If you watch most display pilots you will see them perform this circuit as they set up the model for the landing. The whole arrangement has a very pleasing appearance and demonstrates accurate control at all stages.

Approaching into wind, fly the model past your position to a point about 50 metres up wind of the pilot box. Apply some right aileron combined with up elevator. As the model reaches a position 90 degrees to its original flight path apply a little opposite aileron and release the up elevator input.

Continue to fly straight and level for a further 50 metres before repeating the procedure. Fly a down wind leg of about 95 metres and repeat the turn procedure again using a little more aileron and up elevator to compensate for the wind factor.

Fly 45 metres straight and level before making the fourth turn. This should put the model virtually back on the trajectory of the original approach leg. Fly past your position straight and level into wind to complete the manoeuvre.

You will notice the changes suggested for the distances to the final two turns. This is because down wind turns and turns into wind usually take a little longer to complete.

The final turn into wind will test your appreciation of an apparent control input reversal. Although you will be observing the model approaching you about 50 metres down wind, as you again select right stick for the ailerons the model will actually appear to be turning left into wind. This sometimes confuses the learner but it is absolutely essential you come to terms
with the phenomenon. You will experience it even more closely when you start to fly the "figure of eight" manoeuvre.

**Left Hand Rectangular Circuit**

Once again the approach is into wind flying past your position for 50 metres. Apply left aileron combined with a little gentle up elevator until you have negotiated a 90 degree turn away from yourself. Correct back to straight and level with a little right aileron and release the up elevator.

Fly 50 metres then repeat the first corner. Correct the turn and fly 95 metres straight and level. Repeat the 90 degree left turn again and fly 45 metres across wind toward your original approach position. Once again you will experience the effect of control reversal as you apply left aileron for the fourth corner, the model will appear to make a right turn toward you into wind.

Practice this manoeuvre until you can maintain constant altitude throughout and your final turn into wind is as close to your original approach as possible.

**Clockwise Procedure Turn**

This is an interesting manoeuvre as it contains both right and left aileron inputs. Try to imagine drawing a large letter ‘P’ in the sky. Start by lining up the model for an approach into wind. As you reach a position about 15 metres from your position apply some left aileron and slight up elevator. The model will turn away immediately in front of you if you've got the timing correct.

Apply right aileron and release the elevator input to fly straight and level away from you for about 30 metres. Now apply right aileron and up elevator and hold the turn through 270 degrees (¾ of a circle) at which point you should be coming back on to your original approach line but in the opposite direction. Complete the manoeuvre by correcting the turn with left aileron and releasing the elevator input to fly past yourself at the same altitude as your initial approach but in the opposite direction.
This is an attractive manoeuvre and demonstrates your ability to position your model precisely. Keep the circle part of the manoeuvre nice and wide to retain a pleasant appearance. Don’t forget that you may need to increase the turn inputs a little as the model starts to pull through the down wind section of the circle.

**Anti-clockwise Procedure Turn**

This is the reverse of the clockwise version and commences with right aileron and elevator followed by left aileron and elevator to complete the circle portion.
Figure of Eight

This combines all of the features of our previous manoeuvres, combining both circles and procedure turns. You should ideally be standing 10 to 15 metres to the left of the intersection of the two circles.

Of course when the wind is coming from the opposite direction the approach and turns will be as shown below.
In all of the above examples the test of good control is whether or not you can keep the circles consistent in size and the altitude at which you finish the manoeuvre is the same as that when you started it.

**Take Off**

When your instructor feels you are ready and have the necessary aptitude, he will ask you to take off for yourself. This prospect can be daunting for a beginner but once done, what seems to be a difficult task will present less of a challenge the next time around.

The easiest way for a beginner to learn to take off is to for the instructor to hold the model in its take-off position, run up to full throttle and when you are ready, the instructor releases the model. This minimises the effect of gradually increasing the engine torque and propeller wash both of which can tend to make the model yaw (swing) to the left.

If the model does tend to swing left, keep it on a straight heading using a little right rudder. Gradually reduce this rudder movement and when the model has reached flying speed, ease in a small amount of up elevator to rotate for take-off. If the model has been set up for straight and level flight with the engine at around half throttle, there may be no necessity to use up elevator as maximum throttle should put the model into a natural climb. Once the model has reached a safe altitude, reduce the throttle until the model adopts a straight and level attitude. Turn away from your flight line and do a few gentle circuits to get rid of excess adrenaline!
Two or three attempts at this and you will be ready to take the model off without the instructor’s assistance. Taxi the model slowly out to the take off point and turn it into wind. Reduce the throttle to idle and compose yourself. Progressively increase the throttle, correct any swing if necessary with the rudder and ‘Hey Presto!’ you’re airborne. Don’t forget to fly out straight and level until you have sufficient altitude for your first safe turn away from the flight line.

**Important:**
Do not get into the bad habit of turning in the direction that causes you to fly around yourself. Stand still and fly the model in circuits in front of you at all times. Never fly your model over other fliers and/or the pits area, carpark, etc.

### Landing

Clockwise Approach

By the time you are ready to attempt a landing, you will be taking off and flying around safely. The only thing the instructor will be doing for you is landing for you and giving advice and constructive criticism.

As your ability and confidence increases you will start to feel more comfortable flying the model at lower altitudes. Having practiced the rectangular circuits you will be ready to progress to adapting these circuits for landing approaches.

In essence the landing approach is a normal rectangular circuit during which you gradually loose altitude until on the final turn into wind, you are at the correct height to place the model safely on the runway.
This will be explained and demonstrated to you by your instructor. You will start practicing the approach and good or bad approaches will be pointed out to you. Try to locate visual markers or reference points around the flying field to help you make good consistent approaches.

You will be shown how to complete safe approach circuits. This involves reducing engine power on the down wind and cross wind legs so that the model drops to a lower level. Turning into wind you will maintain a low fly past over the landing area.

It is important to have full control during this manoeuvre and to be able to line the model up accurately and at a consistent safe height a few metres above the landing strip. You will then open the throttle to make a recovery climb out to a safe turning altitude and repeat the circuit again.

Practice these approaches until you are confident you can take the final step of cutting the power so that the model touches down safely. When you do finally cut the power for touch down, watch that the nose doesn’t drop too rapidly and be ready to feed in a small amount of up elevator to keep the nose from ‘digging in’. Too much elevator and you will stall the model with possible damaging consequences.

This all sounds a bit traumatic but when you are ready your reactions should be quick enough to handle the situation. Your instructor, having gained experience with your model through previous landings, will be able to advise you on the best engine settings and elevator controls for successful landings.

Anti-clockwise Approach
**Simple Aerobatics**

Having progressed this far, your skills should be adequate for you to start considering a couple of the most basic aerobatic manoeuvres – the **loop** and the **roll**.

The purpose of this manual is to help you master the basics of powered model aircraft flight, not to teach you to do a full Aresti programme. The two manoeuvres mentioned are however simple enough for the beginner to master once the basic horizontal flying challenges have been overcome.

Consult with your instructor and providing he or she feels you are ready for this progression, take the plunge.

**The Loop**
‘Open the throttle, pull up elevator and go over the top for a loop’. Most people think that’s all there is to it. Not so! Getting the loop circular is definitely not as easy as it would seem. Various factors influence the accuracy of a loop. Wind strength and direction, engine power, configuration of the model, etc., all effect the final symmetry of your loop.

Let’s take a look at what’s involved. Ensuring lots of altitude and that the wings are level, head straight into wind open the throttle for full power and after a few seconds pull in almost full elevator. As the model passes through vertical and approaches the top of the loop, cut throttle completely and release most of the elevator. The model will go over the top of the loop and start to drop its nose toward vertical. As the model passes the vertical (this time heading straight for the ground!), ease in up elevator and open up the throttle again to level out.

If you get it right, you should depart the loop flying straight and level at approximately the same height and position that you entered it. Don’t forget, ensure you have plenty of altitude before commencing your first attempts just in case you get into difficulty.

With practice you will learn to make corrections for wind strength at different positions around the loop much as you did when learning to fly circuits. In still air the loop is relatively simple but in stronger breezes accurate loops are more difficult to master.

**The Roll**

The Axial Roll (to give it its correct title) is pretty straight forward if you have masses of forward air speed and powerful control surfaces. Flying straight and level into wind, bang over full aileron control and hold it until the model assumes its upright position again. Let go the aileron stick and there you have it, a perfect axial roll.
Fine, assuming you are flying a high speed ballistic type aerobatic model with enough speed and roll rate to complete the roll before the nose has the time to think about dropping.

You are flying a trainer that doesn’t have these characteristics. If you tried this simple approach, your model would be on a downward trajectory toward mother earth by the time it recovers to the upright attitude.

This doesn’t mean to say that you can’t fly an axial roll with your basic trainer, it just needs a little more attention to detail to make it happen.

Let’s talk you through it. Ensure plenty of altitude for recovery in the event of disorientation or a mistake (same thing really!). Line up into wind, increase engine speed to almost full throttle. This will start to lift the nose a little. Apply full left or right aileron input and the model will start to rotate about the roll axis depending on which aileron input you selected.

As it approaches the inverted you will need to apply a little down elevator which means pushing the elevator control stick away from you. Release this as soon as the model passes the inverted state and starts to roll upright again.

Once the model is in the straight and level attitude release the aileron control input and reduce throttle back to half for level flight position.

It’s important to practice the manoeuvre rolling both left and right. Don’t get stuck in single rotation mode.

As you become more proficient in this manoeuvre try applying a little less aileron input so that the model rolls more slowly. You will notice that more down elevator is required for a longer period to maintain level flight in the inverted state.

The Engine Out or Dead Stick Landing

So far we have assumed everything to be running smoothly and that your engine is not misbehaving. Occasionally for no apparent reason your engine may stop in mid flight or when you throttle right back during a manoeuvre. You may have been flying for longer than you realize and just run out of fuel.

Whatever the reason, you now have to get your model down safely and ideally, if you are flying a safe radius of the take off area, within a few metres of where you are standing. Most important, of course, is that you land it safely and without endangering the lives or equipment of your fellow fliers.

Your club will have a recognized call to notify everyone of a stopped engine in flight. You need to be familiar with this call so that you can warn everyone of your need to land quickly and safely. Don’t be afraid to shout it out loudly, everyone needs to be aware.

Unfortunately when an engine stops it is often at the most inconvenient of moments where the model has no chance of recovering to the landing area in time. All you can hope to do in this instance is to line the model up into wind, altitude permitting, and control it into a gentle flair out. Do not attempt to hold the model off with the elevator as it will inevitably stall and crash.
If you are lucky enough to have the advantage of plenty of altitude, try to bring the model into a landing approach circuit. Try to judge the turns to lose the altitude for a normal landing on the runway in front of you. Your instructor should be able to advise you the best points at which to turn.

Dead stick approaches and landings should be an integral part of your training schedule. Discuss this with your instructor.

**Using a Flight Simulator**

A very good learning tool for any beginner is an RC flight simulator computer program. Advances in personal computers and software have resulted in simulators with a very high degree of realism.

Although not a total replacement for actual flight training, virtual training in the comfort of home can help teach the student pilot good hand and eye co-ordination. Practicing at home helps the student when he or she goes to the flying field and has the transmitter. Reactions will be quicker.

Less “think time” means more time to correct for piloting errors. Another advantage of flight simulators is that they extend the flying season for those who live in cooler climates. You can “fly” all winter long and never leave the house.

Several flight simulators are available and they all work roughly in the same way. The simulator presents a model airplane image on the computer screen that reacts to your control inputs.

Some simulators come with a control box that looks very much like an RC transmitter; other systems provide an interface that lets you connect and use your own transmitter. You can choose from several types of model provided by the program. You can even create new models or represent your own.

Most simulators offer a choice of flying environments. You can fly from a typical flying field, the surface of Mars, or anywhere in between. You can adjust weather elements such as wind direction, crosswind velocity and gusts. You can make the flight simulation as easy or as difficult as you like.

By using a flight simulator, you can reduce the time it will take for you to learn how to fly your model. You can also continue to fly even when the weather is against you. Enjoy the excitement of RC flight indoors and have fun!
Summary

The more time you can devote to flying as often as possible, the quicker you will progress. The more you fly the sooner the day will come when your instructor will allow you to attempt that first landing. Your instructor must be absolutely sure you are ready for this step. This is a critical time for the instructor since he or she must react quickly if you make a mistake. It may take you several attempts before you actually set the model down on the runway. Even then, it might bounce through lack of control and seem to be flying again. Even though this occurs, you must continue to control the model all the way to the point that it stops rolling.

After what may seem like an eternity, the day will come when your instructor is satisfied that you are proficient enough in your flying skills to fly solo. This can be either or both a harrowing and/or exhilarating experience. You may feel that you have finally reached your goal but this is only the beginning. Now the fun really starts, you can now spend hour after hour practicing and developing your skills.

Don’t become too cocky and over confident. This is only the first stage in your progression to becoming a fully competent model pilot. There’s still a long way to go before you reach the standard of your instructor.

Treat your model with respect, follow the simple basic guidelines and there is no reason why, given enough time and practice, you shouldn’t eventually become equally as competent as those with the skills you envy and admire.

Also, having reached this stage, you may feel you are ready to progress to your next model with more aerobatic potential. Fine but go carefully, don’t be tempted to go buy that WW2 fighter type or an out and out aerobat, 3D machine or “turn it inside out” fun-fly machine, time for those later.

What you might consider is a somewhat more advanced trainer type with mid or low wing configuration, something that is marginally more aerobatic but still with a good measure of natural stability.

There are a good number of attractive designs to take you through this intermediate stage ‘en-route’ to more advanced flying. Consider some of the more interesting scale or semi-scale models of mid-war and modern civil types. Get the opinion of your instructor and look at what other post student grade members are flying before making your final choice.

Whatever your choice, good luck and happy flying, go out and enjoy your new found skills and help promote our hobby safely.
Part 5

Resources

Additional Equipment

The equipment required to get a trainer off the ground can be relatively inexpensive compared to the cost of the other components. There are a few basic items that will suffice to get a beginner into the air and learning to fly but there are other items that can be added to make the job a lot easier.

**MINIMUM EQUIPMENT**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glow Plug Driver</td>
<td>Clip on battery for supplying power to glow plug.</td>
</tr>
<tr>
<td>Chicken Stick</td>
<td>Stick used for flicking the prop to start the engine.</td>
</tr>
<tr>
<td>Fuel</td>
<td>Fuel mixture recommended by engine manufacturer.</td>
</tr>
<tr>
<td>Fuel Squeeze Bottle</td>
<td>Bottle used to transfer fuel to model tank.</td>
</tr>
<tr>
<td>4-Way Wrench</td>
<td>Combination wrench with sizes to fit glow plug, prop nut, etc.</td>
</tr>
<tr>
<td>Tool Box</td>
<td>Any box suitable for carrying the other equipment.</td>
</tr>
</tbody>
</table>

The cost of these items will vary depending on the brand of the items and the place from which the items are purchased. An assortment of screwdrivers, pliers, and allen keys or wrenches may also be needed to perform field maintenance.

**OPTIMUM EQUIPMENT**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starter</td>
<td>Battery powered motor for starting model engine.</td>
</tr>
<tr>
<td>Glow Plug Connector</td>
<td>Clip on battery connector for supplying power to glow plug.</td>
</tr>
<tr>
<td>Power Panel</td>
<td>Power distribution panel for distributing power from a field battery to starter, glow plug connector, etc.</td>
</tr>
<tr>
<td>Field Battery</td>
<td>Small 12 volt wet or gel cell battery.</td>
</tr>
<tr>
<td>Fuel</td>
<td>Fuel mixture recommended by engine manufacturer.</td>
</tr>
<tr>
<td>Fuel Pump</td>
<td>Special pump used to transfer fuel to model tank.</td>
</tr>
<tr>
<td>4-Way Wrench</td>
<td>Combination wrench with sizes to fit glow plug, prop nut, etc.</td>
</tr>
<tr>
<td>Field Box</td>
<td>Tool box specifically designed for carrying model field equipment.</td>
</tr>
</tbody>
</table>

Again, the cost will vary depending on the brand of the items and the place from which the items are purchased. Field box kits are available for a wide range of prices but can be built from readily available materials. Plans are available for either a simple field box that will fill the needs of a beginner or for a basic necessities field box for a beginner who wants something a little more sophisticated. As before, an assortment of screwdrivers, pliers, spanners, and allen wrenches may also be needed to perform field maintenance.
Pre-flight Checklist

When your model is ready to fly, make sure it is thoroughly checked over by someone who has done a lot of building and flying. When I say thoroughly, I don't mean just picking it up and checking the balance and thumping the tyres a few times. Every detail of setup and connection should be gone over in detail. If your instructor doesn't want to spend this much time checking your plane, find a new instructor!!!! The importance of this pre-flight check cannot be overemphasized! Many models are lost due to a simple oversight that could have been caught by a pre-flight check.

Weight
Is the model too heavy?

Balance
Is the center of gravity (fore and aft) within the range shown on the plans?
Is the model balanced side to side? (right and left wings of equal weight)

Alignment
Are all flying surfaces at the proper angle relative to each other?
Are there any twists in the wings? (apart from built in wash-in or wash-out)

Control surfaces
Are they all securely attached? (i.e. hinges glued, not just pushed in)
Are the control throws set to the correct direction and amount? (this is normally indicated in the plans)

Control linkage
Have all linkages been checked to make sure they are secure?
Are all snap-links (clevises) closed and keepers fitted?
Have snap-links been used on the servo end? (They are more likely to come loose when used on the servo)
Have all screws been attached to servo horns?

Engine and fuel
Has the engine been thoroughly tested?
Are all engine screws tight?
Has the engine been run up at full throttle with the plane's nose straight up in the air? (To make sure it won't stall when full power is applied on climb out)
Is the fuel tank level with the flying attitude of the plane?
Is the carburetor at the same height (not above) as the fuel tank?
Is the fuel tank clunk in the proper position and moving freely?

Radio
Has a full range check been performed?
Has the flight pack charge been checked with a voltmeter?
Have the receiver and battery been protected from vibration and shock?
Is the receiver's antenna fully extended and not placed within a fuselage with any sort of metallic covering?
After repair:  
The checklist should be gone through again, with particular attention to the areas that were worked on or repaired.

Before EVERY flight:  
Check the receiver flight pack with a voltmeter to ensure enough charge.  
Check the control throw direction for all surfaces. It's very easy to do a repair or radio adjustment and forget to switch these.  
Start the engine and test the entire throttle range. Run it at full throttle with its nose in the air for 15 seconds or so. (if applicable)

Always remember, with model aircraft;  
Take-offs are optional, landings are mandatory!

RC Propeller Safety

Warning!!! - Follow these Basic RC Propeller Instructions Carefully:

- Always follow your engine manufacturer’s recommendations for size and pitch.
- White painted propeller tips have a more scale appearance and can be seen.
- Always use a "chicken stick" or other approved device for starting. NO HANDS!!!
- Keep yourself and others away from the path of rotating blades, especially hands.
- Make carburetor adjustments from behind prop where possible or with engine at low revs.
- Check for objects that can be picked up and blown back from below and in front of the prop.
- Make sure nothing can fall from your pockets into rotating blades.
- When running a glow engine be sure the attaching cable and clip cannot tangle in prop.
- NEVER TRY TO RECONDITION OR RE-USE A DAMAGED, NICKED OR BENT PROPELLER!!!!
- DO NOT BUY USED PROPELLERS!!!
Knowing Your Engine

Most trainers are flown using a glow plug two stroke engines so let’s take a look at how they work.

Air is drawn in through the carburetor barrel where it is mixed with the fuel before entering the intake port. The piston is on the down stroke so the mixture is drawn up the bypass ports into the combustion chamber.

As the piston travels upwards, it compresses the mixture. The pressure reaches a point where the glow plug ignites the mixture and forces the piston back down the cylinder, opening the exhaust port expelling the exhaust gases and surplus oil. The piston starts to rise again, forcing a new fuel/air mixture charge into the combustion chamber.

Not all of the expanding exhaust gases can pass through the muffler at once. Some of it will stay in the muffler as the next cycle begins. This retained exhaust gas causes a back pressure that helps keep the new charge of unburned mixture from entering the combustion chamber, blowing over the top of the piston and out through the exhaust. Hence, better fuel economy.

Timing is achieved by several factors: Glow plug heat, port locations, crankshaft design and length of stroke (length the piston travels up and down). Any one of these out of tolerance will cause ignition of the fuel air mixture before the piston reaches top dead centre. This phenomenon is called “detonation” or “pre-ignition”.

Breaking in your Engine
The object of breaking in or running in an engine, is to get the engine to the point where all the rubbing surfaces are perfectly mated to each other at all temperatures likely to be attained, while causing as little wear to the engine as possible in the process.

The benefits of doing this properly are that the engine will be a 'better' engine throughout its life, and that life will also be extended. If you can get hold of one, use an old (but working) glowplug when first running in your engine. Often minute pieces of metal from the running in process or swarf left from manufacturing can destroy a glowplug in seconds.

Run the engine very rich and lightly loaded at first and only gradually increase the amount of load on the engine and at the same time gradually increasing the temperature that the engine is allowed to reach through careful adjustment of the main needle valve.
Spread this gradual process over approximately the first half hour of the engine's life. It should then be ready for its first full speed run. During all running of new engines, the setting should be on the rich side of peak power. Try to run the engine in for this period with the throttle fully open.

The difference between a reliable engine and a troublesome one is very often how it is treated in the first 15 minutes of its life!!

**Ringed Engines**
Most manufacturers recommend either castor based fuels or synthetic oil based fuels with the addition of castor for the first run(s).

The first tankful should be run absolutely soggy-rich, leaving the glow-plug lead attached if necessary to keep the engine running. Make these first runs short duration of one-half to one minute, with a few minutes cooling down time between each. The more of these heat cycles there are makes the metal "set" and speeds up the final fit of the components. Rich mixture and short runs prevent the temperature from rising too much. Any debris that forms will be washed away by the excess fuel and oil.

Refill the tank and set the main fuel needle to give a very fast four-stroke with just the occasional hint of two-stroking. Allow engine to run for 30 seconds and then stop for a two minute cooling period. Check tightness of all bolts. Start the engine again for 30 seconds then allow it to cool again. Gradually increase the duration of the full throttle runs, unless the engine shows a tendency to bind. Binding will cause the engine to labour and fail to maintain a steady rpm.

At the end of two tankfuls you can lean the engine out to the point where it is on the verge of two-stroking and four-stroking and go fly. Reduce throttle from time to time to allow the engine to cool a bit. Keep this up for about four litres of fuel.

By this time the engine should be running steadily, with no tendency for the RPM to fluctuate up or down. At this point the engine can be leaned further so that maximum power is achieved. Always back off the needle a bit (one or two ‘clicks’ on the needle should be enough) until a clear drop in rpm can be detected. This should be the normal setting for longevity and strong running in the air. During flight, the engine will lean out a bit, so you will be on the safe side of disaster with this setting.

All this might seem a long-winded process but it is necessary to get the best surface finish with the least wear inside your precious engine.

Everything needs to be done in small and gradual steps so that the rubbing surfaces can mate at gradually increasing pressures. To further complicate this, the component parts of the engine change shape as temperatures are increased.

For example, the cylinder and piston are round and parallel sided when made. As the engine warms up the top half of the cylinder gets hotter than the bottom half and so expands unevenly, worse than this the exhaust side of the liner runs hotter than the fuel transfer side.
To further add to the problem the front of the engine being cooled by the airflow does not heat up as much as the rear of the engine. As a consequence the liner will be anything but perfectly round and parallel when thoroughly hot.

These factors are the reason for a well run-in engine having a bit less compression during starting than a new engine.

Similar stresses effect the piston and ring. The ring changes its length depending on temperature and is also going up and down a bore which is no longer round or parallel sided. At the same time it is taken through this operation by a piston which gets hotter at its head where it is in contact with the burning fuel mixture. The diameter of the head is bigger than the walls, the exhaust side of the piston is hotter than the transfer side so the piston is no longer round nor, as mentioned earlier, parallel sided.

All these distortions vary according on the temperature of the engine. Consequently, the running-in process provides the necessary opportunity for the engine to make the mating working surfaces suitable for every condition.

At various intervals during the running in process (after say every 5-10 minutes) check that all screws and bolts remain tight. If you have to tighten any cylinder head bolts it is essential you tighten them a little at a time and always in diagonal rotation. It is possible the glow-plug will have been affected by small metal particles fired at it during running in. If you are unsure of its condition, change it and keep the old one for running in only, or throw it away.

**ABC Engines**

An ‘ABC’ engine is one with special liner and piston metallurgy, e.g., the piston is Aluminium (A), the liner is Brass (B), and the brass is Chrome plated (C). Generally (but not always) these are performance orientated engines.

Brass expands more than aluminium so that when an ABC engine is warmed up, the top of the liner (brass), will expand more than the piston (aluminium). This would mean that as the engine reaches working temperature the piston seal would not be very satisfactory. To compensate for this difference, manufacturers make the liner and piston the correct sizes for when the engine is hot. This means that when the engine is cold the piston is a very tight fit at the top of the liner. Some engines are so tight they make a light groaning noise when forced over Top Dead Centre (when the piston is at the very top of its travel, or TDC for short).

**Warning:** Never turn a new ABC engine over slowly, especially when still lubricated by the original preserving oil that the engine is shipped with. Slight, but immediate damage will be caused to the top part of the piston fit, because the surfaces are still rough.

These engines require only a small amount of running in. The cylinder temperature needs to be raised to full working temperature as quickly as possible. This will avoid excessive piston wear due to the very tight fit at lower temperatures. It is recommended to fly these engines straight from the box, using a rich setting so that it occasional drops back to four stroking. However, the 15 minute rule does apply – so a good period of running in (preferably on a test stand) will be well worthwhile. It is a good idea to use a fuel with an extra 5% of oil above a
normal fuel mixture. Run the first tank (say 1-2 minutes) at a ¼ throttle position with the engine on a rich 2 stroke setting (ensuring you can still feel unused oil exiting the silencer on your fingertips). You just never know how long the engine has been in its box!, so this nicely lubricates all the moving parts. Allow engine to cool. Next 1-2 minutes the same but at half throttle. The next 3-4 minutes with the throttle wide open – again with unused oil exiting the silencer, but with a stronger rpm setting (to bed in the moving parts). Complete the running in either on the test stand (a handy tool and well worth the investment longer term – most stands will cope with 2cc-30cc engines) or in the model until the engine is capable of holding full rpm without faultering.

During the first couple of flights run the engine in short cycles of approximately 30 seconds at full speed then drop back to 1/3 speed for 5 to 10 seconds. This will keep the cylinder temperature up and the slow running allows time for any hot spots to cool down a little. For the next 4 or 5 flights use the engine normally but keep it slightly rich (just 2 or 3 clicks). After that, normal manufacturers recommended fuel can be used.

**Setting the main needle valve**

This sets maximum power and controls the running temperature of the engine. These two factors not only determine the length of the engine’s life, they influence the life of the glow-plug and the engines overall reliability. Engines don’t very often cut out in flight when they are set slightly too rich, but they most certainly do when set too lean.

For the five minutes or so it takes to learn the drill for correct needle valve setting, it's well worth taking the trouble for the long term benefits gained.

ABC engines start best on low throttle settings. Once the engine is running, open the throttle fully and set engine slightly rich so that it is just four-stroking. Let the engine warm through thoroughly at top speed for a few moments before re-adjusting the needle so that the engine is just off four stroking and running smoothly.

Now further lean out of the mixture until the RPM increases to maximum. From this established point richen up slowly again until a small but definite drop in RPM is noticed but the engine is still two-stroking smoothly. Lift the nose of the model up vertically and if the engine RPM increases back to maximum then you should have a good flight setting. Should the model has a tendency to go rich or go lean in flight then an extra allowance will have to be made for this on the final setting.

What you are trying to achieve is maximum power from the engine when it is needed most, either when the model is climbing or when turning sharply and at the same time provide sweet and cool running during level flight, the best of both worlds.

**What happens when an engine is set too lean**

Glow-plug engines keep running because the heat of compression and the catalytic action of the glowing plug material on the methanol mixture cause the charge in the cylinder to ignite at the correct moment. This catalytic action also keeps the plug glowing.

Sometimes an engine will start without adding power to the plug after it has been stopped for several minutes. The whole system is very temperature dependant and under certain
circumstances requires no glow or injection of fuel to set it off, just the correct combination of
conditions.

If an engine is set lean for maximum RPM at the start of a tankful of fuel, anything that
reduces the amount of the fuel through the needle valve will make the engine run excessively
lean. Some engines will refuse to continue running in this condition. The majority will
continue to run to some degree but at reduced RPM, reduced power and extremely hot,
causing premature wear and/or failure.

The most common factor in reducing fuel pressure is the increased air volume and
diminishing fuel level in the tank as it is used up. The pressure, seen by the needle valve,
gradually reduces and the air/fuel mixture gets progressively leaner as the flight continues.
Because the engine started set in a lean condition it eventually progresses into an over-lean
condition and may possibly cut out, suffer from overheating and incur internal damaged.

The extra stresses caused by overheating and excess pressures that result may only result in
your engine wearing out more rapidly than necessary. Plus, if you run your engine lean
regularly it can result in very early bearing failure, and if it happens to be the con-rod that
gives up first the resultant damage can be very expensive.

**Setting the low speed or idle setting**
As the throttle is closed it not only reduces the amount of fuel entering the carburetor, it also
lets less air through into the engine. To keep the fuel air mixture within combustible limits the
fuel flow ratio has to be altered, it's too fussy to leave to chance. Most manufacturers have
opted for a two needle configuration or something which works in a similar manner.

Start the engine and warm it up and making sure the main needle is properly set. Leave the
glow-plug lead connected to energize the plug and slow engine down by gradually closing the
throttle until the engine starts to run unevenly. Adjust the slow run needle to give smoothest
running characteristics just a little on the rich side of the fastest setting you can achieve.
Having made this adjustment slow the engine further until it runs unevenly again, now adjust the slow needle again until the engine runs smoothly once more. Continue this step by step procedure until the desired tick-over has been reached. At this point the throttle barrel should be barely 1mm open.

Now remove the plug lead and repeat the whole process. If the engine cuts dead in the middle of adjustments it's usually because it is too lean. You may need to set the slow running needle a click richer at each adjustment (1/8-1/4 turn).

With the engine at a slow tick over, check that the engine will pick up properly. Open the throttle to full speed with a smooth sweep without slamming the control stick hard forward.

The engine picks up but splutters a little whilst doing so, the low speed needle is set little rich. The engine appears to miss and then picks up, the low speed needle is slightly lean, the engine cuts dead when the throttle is opened, the low speed needle is set too lean, richen the low speed needle 1/4 turn and try again, adjusting in small increments. The engine starts to pick up pretty well and then cuts at about 1/3 speed or so, try opening the main needle two or three clicks.

There is often a compromise to get the low speed, midrange, top speed and pickup to a useable state. Usually the compromise is that somewhere in the range the carburetor has to be set a little richer than would be considered ideal. This is not really such a bad thing as rich mixtures are an assurance for longevity and seldom cause the engine to stop, unless set extremely rich.

Air bleed carbs work like ‘twin needle’ carbs, although are not normally quite as accurate at setting the low speed air/fuel mixture. To richen the setting, screw the needle (or bolt) in. To lean the setting, turn the needle (or bolt) out.

**The Pinch Test**
Pinch the fuel line between tank and carburetor and observe whether the engine speeds up. If it does it is on the rich side of the optimum adjustment. Just how much is speeds up indicates how close you are.

If it speeds up considerably, the setting is rich.
If it speeds up just a little, the setting is just about correct.
If it doesn't speed up at all, the engine is on the point of going lean.
If it slows down, the setting is lean.

The test causes a temporary starvation of fuel, and is a reliable test for the engine being too lean. The ideal setting is when, at full throttle, quickly pinching the fuel supply line causes the engine to momentarily increase its RPM before starting to die. If it starts to die immediately, then it's already too lean and should be adjusted for a richer setting.

*Authors Note: Thanks go to Just Engines (01228 712800) for help with the technical content of this section.*
Some Beginner Tips

- Roll test steering in a driveway or car park. If it doesn't roll straight at home, it won't roll straight on a runway. Set control to the least sensitive position.
- Put small marks at the C.G. (Center of gravity) on the wing to indicate balance location. Makes it easy to check at the field.
- Balancing laterally (side to side) will help aircraft track better in maneuvers. Hold at spinner and tail. Add wing tip weight as necessary.
- Check receiver battery every 2-3 flights. Make a chart of how long you have flown vs. Voltage drop. Do not operate below recommended voltage level.
- Always turn on transmitter 1st, receiver 2nd. Always turn off receiver 1st, transmitter 2nd.
- Range check your system before 1st flight every time out. This should be performed with engine running at both idle and full throttle.
- When using the buddy box system, make sure both boxes are set identical. Never turn buddy box power "on"!
- Remove transmitter neck straps when starting engines.
- If you don't have a starter, at least use a "chicken stick". Do not hit it against the propeller; start your flick with the stick touching the propeller.
- Never jamb a running starter onto the spinner. Back up the propeller, and place the starter cone against spinner before turning on.
- When you start your engine, look at your watch and keep track of time. After flight, check fuel level to assess maximum available flight time.
- Do not reach over propeller to adjust needle valve do it from the rear of the propeller. Do not position yourself (or others) to the side of a rotating blade. It could fail on run-up or kick up debris.
- Taxi while holding "up elevator".
- Always fly with a co-pilot/spotter.
- Never practice maneuvers at low altitude. Fly 2-3 mistakes above the ground.
- When trimming an aircraft in flight, trim only until it stops the incorrect movement.
- Most trainer aircraft will recover from unusual attitudes (mistakes) by killing the power and pulling up elevator (depending on altitude). Be ready to level out and apply power.
- Remember, unless you are "dead stick", you do not have to land. If it's not right, go around. It's much easier, and safer, to do it over rather than try to salvage a bad approach.
- If you get nervous for any reason, climb out and do some simple circuits over the field. When you calm down, try again. Don't push yourself to try again too soon. Take your time.
- Do not fly too far away as it is easy to get disorientated. This is especially true when the sun is low on the horizon and the aircraft becomes a silhouette.
- Installing larger wheels on your trainer will:
  1) Make taxiing in grass easier.
  2) Improve your visual orientation in the air.
  3) Improve your landings as gear won't bend as easily.
- Maintain your flight path. Do not make any erratic maneuvers to avoid faster, more maneuverable overtaking aircraft (experienced pilots etc.). It is their responsibility to avoid you. However, make a conscientious effort to not be a hazard either.
• If it is obvious that you are going to crash, kill the power to minimize damage.
• If for any reason your aircraft is in trouble and headed for the pit area or spectators: Do your best to kill the power and ditch it. Don't try to save it. Planes are cheaper than people. It's a small sacrifice to make.
• If your aircraft does go down in a field or trees-Don't move! Note where you are standing, and pick a far distance reference point or object. Follow a straight line in your search and rescue effort.
• If you are searching in the trees, listen to aircraft overhead to orient yourself to the flight line and runway. It's a jungle out there.
• When you do recover a crashed aircraft, be sure to pick up every last part, piece and splinter. You'll be glad you did when you decide to rebuild it after the shock wears off. All those little pieces can be glued together to make templates to create replacement parts.
• If you have adjusted the elevator trim to compensate for lower fuel weight during the later part of the flight, when you land immediately reset the elevator trim to the "full fuel tank" position. Otherwise you probably won't remember until you are about 10 feet off the ground on the next take-off (And headed back down to mother earth!).
• Even long after you've gone solo, don't be afraid to ask for additional help or instruction. It's never too late to learn!

**Model Aeroplanes: Glossary.**

• **Aerofoil.** A cross-section of the wing taken at right angles to the span of the wing.
• **Airplanes.** USA spelling of aeroplanes.
• **Aileron.** Movable control surfaces on the wings which roll the plane to left or right.
• **Aileron differential.** Set up where the downward moving Aileron moves a smaller distance than the upward moving surface. Lowering the downward Aileron too low creates induced drag and thus makes the wing skid rather than lift.
• **Aerobatic.** A model capable of performing advanced manoeuvres in the air.
• **Aerobatic Trainer.** Trainers with more advanced airfoils, more power, greater control movements and less inherent stability than a basic trainer.
• **A. M. A.** Academy of Model Aeronautics. USA Governing Body for model airplane activities.
• **Anhedral.** Where the aeroplane wings are set at an angle such that the tips are lower than the centre. Used on high wing aerobatic models. (Full size - see Harrier jet.)
• **ARTF.** Almost ready too fly. Now very popular way of buying models.
• **Aeromodeling.** Overall name for model aircraft activities.
• **Aerodynamics.** The science of flight.
• **Aspect ratio.** The ratio between the span and the width, or chord, of the wing.
• **Ball Link.** Pushrod connection with a link that "snaps" onto a ball on the output arm.
• **Balsa Wood.** Very light wood but very strong. Once the only material used for model aircraft construction. Still used extensively in model aeroplanes and modeling in
general but has been superseded by modern composites in many areas of aeromodeling.

- **Biplane.** An aircraft with two main flying surfaces, or wings.
- **BARCS.** British Association of Radio Control Soarers. All things glider.
- **B M F A.** British Model Flying Association. UK Governing Body for model aircraft activities.
- **Brain Fade.** A mental state where you suddenly forget which way to move the controls. Happens for no known reason, even when you know you're a proficient flyer.
- **Brushless motors.** Vastly superior model electric motors using the three phase system and no, radio interference causing, carbon brushes.
- **Bungee.** Method of launching sailplanes using stretched elastic to give launch effort.
- **CA. Cyanoacrylate. Cyano.** Instant glue available in various viscosities.
- **Canard.** An aircraft where the tail plane is ahead of the main wing.
- **Centre of Gravity.** The lateral balance point of an aircraft.
- **CG:** The balance point of the model. Beginners, it is vital that you do not move it.
- **Clevis.** A device for connecting a control rod to a control horn on a control surface.
- **Closed loop.** A control surface operated by flexible wires under slight tension.
- **Cockpit.** The part of the plane occupied by the pilot.
- **Control line.** Model controlled by two long wires connected to a control handle.
- **Cowling.** The part of the structure, which encloses the engine.
- **Dead stick.** Term used by pilot to warn other flyers that the engine has stopped.
- **Delta.** Aircraft with a triangular wing. Concorde for example.
- **Dihedral.** Where the wing tips are higher than the centre of the wing. A shallow V. Gives pendulum stability. The actual degree of angle varies from design to design.
- **Down thrust.** A downwards tilt to the engine to counteract excessive wing lift.
- **Drag.** Resistance to the forward motion of the model through the air.
- **Dumb Thumb.** See Brain Fade.
- **Electric power.** Models utilising rechargeable batteries to power electric motors.
- **Elevator.** Movable control surfaces on the tail plane. Moves up or down to alter the angle of incidence (or of attack) of the wing. Also controls airspeed.
- **Elevons.** Used on delta wings and flying wings, the ailerons also acting as elevators.
- **Epoxy Resin Adhesive.** A two part, resin hardener glue that is extremely strong. It is available in various types from instant to 24 hour curing.
- **Epoxy glass.** Fibreglass coated with epoxy for a very strong covering.
- **Fin.** The fixed vertical element of the tail plane cluster.
- **Final Approach.** The landing part of the flight when lining up with the runway.
- **Firewall.** A main bulkhead in the fuselage to which the engine is attached.
- **Flaps.** Control surfaces on the wing which increase the drag to lower the speed.
- **Free flight.** Models flown without any remote control system. Still popular despite R C.
- **Flight Box.** Container used to transport all the equipment used at the flying field. Sometimes incorporates a model stand for starting and at-the-field, maintenance.
- **Fun flyer.** Model capable of performing seemingly impossible gyrations in the air. This being achieved by a very high power to weight ratio and control surfaces often up to 45% of total flying surface area.
- **Fuel Proofer.** Impervious coating for model aircraft surfaces to ensure that raw fuel and oil does not seep into the internal structure and cause damage.
• **Fuselage.** The main body of the aeroplane. Acting as an anchor point for the flying surfaces and propulsion units.

• **Glitch.** Intermittent malfunctioning of R C system due to possible radio interference or possibly metal to metal generated electrical interference on the plane itself. Can be particularly bad where a metal to metal connection is used on the throttle connection.

• **Gravity.** The constant enemy of model flight, comes in the form of excess weight.

• **Ground Effect.** The cushioning of the air against the ground as the aircraft comes in to land, increases lift and prolongs the glide, sometimes past the end of the runway. Not a good state of affairs. Poses major problems for trainee model helicopter pilots, transferring from and to ground effect in the hover.

• **Ground Loop.** Where the aircraft performs a complete circle on the runway, often due to side winds. Tail draggers are more prone to this condition.

• **Gyro.** Controls the tail swing on a helicopter by adjusting the pitch of the tail rotor blades as it senses movement. Its introduction transformed model helicopter flying.

• **Hand launch.** Whereby the plane is released from the hand.

• **Hanger Rash.** Damage inflicted on the airframe during transit to and from the flying site.

• **Hanger Queen.** Model which is built and all ready to fly but is never actually flown usually due to extreme fear of the possible impending disaster.

• **Helicopter:** Rotating wing (or blades) flying machine.

• **High Wing.** Aircraft with the wings mounted on the top of the fuselage.

• **Incidence.** The angle of the wing relative to the fuselage center or datum line.

• **Inverted.** Flying the aeroplane upside down, or wrong way up, if you wish.

• **Jetex.** Proprietary name for simple form of jet propulsion unit using dry pellets of fuel as used in World War 2 rocket propelled shells. Popular in jet models in the 1950's.

• **LMA.** Large Model Association. Large means large.

• **Loop.** Basic aerobatic manoeuvre in the vertical plane.

• **Low Wing.** Aircraft with the wings mounted on the bottom of the fuselage.

• **Mid air.** Colloquial name for an airborne collision between two models.

• **Mid Wing.** Model with the wing situated on the centre line of the fuselage.

• **Monoplane.** An aircraft with one main flying surface, or wing.

• **Muffler.** Another word for exhaust silencer. See Engines, Silencer.

• **Neutral stability.** A desirable set up on aerobatic models giving accurate response to control inputs. Exactly opposite to trainers, which have built in stability.

• **One point landing.** Colloquial term for an often terminal dive into terra firma.

• **Overshoot.** Where an attempted landing has to be aborted due to various factors, eg, people on the runway, plane on runway, approach too high, usually followed by a circuit and further landing attempt.

• **Parasol Wing.** Wing mounted above the fuselage on struts.

• **Park Flyer.** Very small, very light R C models, electric powered, flown in small areas and indoor. Please note, insurance is still advisable.

• **Pattern plane.** A class of aerobatic plane designed to fly set aerial patterns.

• **Polyhedral.** Type of dihedral with more than one angle break in the wing.

• **Port Wing:** Left wing, facing forward.

• **Push rods.** Used to transmit movement from servos to control surfaces.

• **Quick link.** Spring loaded detachable links used on pushrods. Another name for a clevis.
• **R C.** Radio Control.
• **R O G.** Rise off ground.
• **Re-Kitting.** Colloquial term for the wreckage left after a terminal dive into terra firma.
• **Roll.** Basic aerobatic manoeuvre in the horizontal plane.
• **Rudder.** Movable control surface on the fin, mostly used to correct direction.
• **SAA.** Scottish Aeromodelers Association.
• **Sailplane.** High performance form of glider.
• **Scale Model.** Accurate reproduction of full size prototype.
• **Semi scale.** Model giving the feel of a scale model but not accurate in every detail.
• **Shot down.** Term to describe your plane crashing due to radio interference. Can be an outside source, but more often some other flyer switching-on, on your frequency.
• **Slope Soarer.** Specialised glider which uses hillside slope lift to remain aloft.
• **Slow Flyer.** See Park Flyer.
• **Solo.** Your first totally unassisted flight with a controlled take off and landing.
• **Sport Scale.** Models designed to look like scale models but with easy flying ability.
• **Sports Models.** Models designed for general flying ability and good all round use.
• **Stall.** A complete loss of lift, due to various aerodynamic factors.
• **STOL.** Aircraft with special wings equipped with lift enhancing flaps and slats etc. to give Short Take Off and Landing.
• **Starboard Wing:** Right wing, facing forward.
• **Tail Dragger.** Plane with single tail wheel and two main wheels.
• **Tail Plane.** Fixed horizontal tail surface of an aeroplane.
• **T Tail.** Where the tailplane is mounted on top of the fin.
• **Thermal.** A rising column of warm air capable of lifting gliders to a great height.
• **Thread Lock.** Type of adhesive which locks up the thread of nuts and bolts in conditions where vibration is prevalent. Helicopters being a case in point.
• **Tip Stall.** Loss of lift at one wing tip, not a desirable situation the wing tip stalling drops suddenly and can turn the plane into a dive.
• **Touch and Go.** Landing and taking off again without stopping. Useful skill.
• **Trainer.** Model designed with inbuilt stability to give beginners thinking time.
• **Tri-plane.** An aircraft with three main flying surfaces, or wings.
• **Trike.** Aircraft with a single nose wheel and two main wheels.
• **Tyro.** Posh term for beginner.
• **Under-camber.** Concave curve on the underside of some aerofoils. Very little used in R C applications due to very narrow speed range. Still popular in free flight models.
• **Undercarriage.** Arrangement of wheels to support the aircraft on the ground.
• **Vortices.** Drag inducing rotating currents of air at the wing tip caused by the pressure differential of the air flowing over the top and lower surfaces of the wing.
• **V Tail.** Where the tailplane and fin are combined into a single V structure.
• **Warp.** Unwanted twist in an intended flat wing surface. At the worst can spell disaster, at the best can lead to some very interesting variations in the flight pattern.
• **Wash-out.** A setup where the angle of attack of the wing at the tips is less than at the wing centre. This helps prevent tip stalling and subsequent loss of control.
• **Winch.** Used to launch model sailplanes to a great height. Usually electric powered.
• **Wing.** The main supporting surface of the aircraft. Can take many planforms.
• **Wing Chord.** The distance from the leading edge to the trailing edge.
• **Wing Loading.** The ratio of the aircraft weight to the area of the wing lifting surface.
- **Z-Bend.** Z-shaped bend in the wire end of a pushrod, used to attach the pushrod to a servo output arm.

- **Z-Bend pliers.** Special pliers to form the above Z-bend in piano wire

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**Model Aircraft Engines: Glossary**

- **ABC.** Engine where the piston and cylinder liner use a combination of Aluminium, Brass and Chrome to give maximum compression at all temperatures. This desirable situation arising due to the equal expansion rate of these three metals.

- **BB.** Ball Bearing engine. Engine with ball race bearings on the crankshaft to give less friction than a plain metal to metal bearing and therefore longer life and more power.

- **Carburettor.** A device that produces a combustible mixture by mixing fuel with air.

- **Castor oil.** Viscous oil mixed with the fuel, gives lubrication of moving parts.

- **Connecting Rod.** Connects the piston to the crankshaft.

- **Crankshaft.** The shaft that converts the vertical movement of the piston into rotation.

- **Cylinder.** Where the fuel is compressed and ignited to produce the power stroke.

- **Cylinder Head.** Top of the cylinder, containing the glow plug or spark plug.

- **Diesel.** Compression ignition engine, which runs on a kerosene based fuel with ether. Popular in Britain for a few years after World War Two due to the non availability of methanol for glow plug engines. Diesel engines were never popular in the USA where methanol was always in plentiful supply.

- **Four Stroke.** A system whereby the engine fires every other revolution

- **Glow Plug Engine.** An engine that uses a platinum plug too ignite methanol fuel. Glow plug engines are actually medium compression diesel engines. See glow plug.

- **Glow Fuel.** Methanol mixed with lubricating oil and various ignition additives.

- **Glow Plug.** Plug fitted with a platinum element that ignites methanol by catalytic action.

- **Jet Turbine.** Pure reaction engine in miniature operating as per full size.

- **Petrol.** Used in spark ignition engines. Called Gas in the United States.

- **Piston.** Moves up and down in the cylinder and delivers the power stroke to the crankshaft, via the connecting rod.

- **Propeller.** Also known as the airscrew, pulls the airplane through the air.

- **Propeller Balancer.** Balance device used to ensure that both prop blades have the same weight to avoid damaging vibration. A vital tool.

- **Pusher Propeller.** A reverse pitch airscrew used where an engine is rear mounted.

- **Radial Engine.** An engine where the cylinders are set around a central crankshaft.

- **Schnuerle Porting.** High performance form of intake porting on a two-stroke engine.

- **Silencer.** A device designed to restrict the engine sound to an acceptable level.

- **Spark Ignition.** System that uses an electrical spark to ignite the fuel, usually petrol.

- **Synthetic Oil.** Modern lubricating oil which has replaced castor oil in most disciplines.

- **Two Stroke.** A system whereby the engine fires on every revolution.

- **Tuned Pipe.** A cone shaped resonance pipe that augments the engine power. As used on two-stroke motorbikes. Originally developed for the V1 flying bomb.

- **AM.** Amplitude Modulation. Simple system which modulates the actual radio wave.
- **FM.** Frequency Modulation. Signal is in a modulated series of discharges.
- **PCM.** Pulse Code Modulation. Signal is in binary code.
- **Aerial.** Used to radiate the signal from the Tx and to receive the signal on the Rx.
- **Analog.** Simple basic transmitted signal.
- **Antenna.** Posh word for aerial.
- **Battery.** The source of electrical power for the radio.
- **BEC.** Battery elimination circuit. Electric motor speed controller that eliminates the need for a separate Rx battery by deriving radio power from the main power battery.
- **Buddy Box.** System used in trainee pilot instruction to link pupil Tx: and instructor Tx: together by means of an umbilical cord. Loved by some instructors, but often claimed by others to give false confidence. Standard facility on most Transmitters.
- **Computer Radio.** Radio transmitter with electronically programmable set up of control movements and then storing each model set-up in a separate memory.
- **Crystals.** A device which controls the radiated, radio frequency of the transmitter. The receiver also has its own matching crystal. All crystals carry a channel number.
- **DEAC.** Button cells. Early generic name for nicads.
- **Digital.** Signal transmitted in binary code.
- **Dual Rates.** A system that enables two different settings of a control surface movement.
- **Gimbal.** The ball shaped mount for the transmitter control sticks allowing movement in all directions.
- **Fail-safe.** A system, which cuts the engine and sets the flying controls to a predetermined setting, if signal is lost. Mandatory on models over a certain weight.
- **Frequency.** The waveband of the radio signal being transmitted to the aeroplane.
- **Frequency Pennant.** A visual indication on the TX of the frequency being used by flyer.
- **Glitch.** Intermittent malfunctioning of R C system due to possible radio interference.
- **Lithium Polymer.** Lithium Iron. High density, high energy, cells, as used in mobile phones. Available for model use but best left to the expert due to their unstable nature.
- **Mixer.** Mixes two or more of the basic controls too give improved control functions.
- **Modes.** The distribution of the basic four controls on the two transmitter sticks.
- **Nicads.** Nickel Cadmium. Type of rechargeable battery used on transmitter and receiver; as the power source. Also used in electric powered model aeroplanes.
- **Nickel Metal Hydride.** NiMH. Similar to nicads but greater duration of operation.
- **Peg Board.** Physical system used to prevent two flyers operating on the same frequency.
- **Rx.** Shorthand for receiver.
- **Rate Switch.** Electronically reduces the throw of a control surface. Prevents over control in slow speed situations, landing, etc;
- **Receiver.** Airborne link of the system that turns the radio signal into electrical pulses.
- **Servo.** Turns the electrical pulse from the receiver into mechanical movement.
- **Speed Controller.** Electronically control the speed of an electric motor.
- **Sticks.** The two primary mechanical control functions on the transmitter.
• **Tx.** Shorthand for transmitter.
• **Trainer Lead.** Trainer cord. See Buddy Box.
• **Transmitter.** The ground-based part of the radio system transmitting the control signal.
• **UHF.** Ultra High Frequency. Excellent, interference free waveband, but now nearly defunct, demise due to very high unit cost.

**Some Useful Websites**

From time to time you may need to contact organizations and other information providers associated with the Radio Control Flying scene in your home country. The following is a list of those official organizations that may prove useful to you:

- [http://www.modelaircraft.org/](http://www.modelaircraft.org/) AMA (Academy of Model Aeronautics) USA
- [http://www.bmfma.org/](http://www.bmfma.org/) BMFA (British Model Flying Association)
- [http://www.fai.org/](http://www.fai.org/) FAI (Federation Aeronautique Internationale)
- [http://www.maac.ca](http://www.maac.ca) MAAC (Model Aeronautics Association of Canada)
- [http://www.lexsoft.at/aeroclub/aeroclub.htm](http://www.lexsoft.at/aeroclub/aeroclub.htm) Austrian RC Model Association
- [http://www.cobra.org.br/index2.htm](http://www.cobra.org.br/index2.htm) Confederacao Brasileira de Aeromodelismo
- [http://www.rc-unionen.dk/](http://www.rc-unionen.dk/) RC-Unionen Denmark
- [http://www.fiamaero.it/](http://www.fiamaero.it/) FIAM (Italy)
- [http://www.modellflygforbund.se/](http://www.modellflygforbund.se/) Sveriges Modellflygförening
- [http://www.modelvliegsport.nl/](http://www.modelvliegsport.nl/) KNVvL Modelvliegsport (Holland)
- [http://www.thk.org.tr/yeni/indexeng.htm](http://www.thk.org.tr/yeni/indexeng.htm) Turkish Aeronautical Association
The following are a collection of particularly useful websites:

- [http://www.towerhobbies.com/rcwairclub.html#usa1](http://www.towerhobbies.com/rcwairclub.html#usa1) - RC Clubs & Organizations USA & Canada
- [http://www.ivyandmartin.demon.co.uk/page2.htm#wmodelclub](http://www.ivyandmartin.demon.co.uk/page2.htm#wmodelclub) - Clubs and Organizations Worldwide
- [http://www.flyingsites.co.uk/clubs/index.htm](http://www.flyingsites.co.uk/clubs/index.htm) - Find UK Clubs by County
- [http://www.flyingsites.co.uk/links/index.htm](http://www.flyingsites.co.uk/links/index.htm) - Useful Links Mainly British but some Worldwide
- [http://www.rc-directory.co.uk/fixedwing.htm](http://www.rc-directory.co.uk/fixedwing.htm) - UK Radio Control Directory – Fixed Wing
- [http://scalemodel.net/](http://scalemodel.net/) - International List of Scale Model Related Web Sites