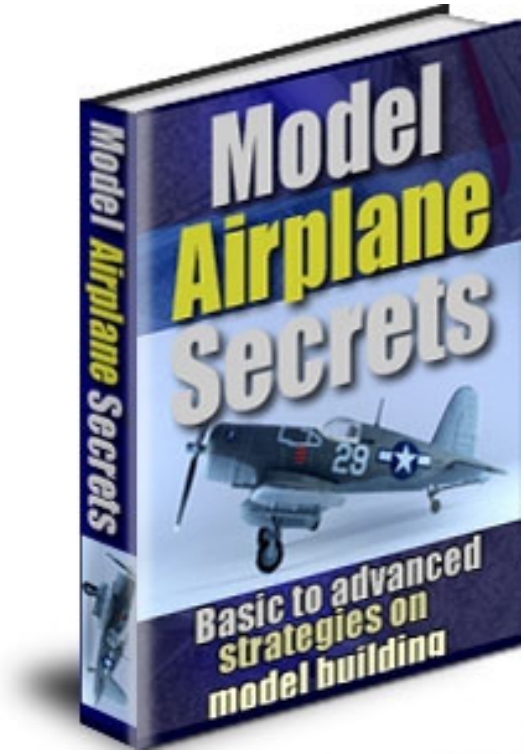
Model Airplane Secrets



Basic to Advanced Strategies On Model Airplanes

Bruce Bird

Contents

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Introduction: *The Joy of Flight*

You've always had that dream. You know the one, you take one step outside yourself and all of a sudden you're soaring among the clouds. Ever since you can remember, the mysteries of the deep blue sky above have attracted you. You wanted to be an astronaut, a pilot, anything to get you up there, where you'd have limitless freedom to bank and turn, swoop and soar above the static world below.

But, sadly, life got in the way of your flying dreams. Somehow, at some point, the line of people destined to become pilots diverged from your own – or maybe it just hasn't happened – just yet! How and why is your personal tale, but it doesn't mean those dreams must be lost forever.

Thousands of people take up flying every year. But they attend no courses, enter no cockpit, and don't even visit an airport. Still they get the sensation of freedom, the command of controls, the adrenaline rush and the satisfaction of a great landing on a blustery day.

Welcome to the world of model airplanes.

When most people think of model airplanes, they usually think first of the plastic scale models available in most toy shops. These can be an absorbing hobby in themselves with a particular branch of aeromodelers devoting many hours to meticulous completion of models to an incredibly high standard.

While this certainly describes one type of model airplane, we're going to focus more on flying models in this book.

We'll discuss something that's more a passion than just a simple hobby. The type of model airplanes that we're interested in can have wingspans of up to 20 feet, can reach speeds up to 200 miles per hour, and can travel as far as the eye can see. Or may weigh only a few ounces and fly slower than you can walk. Either way, these are serious planes for serious people.

The great thing about model airplanes is that there is something for everyone. You can choose a simple plane, perfect for a child or novice flyer, or build one from the ground up and get involved in some serious competition. You can spend from $30 for an off-the-shelf model to thousands of dollars for a personal, one-of-a-kind, creation.

People of all ages can enjoy this exciting hobby. If you're looking for something new and different, something exciting and fun, then model airplanes could very well be the answer. As you'll discover in this book, there are hundreds upon hundreds of incredible models from which to choose, each with it's own unique characteristics.

Each with its own special thrill.

Because of the great diversity (and the wonder of flying), you'll have a blast getting started and quickly become hooked! And this is a social pastime - there are many clubs where you can meet other model plane enthusiasts, and get the opportunity to watch others and learn from real experts.

Convinced? Well then, you've got a lot to learn. So sit back, tighten your seatbelt, and put your hand on the throttle - *it's time for lift off!*

In The Beginning....

A Frenchman, *Alphonse Penaud*, is generally credited with the first public demonstration of a model airplane. His rubber-powered model plane "*Planophore*", made its public appearance in Paris in 1871 and flew 131 feet.

He had first worked on rubber powered helicopters before turning to fixed wing aircraft and he is credited as an early inspiration by the Wright brothers who went on to develop the first powered aircraft after their father gave them a toy helicopter based on *Penaud's* designs.

The famous *Wright brothers* flight with the *Kitty Hawk* in 1903 generated some interest in modeling and a model club was formed in New York in 1907.

Although the designs of these initial planes were very basic - they were generally constructed out of materials like bamboo, pine, spruce, basswood, and tissue paper - they offered a means for aviation enthusiasts to enjoy traversing their own little piece of blue sky.

The Wright brothers Kitty Hawk

Meanwhile, back in the full-scale world, the 1920's and 1930's became what was called the "Golden Age of Air Racing." During the Great Depression people participated in air races for a chance to win thousands of dollars. This incentive inspired many inventive souls to build race planes in the hope of winning the big prizes; everyone needed the money in those days immediately after the Great Depression.

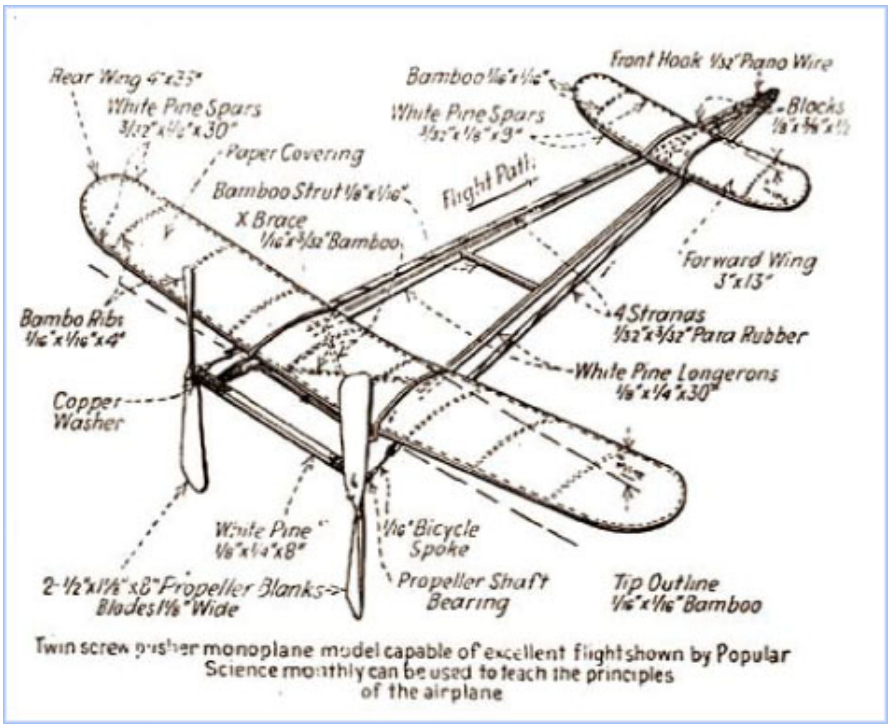
With big financial incentives the competing designs soon turned into serious racing planes capable of clocking amazing speeds. As air racing became more popular, the enthusiasts vying for the big prize included everyone including entrepreneurs, aircraft companies, members of the military and even members of the general public.

The Granville brothers of Massachusetts, for instance, began building a two-seater biplane called the *Gee Bee* Model A. It was a tremendous success. Following up on their groundbreaking creation, *Granville Brothers* Aviation continued the quest for speed and built a whole series of *Gee Bee* aircraft which became among the best-known (and some say most dangerous) race planes of that era. On one occasion they made $16,000 in prize money flying a plane that cost $5,000 to build, so you can see the incentive.

The Gee Bee racer
All engine in the pursuit of speed.
No wonder it was considered difficult to fly.

Coupled with this enthusiasm for air races, it was Charles Lindbergh's flight across the Atlantic to Paris in 1927 which really fired the public imagination. Several thousand model kit manufacturers sprang up in the year following his flight to satisfy this burst of enthusiasm.

Today the world of do-it-yourself aviation is stronger than ever, though the desire to build one's own flying machine is usually converted into a passion for model airplanes. You'll find thousands of clubs around the country, and hundreds of model planes from which to choose. There are, however, different niches from



An early twin-pusher model –it remains a very successful design.

which to choose: many people simply want something small and easy while others go all-out, looking for the maximum in power and speed. Yet others are fascinated by the challenge of designing and building their own airplane from scratch.

Most people involved with model airplanes love being able to control their plane courtesy of the wonders of radio control. Although there are still those who will have nothing to do with this modern jiggery-pokery and prefer to stay with free flight planes just as there are those who prefer sailplanes to powered models. There are also those who do some of both according to their taste. *But how did radio controlled flight begin?*

Radio-controlled flight, usually referred to as *RC*, was largely developed by people blessed with interests in both flying and amateur radio; two very different activities. Two early pioneers were *Clinton DeSoto* and *Ross Hull*, who flew sailplanes in the first public exhibition of *RC* flight.

About 1933 the first small gasoline powered engines were developed to turn those early sailplanes into model airplanes. Although this made the model more realistic it also created the problem of preventing your model together with its expensive engine simply flying off over the horizon because, once airborne, you had not way of controlling it. *Clinton deSoto* was probably the first to envisage radio as the solution to this problem.

At that time radio was in its infancy. It is difficult to believe in this day and age when there is so much computing and communicating capability wrapped up in the form of a tiny mobile phone that the simplest radio set up achievable at that time to operate just a single channel weighed in at 5 lbs (2.3kg). The 'model' airplane developed to carry this assembly of bulky radio equipment had a wing span of 18 ft and a total weight of 20 lbs! With continuous development and help from his colleague, Russ Hull, who came from the rapidly developing world of radio, the weight of the radio equipment was progressively reduced.

Two other names must also be mentioned in conjunction with the origins of *RC*: *the brothers Bill* and *Walter Good*. *Walter* had an enormous passion for model airplanes while his twin brother, *Bill*, understood radio transmission and together in 1937 they built the first *RC* model plane. That first successful plane was given the name "*Guff*," had an 8-foot wingspan, and weighed 8.5 lbs.

For the '*Guff*', two radio frequencies were used: one to control the elevator and the other, the plane's

rudder (we'll go over these terms soon). The servo to convert the radio signal into physical movement of the aircraft controls was mounted on the tail surface, and an outlet and extra-long extension cord was used for the transmitter.

Just as the *Kitty Hawk* was the beginning of something wonderful for full size flying, the *Guff* was considered a huge step in the history of model planes. So much so that you can still see it on display today at the Smithsonian National Air and Space Museum in Washington.

The "Guff" hanging in the Smithsonian Museum.

Radio-controlled planes have come a long way. While some people use them as toys for amusement, others are serious competitors. If you're interested in model planes, you can choose anything from a high-wing mounted trainer to sailplanes to jet powered models of modern military aircraft. *The sky's the limit!*

As you would expect with such a range of goodies, you also have a huge selection of prices. When you start looking at all the components you can add, it gets really exciting and, as you can imagine, more than a bit overwhelming. That's what this book is for - to help guide you through the whole process, from buying to flying.

Getting Started

Now that you have a little background on model planes, you'll want to figure out what it takes to get started - to make sure this is truly the right venture for you. There are many initial considerations with model airplanes so we'll just go over the basics so that you'll know what to expect.

Cost

The cost of your hobby can be whatever you decide to make it. The principles of flight remain the same whether you make paper airplanes from cast off copy paper or the most complex, technical models. All the same, before you do anything else, it's wise to determine your budget - and then stick with it. For instance, if your really strapped for cash you can find sites on the web which show you how to build models from paper and cardboard, or you could buy a nice fun plane for as little as $100 - or spend $1,000 or more for just the basic equipment of a high-end version. You need to know in advance where you're likely to fall on the scale.

Whatever your price range, packages are available that come with all the equipment needed. You can start with toy airplanes often known as park or backyard flyers that may cost no more than $30. Then a 'proper' radio controlled model ready to go will often start around $150 for a beginner, and head into the thousands for those who get really serious.

This can be an expensive sport and the costs can get out of hand if you allow them to, so it's best to understand the financial aspects of model airplanes before you go out to buy. Yet keep in mind that you do not have to spend a lot of money to enjoy your hobby; if you pay attention, you'll have a blast no matter how much you spend. Don't forget that everything you learn with a low cost model will save you money when you move on to something more expensive.

A B-17 model.

An indication of what you can achieve.

Good to dream about but best to keep your dreams in check as a beginner.

Power, Speed, and Range

An important factor, especially if you plan to take part in one of the many types of competition, is the power source. As we'll discuss later, most beginner's models these days will be powered by electric motors. You might then choose to move on to two-stroke engine internal combustion engine that burns a mixture of methanol/nitro-methane/oil known as glow fuel. However, there are also four-stroke engines, rotaries, turbines and others as well. The type of motor will determine your maximum speed or the amount of torque you have available for prop driven airplanes. The power derived from jet engines is defined differently and you can probably leave that till much later.

There is a wide choice of airplanes suitable for beginners with max speeds that might range from so slow that you can fly them indoors up to about 45 miles per hour and with the bigger ones landing at speeds between 12 and 15 mph. Yet if you develop your skills to fly the more advanced type of plane, you can reach speeds up to 200 mph - amazing for a model, *right!?* Just go and look at this video for an example:

http://www.hugi.is/hahradi/bigboxes.php?box_id=51208&f_id=1277

As for distance or range, the radio-controlled models on the market today may fly about one mile though park flyers for beginners will be rather less. Just remember - you have to maintain control of the plane, which means you have to be able to see it. Therefore, even if you're flying a plane with a six-foot wingspan, once it's half a mile or more away, depending on visibility, it will be nearly impossible to see. And if you can't see it then you can't control it.

Types of Airplanes

There are many different types of model airplanes, so this chapter is dedicating to outlining the major types - we'll also give some examples associated with a few of the categories. Armed with this information, you'll have a much better idea of your options when you're ready to buy. There are also numerous types of engines, which will be discussed in-depth in a subsequent chapter.

Static Airplane Models

Just like the flying variety, static models can vary from the cheap and cheerful to the deadly serious with the choice of size, cost and the quality of the finished model being entirely your own choice. The most common variety to be found is the plastic model found in most toy shops and it is this type which is often the introduction to the hobby for many who go on to become serious aeromodellers.

If my own experience is anything to go by, your early efforts of gluing and snapping the parts together will probably be rather messy and taking the next step of painting and finishing with the stick-on markings known as decals is often postponed – often for a very long time. But eventually it is the realization that careful preparation and handling and, above all, patience learned from assembling these models that will have most effect on the quality of your finished model and will be the foundation of your later success.

The parts for these kits are made by the process of injection moulding where molten plastic is forced into pre-prepared moulds where it sets. This allows great accuracy of details and finishes which are machined into the moulds – even down to lines of rivets and other small details of the full size aircraft on which the model is based. Painting and finishing in the colours actually used then enables the modeler to produce a very high quality representation of the original, accurate in every detail and frequently put on the bookshelf or in a display cabinet.

The popularity of such models dropped rather over the last twenty years, perhaps as a result of computers and flight simulation games which took the attention of young aviation enthusiasts. Today, interest is returning again.

These models often serve as the basis of a very detailed and skilled work of the expert scale modeler who sets out to reproduce exactly how a specific type of aircraft actually looked at some point in history. Detailed research into historical photographs and drawings helps these experts to get an image of how the airplane looked. Then their meticulously developed expertise is used to produce an appearance as close as possible to the original – even down to reproducing the dirt, exhaust smoke markings and normal wear and tear seen on a working airplane

Of course, models can be made from any material. Aircraft models carved from mahogany are a common display item. However, these represent the skill of the carver rather than that of the owner and tend to be a visual representation rather than an accurate scale model. It is a very accomplished modeler who is able to begin from scratch in any material and build an accurate model. Should you decide to build your own models then you will usually work from prepared plans included in the kit or often given away by modeling publications.

Lets not forget that static models often serve a serious purpose. Scale models are built by airplane manufacturers to test their theories and new production types in wind tunnels; data is collected and then actually used to determine the design of full-scale planes. However, for the collector, the static airplane is a model requiring construction, gluing, painting, snapping, decal application, and so on.

What are the benefits of choosing to build a static model? Well, it requires you to develop the skills and patience necessary for model construction, and thus is a great learning tool. When the model is complete, you'll have something of which to be proud and you can judge your progress in construction methods before deciding to move on to something more expensive. Usually, these planes come in scales of 1/144, 1/72, 1/48,

and 1/32, (1/32 means the model is 32 times smaller in every detail than the original) although there are a few odd scales sold on the market – and will only cost very little money.

Flying Models

The use of flying models is often referred to as “aero-modeling”, whether it is for fun or competition. The flying model plane may frequently be designed and built according to exactly the same principles that apply to a full-sized airplane. So the construction of this type of plane can be considerably more difficult. This is not always the case. The strength of materials does not change in scale. So for example a wing can be cut and shaped from foam for a model because the strength of the foam is sufficient for the greatly reduced weight of the model - but a foam wing would be impossible for a full sized airplane.

The key to model airplane construction is lightness. So flying model planes were traditionally made mostly from a very light wood like balsa and covered with a skin covering usually of tissue paper – or whole sections such as the wing we talked about before may be formed out of a strong, light material such as foam. Today, modern lightweight materials such as Depron, carbon fibre, moulded foam and other composite materials are rapidly becoming commonplace for all elements of the model.

In the early days, and still to be found today, the covering was a tissue paper skin painted with dope. Surprisingly, when the dope dries and hardens, it shrinks the tissue paper over the frame of the airplane, making a very light but strong construction with a hard, though rather delicate finish. These days, modern technology offers greater strength and robustness with very thin and light plastic materials. Traditionally, the fuselage was built up of longerons and formers along with ribs and spars for the tail and wing surfaces. In the more sophisticated models these may be made from solid sheets of thin ply or increasingly these days from very strong, lightweight composite materials. There are a whole range of ‘SPAD’ or Simple Plastic Airplane Designs available these days which take advantage of modern materials that were never originally considered for model making but have proved extremely useful.

Models can be powered with many different types of engines, though, because the builder is trying to produce a model as faithful to the original, full-sized airplane as possible, a balance must be struck between the power required and the size, sound, and appearance of the engine. If the most practical power output, torque, noise etc comes from an engine that does not look good on the model then it may have to be disguised.

Kits versus Pre-builts

Until just a few years ago, models were mostly sold in kits. You opened the box to discover a bunch of parts, plans, hardware, and an instruction manual. The kits on the market today are the same. Many people enjoy building kits and going through the entire process of putting the plane together. This is a great way to spread your hobby throughout the year as a model built indoors over several winter months can occupy your flying time throughout the better flying weather of the summer.

However, not everyone enjoys spending weeks or months building a plane when their main interest is to fly one. If this is your preference then choose a pre-built plane. This is a great option for beginners and pre-built model airplanes are now readily available.

The best and most obvious characteristic of the pre-built model airplane is that everything comes factory assembled. You know the plane is built well and you don’t have to spend too much time putting it together. For those who want some assembly experience, there are models sold in varying degrees of completeness.

Pre-built planes include the following types:

RTF

RTF is the acronym for "***Ready to Fly***", which means that very soon after taking everything out of the box you can have the plane in the air. You'll have very few things to assemble. Or, you can also find what are called "*true RTF's*", pre-built kits where everything is assembled, including the radio gear and engine.

ARF/ARTF

This is the acronym for "***Almost Ready to Fly***", a type of model airplane that is just that - not complete, but almost. After some hours of assembly, which varies with the kit, the plane will be ready to go.

Typically, this type of pre-built comes with the wing halves, tail fins, and fuselage completely assembled and covered. Therefore all you have to do is fit those sections together, install the radio gear and power plant, attach the landing gear, add a few small pieces of hardware, and you're finished.

If you decide to buy a kit to build yourself then you may well have the choice of pre-built wings or building the wings yourself. As a beginner it is preferable to pay the small extra cost and buy the pre-built wings. These are usually a moulded foam core with a thin wooden veneer. These are more robust and much less likely to be badly damaged in an accident.

More Acronyms: Free Flight and Control Line

FF

This is the acronym for Free Flight, which is a type of model airplane designed and built in such as way that the plane can fly without any kind of attachment to the ground. It may be a sailplane or even powered, though fitting an engine to an airplane over which you have no control after it is launched is hardly sensible as the early pioneers discovered. A free flight sailplane on a successful flight may have such good flying conditions that it continues to climb in thermals and can easily be lost. To prevent this they can be fitted with a de-thermaliser. This is a mechanism which, after a fixed period of time, will lift the elevators so that the aerodynamics of the sailplane are badly affected. This will bring the model floating gently to earth, hopefully still in sight of the owner so that it can be easily recovered.

C/L

Also known as ***Control Line***, this plane is made to be flown with the use of wires attached to a control handle held by the operator. Typically, two lines lead from the control handle to the inboard wing tip of the plane to a mechanism that translates the handle movement to the airplane elevator, allowing maneuvers to be performed along the airplane pitch axis. In simple terms you can only adjust the height of the plane but in practice you can fly the model in the complete hemisphere centred on you. This poses some unique and exciting challenges for the flyer, especially in competition with others. Of course, it also avoids the cost of RC equipment so may be an option you can explore.

Another variation of the *C/L* plane is the *RTP*, or Round-The-Pole plane. This was developed in the early stages of electric motors and provides power to the model through a low voltage cable which also serves as a tether connected to a rotating bearing on top of a pole. *RTP* is also used for educational purposes.

Gliders and Sailplanes

Gliders and sailplanes are just different names for the same thing. Technically, a glider is intended just to be released and then glide down to earth. An example would be a load carrying glider like a military troop

carrier or even the space shuttle (technically a lifting body). Sailplanes, on the other hand, are optimized to extend their flying time by riding rising thermals and updrafts. Model sailplanes are usually launched by hand, or with an elastic bungee that catapults them into the air. Obviously, to fly successfully without an engine, the sailplane must be flown when the plane can find the required lift. A warm, still day, when warm thermal columns of air are rising through the atmosphere, is ideal.

The original sailplanes, before the development of radio control, were free flight models. In good flying conditions with warm air rising in thermals up from the earth's surface, a model sailplane without any means of control can easily disappear for ever – together with the hours and hours of labour the builder has put into it. To have some chance of recovering a model the 'de-thermaliser' described before was developed.

Lift can also be found when a steady breeze blows against a hill and is forced upwards over the top. Flying in such conditions is called "slope soaring," and provided the wind keeps blowing, the flyer can keep the sailplane in the air for a long time. Slope soaring proficiency tests include a requirement to keep a sailplane airborne for specific periods of time which can run into many hours.

RC slope soarers can be launched from the top of the hill and flown into the wind to gain altitude and then circled back, both to stay within range of your transmitter and to return to the point over the hill crest, where they can ride the wave again. The challenging aspect of flying a sailplane or sailplane is that lift cannot be seen, but only deduced from the reaction of the plane. Mastering this technique requires patience and skill.

Toy Planes

I referred earlier to toy planes or park flyers. Although originally intended for children they can also be great fun for adults. With these more basic flyers everyone can learn the joy of having control of a flying model airplane.

The majority of these planes are sold in *RTF* form including the radio gear, batteries, and a rechargeable motor battery. The nice thing about choosing a toy plane is that in addition to being affordable, most are virtually indestructible.

There's nothing like the sight of a little boy or girl's eyes as he or she opens up a package to discover a model airplane. They make excellent and uncommonly instructive birthday and Christmas gifts - as well as "just because" gifts. There are many different models you can consider, including the following:

Cox E-Z Flyer

Great introductory plane for young flyers. Designed with twin engines to control direction and altitude.

Sky Hunter

This Delta-wing style is an *RTF* that is easy to operate and extremely durable as you can see from the illustration. The wings can be bent right over without damage.

Air Phantom

Simple, yet very robust model that is literally crash proof

B5 Stealth Bomber

RTF that features twin 15,000 RPM electric motors, as well as Thrust Vector steering capability.

These toys are all in the $30-$70 price range and all claim to be very robust and crash proof. So you might consider spending that sort of money just to try the whole idea and before you commit either more money or time. Just bear in mind that they are all 'stand alone' products. Some of them use unusual control mechanisms and it is unlikely that you will be able to re-use the component parts such as the radio equipment for other models. And don't get into the crashing habit just because it doesn't damage easily! The model you eventually build yourself is going to be a lot more delicate than these. Despite this, they can be great fun and certainly get you airborne and in control very quickly.

Trainer RC

Your first serious *RC* airplane is usually referred to as a trainer. That's because you are now setting out not to 'crash and burn' but to learn how to fly well. That means in control at all times and in a disciplined way. This is just like any other sport. The experts, the winners, make it look so easy. That's because they know exactly what they are doing and why and have spent innumerable hours in practice. The great thing about model airplanes is that every hour of practice is great fun as well!

So I'm going to tell you what your first trainer should be like. Not because I don't want you to fly an F-16 or an A-10 but because if you learn to fly right with a trainer you will automatically graduate to flying more difficult airplanes better. Your first trainer should have a high wing, that means the wing should be mounted on top of the fuselage like the planes shown on the next page. *I'll explain why shortly.*

Radio-controlled model airplanes are controlled by a radio system that consists of a transmitter (the box

that remains with you on the ground), a receiver, receiver battery, and servos – all fitted in the airplane. The majority of radio systems are sold with everything needed, which often includes a rechargeable battery pack. It's best to seek the assistance of an experienced instructor when learning to fly your model (for reasons we'll explore shortly). One advantage of learning with an instructor is that he or she can teach you on what is called a buddy system.

A buddy system is similar in concept to those found in driving-school cars. The instructor has a controlling transmitter linked to the transmitter of the student. In *RC* buddy systems the instructor will start out controlling the plane with his controls, then gradually allow you to take over with your transmitter. However, if the instructor sees you're about to get into difficulties, he or she can quickly take over, saving you both cost and embarrassment which usually come in equal quantities when your model makes an unintended hole in planet earth!

Trainer planes generally use a radio with four channels. One controls the throttle, one the elevator, one is for the rudder, and the fourth is for the ailerons. *More on this to follow…*

Radio-Controlled

The radio-controlled plane, often abbreviated to just '*RC*', is controlled using a radio link. For this type of plane, your equipment consists of a transmitter you operate, and the airborne unit in the model, which consists of a receiver, receiver battery and one or more servos depending on the number of mechanisms you want to control. Each mechanical item you want to control in your plane e.g. the engine throttle, the ailerons, the elevator needs a servo motor and each servo requires a single radio channel. Therefore, your transmitter will need to be able to accommodate as many channels as you have servos. This usually amounts to four channels; engine, ailerons, elevators and rudder.

Electric Power

The electric *RC* airplane is increasingly popular. It used to be considered the next step up from the RC toys we talked about earlier due to the short flight times possible from the available batteries. This has now changed dramatically due to advances in battery technology and flight times are now on a par with glow and gas models giving you all the fun but without the noise and smell. The cheaper models can give you all the convenience of the electric motor as well as a quick and easy way to learn powered radio-controlled flying. Electric *RC* planes are affordable, and you can find them at most hobby shops in a number of fun, exciting styles and colors.

These planes are super easy in that most of them are ready to fly (*RTF*) or almost ready to fly (*ARTF*). So, in a matter of minutes you can be working with a trainer to fly. For people just starting out, the electric *RC* plane is an excellent choice. Yet there are many different options, and while this type of plane is easy, there are a few other things to think about before making your final decision.

Firstly, take advantage of all the convenience offered by electric power. Many of the *RC* planes designed for the novice flyer are electric powered. Choose an *RTF* model, allowing you to get airborne fast and without aggravation and look for models that have a high wing design - they're the best planes to learn with due to high levels of stability.

You need to distinguish between 'toy' planes and more developed models the big question is the radio frequency channels available. Toys will come

with a limited number of radio channels, maybe just 2, on 27 Mhz (Megahertz) frequency where there are a very limited number of channels shared between lots of toy products – and not just airplanes. So on a good day out with lots of people in the park with RC cars, boats on the pond and other airplanes you might find interference from somebody else's model spoiling your enjoyment. Aero modeling has obtained it's own dedicated frequencies at 72 Mhz in the US and 35 Mhz in the UK. You should check with your local club or hobby shop for the correct frequency range in other countries.

In practice, the manufacturers will set the correct frequency range of the equipment they sell in any country. But check that the equipment has a sticker confirming that it is authorized in your country to avoid uncertain 'grey' imports. Only aeromodelers will be operating on the approved frequencies so your model will be much safer. So 27Mhz is fine for a cheap start but limits you to just that model. You will need to buy the radio equipment all over again when you decide you want to move on to a more advanced model.

To avoid that sort of problem find a low cost trainer with four-channel radio gear in the frequency range dedicated to model airplanes in your country. You will then be able to re-use the radio gear with later models. If you buy a low cost model with limited radio channels you will be saving money now but may have to pay more later.

Look for a model with a rechargeable motor battery pack, and preferably one with spare props. Finding an electric *RC* plane with spare parts included makes it much easier to keep flying. It keeps you from grinding to a halt when some original part is broken, usually just as things were getting exciting. If the kit itself has no spare parts, you'll want to ensure the parts are easy to find at your local hobby shop or over the internet and are affordable.

It is very useful to buy a second motor battery, so while you're out flying your plane, the backup can be charging and ready to go whenever you need it. Although electric *RC* planes have been around for years, only in the past few years have they become truly popular. The principal reason for this is that with advancing technology, we now see the batteries and other equipment such as motors, gearboxes, receivers and servo becoming smaller and lighter, thus enabling better performance from the plane and longer flight times. If you have to travel any distance to your flying site then only getting 5 or 6 minutes of flight time from a single battery charge is pretty frustrating – though the knocking knees and sweaty palms resulting from your early flights may well make it seem like an eternity!

When electric powered model airplanes first came out, the motor battery packs were large and heavy and generally pretty unsuccessful. Today however, everything you need to get your plane off the ground is not just small but extremely lightweight. Because of this, these planes can be flown at slower speeds, making them excellent starters for the novice.

Out of this has grown another specialization, that of micro models where weight is measured in less than 10 grams and the models can be flown in your living room. However, let's stay practical for the moment as such specialization also leads to increased costs. For the moment you need something reliable and robust. You can always come back to specializations when you have mastered the basics.

Electric motors are also environmentally sound and much more acceptable close to residential areas. The electric RC plane does not pollute the air with the fumes a gasoline or glow powered plane puts out, and the level of noise is dramatically lower. But don't forget to dispose responsibly of any unwanted batteries. The bottom line: an electric *RC* plane is an outstanding way to have good, clean fun without the possibility of complaints from anyone bothered by fumes or noise. Some examples follow with the ever important price indication. Click the model name to link through to the store for the latest price:

Megatech Freedom Flyer

Great as a trainer plane or for a more advanced sport-flying plane. The **Freedom Flyer** is a 4-channel "*Beginner-to-Intermediate*" Park Flyer c/w radio, battery and charger. This particular model works well for aerobatics and with the four-channel aileron option, it maneuvers with ease. *Around $180*.

J3 Piper Club

Although of a simpler style, this two-channel plane is a great starter choice. *Around $60*.

Glow or Gasoline Fueled Radio-Controlled

Next comes the glow or gas powered radio-controlled plane. These are internal combustion engines or '*I.C.*'. Let's think about the complexity for a moment. We've now added a fuelled engine that you might have to buy separately, plus *RC* equipment that you might have to buy and assemble separately plus the possibility of your building your model from a kit – so the potential for hazards both in building and flying have increased considerably.

In truth, these days you can purchase an *RTF* or *ARF* gas plane that is both affordable and easy to fly and these days you can progress to this stage while avoiding most of the traditional risks. For example, a multi-channel gas plane can be an excellent training plane - many come with software and a simulator to help you get started. It will simply cost you more.

To choose the right *IC* powered model for you, start by determining if you want to fly a realistic scale model or non-scale. This is largely a matter of personal preference.

For training, you again want to go with a high-wing design, usually around 40 in size. This type of plane would normally use a .40 or .46 cubic inch glow-plug engine. For the non-scale options, there are many classic high-wing patterns to consider. Some may require engine and radio installation, as well as some finishing assembly.

When choosing a glow or gas radio-controlled plane, understand that by going this route (instead of buying an electric *RC* plane), you could be limiting yourself to flying at a model airplane flying club where the noise is not an issue. What is music to your ears can be extremely irritating to your next door neighbour and club sites usually have this situation under control with permits and authorized flying hours. This will be the case unless you have the benefit of owning land, know of someone who has land over which you can fly, or live in the country where vacant land is easily accessible - *with the owner's permission, of course!*

The glow or gas powered airplane also requires more pieces of field equipment, due to the engine. You will need to deal with the transport and storage of fuel and fuel filling equipment and these can be major fire risks both at home as well as at the flying field so ensure that you find out about all the relevant regulations.

Many of the essential items may be borrowed from fellow flying enthusiasts, particularly if you belong to a club. Without doubt, a glow or gas radio-controlled airplane is exciting. Although not for everyone, some people swear by them. Some representative examples include the following

NexSTAR RTF Nitro .46 Radio-Controlled Model Airplane.

Loaded with all kinds of exciting features, this plane can be learned quickly and flown safely. A fully featured airplane with lots of training facilities, this is a nice introduction model if you have the price of *around $400.*

Wingspan: 68.75 in (1740mm)
Length: 56 in (1420mm)
Wing Area: 722 sq in (46dm2)
Wing Loading: 21 oz/sq ft (62g/dm2)
Weight: 6.5 lb (2930g)
Radio: 4 channel
Engine: glow 0.46

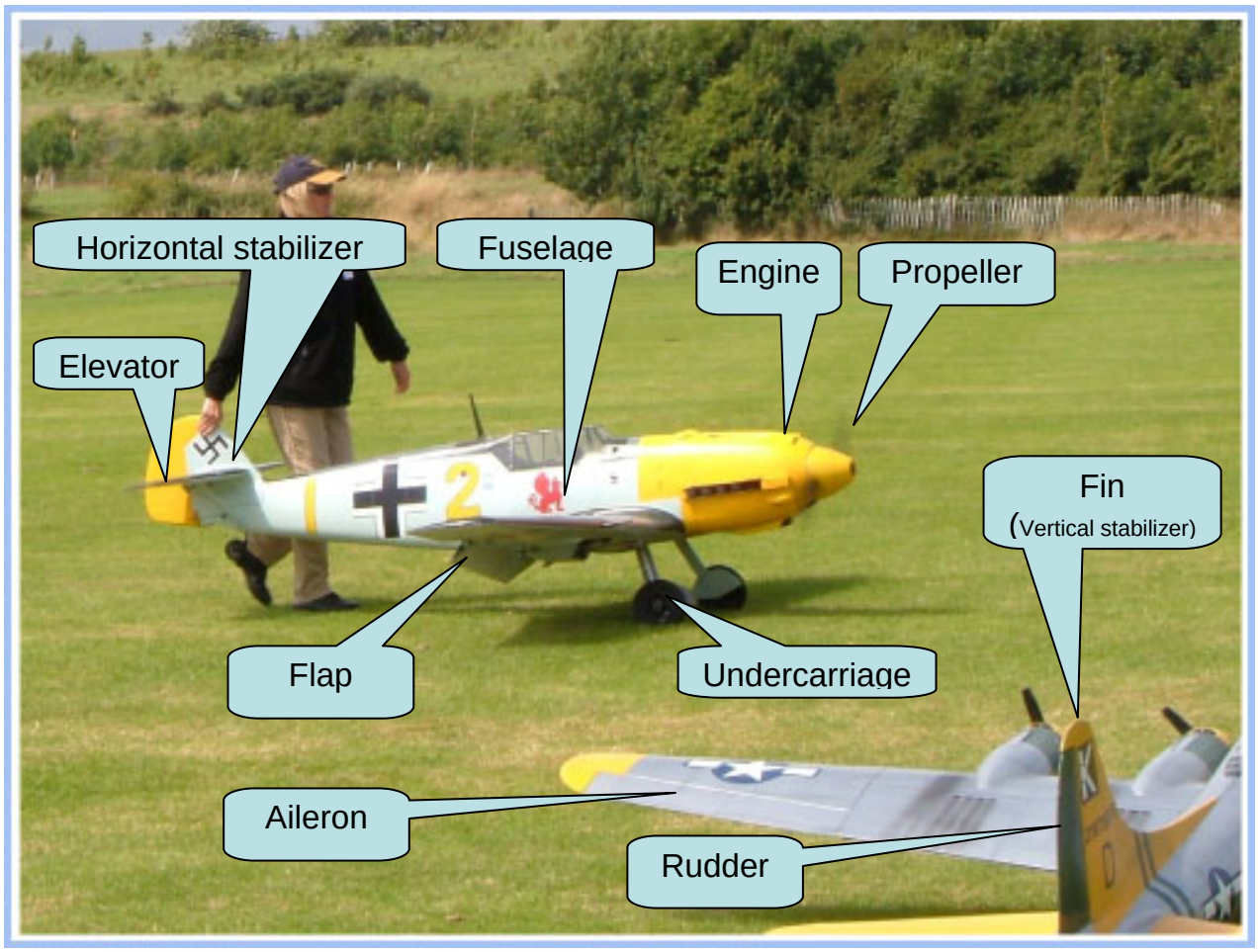
Megatech Nitro Airstrike

Completely *RTF*, this plane is ready to go and can be flown in a matter of minutes. With the low wing-loading and flat bottom airfoil you'll love the gentle flight characteristics and ease of landing offered by Nitro AirStrike...*Approaching $500.*

Fuselage length: 21"
Wingspan: 61"
Wing area: 686.25"
Wing Loading: 17.82-oz/sq.foot
Weight: 5.lbs. 5oz
Radio: 4 channel
Engine: glow 0.40 – 0.59
(Electric version of this plane is also available)

Model Plane Anatomy – the naming of the parts...

To be a successful flyer, you need to understand your plane. Just as a good doctor knows the anatomy of the human body, you should understand each part of the plane and how they work together. If you're not familiar with the terminology yet then try to relate the description of parts in the next few pages to the picture below.



Aileron

Hinged control surface located on the back of the wing, furthest from the fuselage. When the servo moves the aileron via the pushrods, the aileron on one wing moves up while the aileron on the other wing moves down. This causes the plane to turn and roll.

Elevator

This hinged control surface is connected to the back of the trailing edge of the horizontal stabilizer (the part of the tail parallel with the ground at takeoff). When the elevator is moved, the pitch of the plane is changed so that it dives or climbs.

Engine

This is a mechanical device providing power to the airplane so it can fly. It uses battery power or internal combustion. For RC model airplanes, there are two primary choices of internal combustion engines - glow, which burns nitromethane fuel or gasoline that burns a mixture of gas and oil. Both engines types come in two and four-stroke designs.

Flap

The flap is a control surface on the wing, closer to the fuselage than the aileron, which moves up or down, increasing drag or lift. When used, the flaps on both wings move up or down together.

Fuselage *(often shortened to fuze or fuzz)*

Body of the airplane

Glow Plug

A plug screwed into the top of the engine to provide a source of ignition. A platinum wire in the plug is initially heated by battery power and provides the ignition source for the glow fuel. There is a catalytic reaction between the platinum and the fuel that generates heat that, together with the heat retained from the previous ignition, continues to ignite the fuel on each rotation of the cylinder after the battery is disconnected. The difference between this and a gasoline engine is that, for the gas option, a spark plug is used for ignition which then requires an additional electrical system.

Horizontal Stabilizer

The horizontal portion of the tail that provides stability around the longitudinal pitch axis, and to which the elevator is attached.

Landing Gear/Undercarriage

The structure and wheels that support the plane on the ground as it takes off and lands. The two primary types of landing gear are the tail-dragger, with two wheels under the wing and a skid under the tail; and the tricycle, with two wheels under the fuselage or wings and one under the nose.

Propeller

The rotating device located on the nose of the plane, which is designed to convert engine power into thrust. Propellers, along with *Bernouli's principle*, propel (what else) the plane through the air by creating a disparity in the air pressure between the surfaces of the blades. The thrust of a propeller depends in large part on the volume of air it accelerates, to what extent this volume is accelerated, and the relative density of the air.

These factors depend, in turn, on the diameter of the propeller and the *RPM* and torque of the engine, which is responsible for turning the prop. The aerodynamic design of the propeller also influences its performance. Model plane propellers are commonly made from wood or more likely these days to be specially molded nylon or reinforced plastic.

Pushrods

Rods connecting the servos to moveable parts of the plane.

Servo

This component converts the incoming radio signal into physical movement in the airplane, moving the pushrods connected to the flying control surfaces, such as the rudder, elevator, and ailerons of the plane.

Tail

The part of the airplane located on the rear of the fuselage, which includes both vertical and horizontal stabilizers.

Vertical Stabilizer

The vertical stabilizer, or fin, is the portion of the tail that provides side-to-side stability. It is perpendicular to the ground at takeoff.

Adhesives – holding it all together

"Glue" has moved on a lot in recent times and you will use a range of different adhesives depending on the materials and the requirement. The most common one you will come across is known as *CA*.

Cyanoacrylates

Cyanoacrylates, commonly known as '*cyano*' or *CA* (hardly surprising, really) in the modeling world and 'Instant' or 'Super' glues to everyone else. Good for wood, plastic, metal, glass, ceramic, fabric, rubber, fiberglass, carbon fiber or combinations. *CA* comes in different thicknesses or viscosity and in different formulations according to the material it is to be used on. Be careful to use the right one as the wrong choice can literally melt the structure of your model! Follow your model manufacturers' recommendations or if there are none then your local hobby shop and clubmates can be your best source of advice - or spend a little time researching on the internet. Thinnest viscosity is excellent for gluing balsa as the very thin glue can be applied to the edge of the join and will penetrate both the join and the surrounding balsa wood to create a strong bond. The downside of this very thin viscosity is that it cures or 'goes off' very quickly, literally in seconds.

Accelerator/Kicker

To speed up curing even more there is another product called an accelerator which will cure the top surface of the adhesive instantly and then progressively cure the remainder. Alternatively, apply *CA* to one surface and spray kicker on the other before mating them together for a really fast bond.

CA debonders

Sometimes *CA* 'superglues' are just too good and you end up glued to your own model, the table or anywhere else you put your hands. Debonders can remove cured *CA* glues from skin, work surfaces, most plastics, and model finishes.

Epoxy resins

Epoxy resins come as two part adhesives, one part resin and one part hardener that have to be mixed to become active. Vibration resistant and fuel proof, epoxy is perfect for fire wall and engine mount installations, for attaching bulkheads and formers in epoxy glass fuselages. It comes with different curing times e.g. 5 min, 30 min, 1 hr which are used according the result required. Since epoxies cure by an exothermic chemical reaction, (that means they give off heat) and heat can speed the cure of epoxy, mixing more than you need can mean it hardens and becomes unworkable before you have had the chance to use it.

Finishing resin

Finishing resin is a light weight two part epoxy laminating / finishing type resin used when fiber-glassing. It can also be used to seal all engine and fuel tank areas. It is absolutely the best for sheeting foam wing panels. It will bond to itself and does not get brittle with age. But like cyano, you must use the right formulation produced specifically for use with foam. Many finishing resins will just eat up your foam wing. Finishing resin can also be used to seal and prepare all types of wood projects for painting. Finishing resin will penetrate into porous wood, so several applications may be required to fill and level the surface.

Clear or Canopy glue

Don't go spoiling your beautiful model by using inappropriate glue on the clear Perspex canopies and

windscreens when there are special canopy glues available. They're actually just another type of glue for plastics and vinyl with the advantage that they dry clear and transparent.

Engines

When you hear about the size of a model airplane, it will usually refer to the size of engine needed to power it (measured in cubic inches). Typically models will be described as a size 20 (which needs a .20 to .36 engine), 40 (.40 to .53) or 60 (.60 to .75). These sizes refer to the capacity in cubic inches, e.g. 0.36 cu in, of the most popular 2-stroke glow engines in use and will be adjusted if you change to a different type of engine.

Typically, trainer planes have .40 to .53 engines, because a reasonably large model is best for learning to fly because the greater size offers better stability, therefore you will need a reasonable size engine to power the larger model and a .40 engine gives adequate power for windy conditions. They are also made in large numbers so they are both reliable and affordable. Some trainers are even larger and have engines in the 60 category. The bigger size gives greater stability and easier visibility after take off.

Just as model airplanes come with various engine sizes, they also have a range of power sources. For instance, an electric motor is powered by a battery while glow and gas engines run from tanks of their respective fuels. Sailplanes or gliders, on the other hand, have neither engine nor fuel and fly on naturally occurring air currents, though some use electric motors for take-off or to attain greater heights.

The most popular choice of engine is usually the two-stroke glow engine. After many years development these are reliable and economical and are considered a good choice for beginners. The lower cost versions are built with brass bushings to support the crankshaft. We'll get into engines in depth a little later. A more advanced version would have the crank shaft supported by a ball bearing race instead of the brass bushing. This type is often identified as a *BB* engine. The ball bearings create less friction with the crankshaft and the engine therefore produces more power and has a longer life. The only drawback is that the ball bearing type of engine is more expensive to produce and will cost more to buy.

Another option is the four-stroke engine. Though not quite as powerful as the two-stroke engines, and a little bit more expensive, with the four-stroke you will benefit from more torque. This enables these engines to drive bigger propellers, use less fuel, and produce a sound nearer to that of a real airplane.

In Focus: Model Airplane Engines

There are numerous options when it comes to engines. Rapid technology advances mean you'll find exotic new models on the market quite often. However, as you'll see in this chapter, determining the best engine for you does not have to be an overwhelming task.

Some airplane engines are more expensive than others. But, as with all things technical, prices always fall, and you get more 'bang for your buck' every year. Engines are now quieter, more reliable, better performing, and produce less fumes - and this trend is likely to continue.

Types of Engines

If you're just starting out with model airplanes and want to use a glow or gas-powered trainer, then I would recommend you use a two-cycle glow engine. This is a basic engine, and just about anyone at the flying field will be able to assist you if you run into problems or if you have any questions. Electric power, on the other hand, is more expensive for the first purchase bearing in mind you are buying rechargeable batteries as well as the motor, although it is easier to manage and comparable in cost in the longer term. Gas engines tend to be for the larger models. Remember the extra electrical system required by the spark plug of gas engines? Everything "extra" means heavier and eventually turns into a bigger airplane.

Two-Cycle Glow

The fuel/air mixture of a glow engine is ignited at the top of the compression cycle by the glow plug. This is made hot when starting the engine by passing an electric current through it from a battery so that the platinum wire within it glows in the same way as a light bulb. Once running, the battery is disconnected and the glow plug keeps on glowing from the heat created in the engine cylinder by the combustion of the fuel and a catalytic reaction between the platinum and the fuel mixture. If the engine stops for any reason there is no way to re-start it because the glow plug cools down and there is no ignition source. As a result the engine is simple, light and efficient.

The two-cycle glow engine is the most popular type for model airplanes. It is affordable, but also powerful and more importantly, reliable. It delivers high revs per minute (RPM), so if you're going with a propeller-driven plane, and you want speed and rpm then this is the best choice.

Four-Cycle Glow

The difference between the 2-stroke and 4-stroke engine is something for another day. Sufficient to say that the four-cycle engine has much more torque than the two-cycle and turns at lower RPM. If you have a model airplane that needs stronger vertical climbs and requires consistent airspeeds, the four-cycle is a better choice. This type of engine is highly reliable, but also more complex. Until you gain some experience, it may be more difficult for you to maintain yourself.

The four-cycle glow engine became more popular during the 1980s. Since that time, it has become a great choice for *RC* model airplanes. When this type of engine first came out, it was advertised as producing realistic airplane noise. Although this is a little bit over the top, they do produce a better sound. The four-cycle engine is more fuel efficient than the two-cycle, so you'll get more flight time from a single tank of fuel. If you

don't need high RPM to deliver high speed, I would recommend the four-cycle glow engine. The only real drawback is the higher price.

Two and Four-Cycle Gas (petrol)

Years ago, the large model airplanes were often powered by engines converted from use in weed eaters and chainsaws which were the smallest gas engines available at the time. Today, manufacturers have understood the need for engines specifically for the modeling community and come up with both two and four-cycle gas engines intended for that purpose.

The good thing about these engines is that gasoline is much less expensive than glow fuel, so you can enjoy flying your larger model plane without worrying so much about the cost. Most expert flyers will tell you that the four-cycle gas engine sounds the most realistic of all engines, which is a big selling point for enthusiasts. For some reason, a realistic noise from your model makes flying more fun.

All model airplane engines are capable of doing serious damage to you and to others if you do not handle them properly. This type of engine is usually used on larger models and is also larger and heavier than glow engines and with a bigger prop. So it is capable of doing serious damage and like all engines must always be respected and treated with caution.

Diesel

I'm not sure why, but the diesel engine is simply not a popular choice for model airplanes. There are numerous benefits that argue for a diesel engine over other types, yet you'll rarely, if ever, see one on the flying field.

One advantage: just as with diesel engines in cars is that they produce more torque at low rpm and can therefore push large propellers far better. In addition, this type of engine requires no battery or glow driver. If you decide to use one then the problem usually lies in trying to find them. Unfortunately, when you do find a diesel engine for *RC* model airplanes, they tend to be expensive.

The biggest drawback, other than cost? When you get out to the field, if you should run into a problem, chances are there won't be anyone there knowledgeable enough to provide assistance. Some flyers are trying hard to increase the popularity of the diesel engine, but this will probably not happen overnight.

Wankel

The Wankel engine requires more space than is available here to explain how it works. But it is smooth and can achieve high rpm because the pistons do not go up and down as in most other internal combustion engines. Instead there is a single, almost triangular, piston that rotates within a housing. The technical difficulty with all Wankels is that the tips of the rotating piston tend to wear because of the high speed at which they sweep the chamber wall. The only Wankel engine designed and produced for model airplanes is a .30 version. Manufactured by a company called O.S. Max, the performance is reportedly very good. The only complaint about the Wankel engine from flyers is that it consumes too much fuel making it a trade off—you can have high performance but at the expense of high fuel consumption and cost.

Gas Turbine

If you're a beginner then it may be some time before you need concern yourself with gas turbine 'jet' engines. When shopping around for a gas turbine engine for your model airplane, keep in mind that this

particular type of engine is miniature in size. However, do not let the size fool you – they are extremely powerful and they produce lots of noise just like the real thing. While the gas turbine engine is expensive, it is a popular choice for scale jets and very fast airplanes.

Pulse Jet

Pulse jet is another extremely powerful and very noisy engine, for flyers who feel the need for great speed. One thing to remember with this engine: there's no way to throttle it.

Probably the most important thing to keep in mind is that, because the pulse jet engine can be highly dangerous if not handled properly, many flying fields and clubs have banned them.

Therefore if you eventually want to experiment with a pulse jet engine, you need to check around first to see if you can even fly your plane anywhere close.

Multi-Cylinder

Reflecting the advances we have already talked about in miniaturization of radio and electronics, and driven by modelers desire for realism, engine manufacturers are now producing scale versions of pretty well every type of internal combustion engine. These include "horizontally opposed," "radials," "Inline," and "V". Their characteristics mirror those of the full size engines and they will usually produce less vibration when compared to a single cylinder engine of the same size. The downside is that they are less powerful as the additional machinery is bound to absorb some of the power produced.

Ducted fans

You may well see a great looking 'jet' airplane – but with no jet noise. A neat solution to avoiding the cost of jet engines is to provide the required thrust by a propeller engine (the 'fan') hidden in the bodywork and with the airflow directed past the engine/s by a duct looking like the jet engine intake and leading past the engine and propeller to the exhaust. The prop and engine are fitted with minimal clearance between the prop and the duct in order to force the airflow through as efficiently as possible. So the airflow generated by the propeller is being directed through the 'exhaust' duct to provide a jet effect. A jet engine/airplane combination is usually looking for high speeds so engines with the simplest possible operations without efficiency losses are most appropriate. This will tend to limit it to 2 stroke and electric motors. This is, of course, a great way to use silent electric motors in a 'jet' model that you want to fly somewhere that is noise limited.

How to Choose an Engine

I hope this section has given you a better understanding of the different engines people use for model airplanes. As a beginner I would suggest that you simply go with the engine that comes with or is recommended for your first kit. But when the time comes for you to branch out and start making your own decisions then you've now got a basic understanding of the choices. Here are a few more tips.

Top Rated

Most flyers will choose the engine rated at the top of the manufacturer's recommended range. For instance, if you have a model plane kit that recommends .25 to .40, then go with a .40 to .45 engine. There is an exception to this rule: 1/2A RC airplanes are limited to.15 size engines and under.

As mentioned, a four-stroke engine does not produce the same level of power as a two-stroke engine (but

does produce more torque – remember the difference). Therefore, a good rule to follow if you want to substitute a four-stroke in place of a two-stroke is that with a two-stroke, you'll only need about 66-75% the size you will with a four-stroke engine.

In this case, if you have a model airplane designed to run with a .45 two-stroke, you could instead go with a .60 four-stroke. On the other hand, if the recommendation is a .90 four-stroke, you could choose a .60 two-stroke. Because the four-stroke engine is more fuel efficient, the tank size for these swaps would remain constant.

Reliability

Choose a reputable brand. Normally, as long as you stick with a name brand, you'll find a good one for your particular needs. The key is to go with quality, even if it means spending a little more. Although you'll find some "generic" engines that appear to be identical except for the brand name, we recommend you go with the known brand. A good engine may well last you through several models. An imposter will probably not.

Tuned Mufflers

The next tip is to not use tuned mufflers, which are usually referred to as "tuned pipes" unless you really understand what you are trying to achieve. The cost of a tuned system will push your engine up into the realm of the next-size-larger engines.

Rather than go with a tuned system and set yourself up for problems, why not just go with an engine one size up? If you already have your engine, you can buy a pipe, especially if the larger engine does not fit the airframe.

Of course, there are always exceptions to every rule. In this case, there will be slight advantages in competition flying. Yet if you love a plane with speed, remember that this comes from RPM and you will not get much more speed from a tuned pipe. You will notice improvement in climb, as well as hovering if you are doing stunts, and power but when it comes to speed, look at the engine's RPM rating.

Fuel

Glow engines burn a fuel mixture consisting of methanol (methyl alcohol) and oil, usually castor oil. The basic mixture is 80% methanol with 20% oil. In addition you will often find nitromethane added, maybe 10%. It's from nitromethane that the common term 'nitro' is derived. Nitromethane carries a lot of oxygen to help the combustion process and produce more power. So 'nitro' has come to be associated with 'get up and go' rather like *GT* models of cars.

Most glow engines will come with a manufacturer's recommendation for fuel/oil mix with a type and percentage of oil specified. There will probably be two recommendations; one for running in and one for normal use.

Stick to these recommendations if you do not want to invalidate the warranty on an expensive piece of machinery. There are some experienced modelers who make their own decisions about their fuel mix – but leave such decisions until you can call yourself ‘experienced’ and can afford the cost of any mistakes you make.

Propellers

Most *RC* model airplanes, regardless of propulsion method (gas, electricity, rubber bands etc.) generate forward momentum through the use of a propeller. Propellers (props) come in many sizes and configurations usually with 2, 3 or 4 blades.

Understanding how a prop can affect the flight of your model airplane is an important thing to know. Once you know how the length and pitch can change your airplanes flight characteristics, picking the best prop can be fairly easy. The two factors that differentiate model airplane props from one another are the length, and the pitch. These are usually displayed as Length x Pitch (i.e. 12x6, 11x7, 8x4) on the propeller.

Propeller Markings

The first number, representing the length of the prop, is usually specified in inches unless otherwise stated. This means that a 12-inch prop will have 6-inches on one side of the center hole, and 6-inches on the other. A lengthy prop with a low pitch will give your engine more power to pull your airplane forward. This power is referred to as “thrust”. The more thrust your RC model airplane engine puts out, the more responsive your model will be. Thrust can be described as a measure of weight. Matching the thrust output of your engine/propeller combination to the weight of your model can help you determine just how responsive it will be.

A model airplane with a 1:1 thrust to weight ratio will fly just fine. This means that your model airplane engine has just enough thrust to support the weight of the plane – so in a vertical climb it would come to a halt and hover in mid air. This is not a good position to be in because without more power to continue the climb the only way out is downwards and backwards and airplanes are pretty difficult to control like that!

This is why aerobatic airplanes demand thrust to weight ratios higher than 1:1 so that they can continue to climb their way out of that situation. Choosing a longer prop will give it more thrust and allow you to climb vertically for longer distances. Give it enough thrust and you can do 3D maneuvers (3D = highly aerobatic,) such as bring your *RC* airplane to a complete stop in mid air – as described above - and have it stay there, hanging from the prop. The difference, of course, is that the aerobatic airplane has enough thrust to climb and fly out of that situation under control.

The second number that describes the propellers characteristics is called the pitch. The pitch refers to the angle and width of the prop. Similar to the way a longer prop will change the amount of thrust that your model will generate, a higher pitch will give you more speed. For example, a 10x6 prop, under perfect conditions, will pull your aircraft forward 6 inches for every revolution of the prop. Choosing a prop from your manufacturers suggested prop list that has a shorter length and a higher pitch will allow your airplane to go faster. Reversing this theory will give you more thrust.

Using this information to calculate the thrust and speed your model airplane will have before you fly can be very rewarding, and is often necessary when building a 3D aircraft. After you’ve worked with the numbers for awhile, and seen the results in the field, you’ll be able to look at the numbers and know right away how your model will respond in the field.

Assorted propellers

Aerodynamics - The Basic's

This section will discuss some of the basics you need to know to fly a model airplane. Everything that flies, big or small, man-made or natural, is bound by the laws of aerodynamics and it will help you to understand why your model flies and why it flies the way it does if you know something about aerodynamics. Don't forget that much early development in aerospace came about because the designers and engineers involved tried out their theories with models. As a modeler, most of your expertise will come from practice as theirs did but this material will provide you with a good starting point about the theory.

General

For an airplane to fly, it must be able to conquer gravity to stay in the air. This happens when the lift generated is equal to or greater than the plane's weight. This cannot be accomplished with the plane sitting still so you need an engine to produce thrust, which is a force directed backwards. *(I'm excluding sailplanes here which depend on rising air)*

With thrust provided by the engine and propeller, the wing is moved forward through the air, thus generating lift. The thrust must be equal to or greater than the drag created by the shape of the airplane for the airplane to move forwards. Drag is the resistance of air to a body moving through it. Therefore, if thrust is greater than drag and the lift is greater than the weight of the plane then the plane will fly.

In other words, when the specially-shaped wing of the airplane moves forward, air lifts it. If the plane is traveling too slowly and does not produce the required lift, it will stall and fall. Therefore, the speed of the plane must be produced by an engine or propeller. The entire time the plane is moving forward, the wing is lifting, even if it's in a turn, upside down, doing aerobatic maneuvers, or inverted. There are different designs of wing with different sections. You can see a neat video of the two basic sections illustrated in real life at

http://pbskids.org/dragonflytv/show/modelairplanes.html .

The plane is turned using the ailerons and rudder. A turn using just rudder is inefficient because the wings stay level and the plane yaws sideways through the air. A turn using ailerons is more efficient as the ailerons move up on one side and down on the other thereby lifting one wing and dropping the other and the plane flies neatly around the turn. You will almost invariably be taught to turn using ailerons first when learning to fly.

To get the plane to go up or down, you use power and then the elevator. To increase height you use more power/speed to generate more lift. To maintain a constant speed you use the elevator to lift the nose and slow the airplane down. This also increases the angle of attack of the wings thereby generating more lift. You can see that this can be a complex question and needs to be reduced to some simple flying processes. You use the elevator to change the nose up/down attitude of the airplane. As the elevator surface angles upwards, air hits it in a way that moves the tail down and the nose up. When the plane goes up, it will begin to slow down unless additional engine power is applied and, again, if it slows down too much, it will stall. This is one good reason for ensuring that you change altitude by applying more (or less) power/speed first.

Airfoil

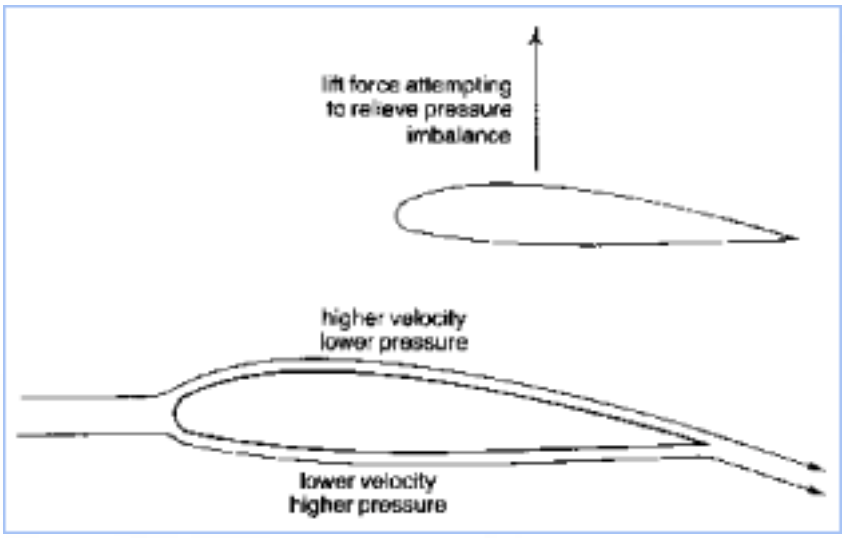
The airfoil is a section taken through the wing at any point along its span. The span is the distance from one wingtip to the other. To develop lift at low speeds, and to provide a stable airplane that returns easily to horizontal flight, a flat-bottom airfoil is needed. This is obviously very beneficial for beginners just getting

started with flying model planes. If they release the controls the model will return to level flight and right side up.

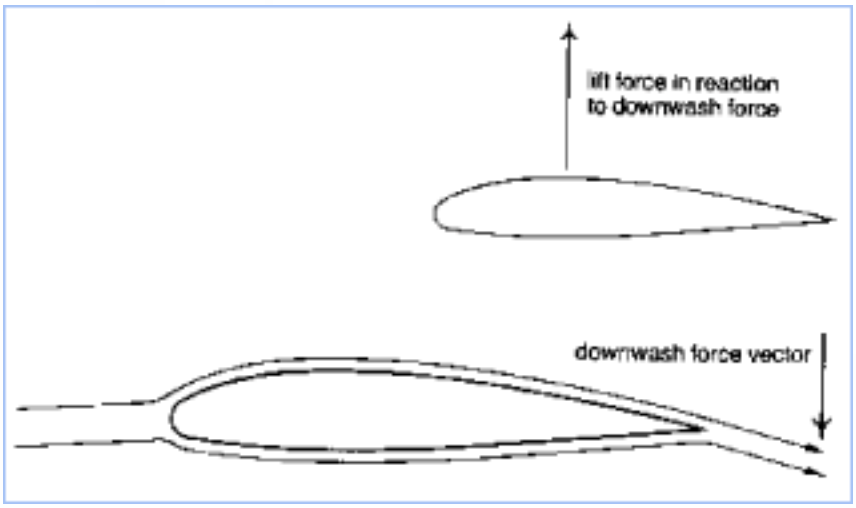
A wing with an airfoil section shaped the same on top and bottom will produce lift equally, regardless if upside down or right side up. So the orientation of the wing in the air depends entirely on the control inputs of the pilot. The symmetrical airfoil is recommended for advanced flyers. There is also the semi-symmetrical airfoil, which is a combination of the two and is used by both intermediate and advanced flyers.

We've talked about 'lift' but *what is it?* There are two explanations for lift which even the experts are not agreed upon. The two theories were proposed by two very famous scientists, *Bernoulli* and *Newton*, so there is probably some truth in both.

The diagram below shows air flowing past an airfoil, i.e. a wing. The airflow over the top of the wing has a higher velocity than the airflow under the wing. Experiments have proved that this creates a lower pressure on top of the wing. A basic rule in physics states that when an imbalance exists, a force will result tending to relieve that imbalance. Therefore, to relieve the imbalance there is a force from the higher pressure to the lower pressure and this is called lift. This is *Bernoulli's* explanation.



Newton's laws state that for every action there is an equal and opposite reaction and the alternative explanation is as follows.



The airfoil shape of the wing causes the flow of air to be deflected downwards – and this is the importance of the airfoil shape of the wing which causes this deflection which is necessary for either of our two scientist's

theories to hold good. Therefore there must be a reaction in the opposite direction which is equal in force to the force of the downwash – and this is lift.

Whichever one is right, or maybe a combination, you can see that the shape of the wing is critical as is its position on the airplane and that its surface is maintained in a smooth condition so as not to disrupt the intended airflow. All of these things are critical for your model just as they are for full size airplanes.

Dihedral

If the wings of your model sweep upwards from the fuselage, then it has 'dihedral'. This helps increase stability while decreasing aerobatic ability and is what you are looking for in your first trainer.

Anhedral

Anhedral is the opposite of Dihedral and is when the wing sweeps downwards from the fuselage. This is much less common.

Landing Gear Location

To make takeoffs and landings easier, especially for someone just starting out, tricycle undercarriage comprising two main wheels and a nose wheel is used.

Wing Specs (Area, Loading, Location, and Thickness)

The wing area is the wing surface available to create lift.

Wing loading is the mass of the airplane divided by the wing area. This is generally measured in ounces per square foot. Typically, beginners want a light wing load to make controlling the plane easier.

Wing location means wing placement, and falls within two primary categories, the high-wing design and the low-wing design. With the high-wing, the model plane's weight is suspended under the wing, so when the plane tilts, the weight of the plane tends to push it back toward a level position. The plane has more natural stability, making it easier to handle and thus a good choice for beginners.

On the other hand, with the low-wing model, the main weight of the fuselage is above the wing, which tends to make the airplane less stable. Because of this, the low wing design would be used for advanced flyers who are interested in performing aerobatic maneuvers such as rolls and loops.

The thickness of the wing determines the amount of drag created, is measured from top to bottom and often expressed as a percentage of the wing chord at the point of measurement. Because they are thicker and harder to push through the air, thick wings create more drag, which causes slower speeds and gentler stalls, making this style good for beginners.

A thinner wing produces far less drag, meaning high speeds and sudden stalls are both possible. Typically, you see the thin wing used on fast, high performance airplanes required to carry out aerobatic maneuvers and deliver fast responses.

Radio Control

Aeromodelling would be a whole lot duller without the spark that radio control brings to the hobby. After all, it is the ability to put you in control of the plane which makes it so exciting. So many of us would love to be pilots, to fly aloft among those fluffy clouds but are prevented from doing so by so many different reasons. Yet model airplanes bring that excitement within reach and radio control is what brings the control into our hands. So in time we should spend a little time trying to understand how that control comes about.

For most of us it is and will remain a mystery. All we will need to know is to buy the boxes, connect up the wires the way the manual says and away we go. But for those who are interested then here goes with some basic technical stuff.

Transmitter

These typically have four to six channels and these days are almost always “proportional” meaning they control devices or surfaces that move proportionally to the movements of your control sticks. Four channels would be used to control flying surfaces while the other two channels may be used to retract landing gears, turn on lamps, etc or anywhere where a simple on/off command is required. They would not have to be proportional for these simple on/off tasks. The more complex your models get as you become more experienced the more channels and options you will require.

The transmitter may have a dual rate and/or exponential facility. With dual rate you can change the maximum throw angle of the control surfaces while the plane is being flown. Choosing one rate or the other will change the physical distance the servo arm will move and therefore the amount of movement of the flying control surface. The movement remains linear throughout the range. i.e. you get all more or all less). Exponential allows the stick position/control movement ratio to be non-linear and control movement is reduced towards the centre of the stick movement range. This is desirable for very fast aircraft as larger movements are required at low speed e.g. take-off and landing while small movements are required at high speed or the forces on the airplane can cause it to break up.

Many of the transmitter models on the market today have a servo-reversing feature to facilitate linkage assembly. Remember to reset and carry out thorough pre-flight checks after using this facility. Others have channel mixing, which allows you to make V-tail and flying wing configurations including flaperons (a type of control surface that combines flaps and ailerons into one) and elevons (combining elevators and ailerons). Increasingly these days transmitters come as standard with memory and a microprocessor, allowing you to save the settings and configurations for several different planes.

The transmitter works by sending data to a multiplexer which then generates a radio frequency carrier for the receiver with is tuned to the transmitter’s carrier frequency. Older equipment using radio crystals is now being superseded by synthesized transmitters and receivers and frequency tuning is highly accurate. The receiver detects data from the modulated carrier, decodes it, then instructs the appropriate servo to move according to the user input.

Receiver

You’ll find receivers come in all shapes, sizes, and weights. Some work for long-distance flying, some for safe programming, some for miniature planes, and so on. As you’ll discover below, you’ll determine the type of receiver you need based on your plane and the type of flying you do.

Servo

A servo is a small motor wired to the receiver in the airplane. The receiver decodes the signals from the transmitter and instructs the servo to move a certain amount. This movement is transmitted to the aircraft’s

control surfaces - usually by the pushrods connecting them to the servo.

As you can see from the picture, servos are usually small black-box type devices.

Buddy Box

Some flyers use what is known as a “buddy box.” This allows you to use two compatible transmitters connected by a cable. Most instructors will use the buddy box for training purposes: the instructor has one of the transmitters and you have the other. This is strongly recommended for you while you are learning to fly. It can save you a great deal of time and money in replacing damaged models that you have crashed – all by yourself!

You control the plane only if the instructor is holding down the push button on his transmitter. The benefit of this is obvious. If you get in trouble during takeoff, flight, or landing, the instructor simply releases the push button, giving him or her complete control over the plane. If you are planning to work with an instructor then make sure that the transmitter you buy is compatible with his buddy box. When connected together, the power and the frequency is obtained from the instructors transmitter. So compatibility is very important.

Frequency

Radio controls use several frequency bands, which vary depending on the country in which you live. These bands are then divided into many different channels. Thus you need to know the bands for your country in order to ensure that you buy the correct equipment. In the USA this is 72 Mhz and in the UK 35 Mhz. Your local hobby shop will advise you on this when you’re starting and properly certified equipment will have been set up by the manufacturer to operate in the country in which it is being sold. Be very careful with this if you are buying on-line or across national borders. So make sure you know what band you are supposed to be using and that the equipment that you buy is properly approved. It is illegal to operate equipment outside the approved band!

The channel you are using is also the most important issue when you go to your club flying site. There will be strict rules governing the channels in use by each flyer to prevent two flyers using the same frequency at the same time. You will often find coloured ribbons tied to transmitter aerials for the 27 Mhz range of ‘toys’ and numbered pennants in the aeromodeling frequency band. You may even have your transmitter taken from you by a central control office until you are ready to fly. Pay real attention to the local rules wherever you fly. There is no quicker way to lose a friend than to switch your transmitter on to his frequency while he is flying.

There is much more that could be written about radio systems and it used to be the case that *RC* models were the preserve of seriously technical people who could understand that stuff. However, these days in the digital era life has become much simpler and for the beginner you can be secure in the knowledge that you can save all that up for another day.

Flying

This is what it's all about. If you buy it *RTF* or *ARTF* then you're going to fly it. If you build it yourself then you're going to fly it! However fast or slow your preparations your objective is to get out there and fly your airplane.

When it comes to flying then exactly the same considerations apply to your model as to any full sized airplane. When you unleash your model into the skies you have to be responsible for anything that may happen as a consequence. Without wanting to be a killjoy, safety is a pretty important concern when flying model airplanes and you need to remember to put the safety of other people and their property above your own enjoyment in your priority list.

More important than size, speed, height, model, and engine, is the safety of you, the people around you, and the plane itself. Much of the knowledge required for safe flying arises from practice and common sense, but nonetheless, in the name of leaving no stone unturned, we've dedicated much of this chapter on flying technique to safety considerations.

Where to fly

When flying, you need lots of open space, a large field or preferably the flying field of your local model club where you know the activity is approved. Most model planes must be flown in approved areas that are open and unobstructed. Therefore, a model plane, especially a large one, should never be flown from a residential street, a backyard or any restricted space. Regulations vary from country to country so check on the situation in your own area before you go flying.

Pre-flight

To fly safe and smart, you should take follow the same steps every time you get ready to fly. Keeping to a good preflight routine will protect you from many major problems.

Radio checks

Put simply, always check that your model control surfaces are responding and working in the correct direction in response to control inputs you put into your transmitter. Although there are lots of technicalities about radio that you can get involved in you can safely leave them to a later stage of your modeling career. By the time you'll need it, you'll already have learned a great deal from your experience or your colleagues. What you need to do at this stage is to simply check your model is working properly and control surfaces are moving in the right direction.

However, there a two important issues to remember right from day one.

- When you are switching your radio equipment on or off; the transmitter always has power before and after the receiver. Switch the ***transmitter ON first*** before the receiver. Switch the ***receiver OFF first*** before the transmitter. The transmitter has power first and last.
- one very important point is to carry out a range check of your transmitter to ensure that it is

putting out a sufficiently strong signal. This is done by extending the transmitter aerial only a couple of centimeters outside the case and move about 10 metres (30ft) away from your model. Then exercise all the control surface movements as before. They should move to the full limit of their travel and without any judder or hesitation. You will need to share this task with your instructor or a friend as you may not be able to see the movement properly from that distance.

Carrying out a range check is equally important after you have changed or adjusted any part of the electrical or radio system.

Co-Pilot

There are some models available with this additional feature which you might consider if you are concerned about your flying ability. The equipment works by monitoring your airplane's relationship to the ground's horizon using four infrared temperature sensors. During flight, the co-pilot senses any changes in altitude relative to the horizon.

Corrective signals are then sent to the aileron and elevator servos to keep the plane level. If you have an extra, unused channel, then you can turn the co-pilot on and off, adjusting sensitivity from the ground. You will need to locate a model with this feature if you want this sort of safety backup.

Weight and Balance

This is critical. For *RTF* kits, you don't need to worry much about the weight and balance in the beginning. However, you should always check the balance before each flight. If the airplane is not balanced, it will be much more difficult if not impossible to control and may well crash. Every object, including planes, whether model or full size passenger jets, has a center of gravity (*CG*) which is a single point at which the object's mass can be assumed to be concentrated.

Just to make the point about how important this can be here's a quote from the aviation industry magazine "*Flight International*": *But the Air Accidents Investigation Branch (AAIB) says (xxx airline) has suffered an "abnormally high frequency" of loading errors since mid-2004, and had "not given necessary priority" to loading issues.*

It lists eight other instances of incorrect loadsheets being generated for A340s and Boeing 747s; more than half of these were not detected before departure, although the flights stayed within balance limits. Incorrect loading also resulted in an in-flight "excess aft centre-of-gravity" warning to the crew of a transatlantic A340 on 7 June 2004

"Incorrect weight and centre-of-gravity can have very serious consequences and should be given a high degree of importance in terms of staffing, training, monitoring and auditing," says the AAIB. So if you think this does not apply to your airplane then think again.

The position of the Centre of Gravity (*C* of *G* or *CG*) reflects the weight and point of balance of the airplane and has a direct impact on the way if flies – *if at all!* As a general rule, the center of gravity can be around 25-33% of the way back from the front edge of the wing depending on the model (and 66-75% of the "wing-chord" forward from the trailing edge). A crude test is to place the tips of your index fingers under the wing tip, about one-third of the way back toward the trailing edge.

Then, very carefully, lift the model airplane up, balancing it on your fingers. If the balance is good, the plane will be level, with the nose pointing straight, or just a bit downward. If the plane's tail is pointing downward, then you have a balance problem and should not fly the plane until it is fixed. This is another occasion when taking advice from experienced modelers at your club is a good idea.

Before adjusting it, think of what might have caused it. If you tested your model before leaving home and it

was OK but now it isn't then what might be the cause? A loose screw or piece of material which has moved around during transit can be enough to affect the *CG*. If you now adjust it back to balance by adding another weight then you may have left a loose item inside your model which will surely come back to haunt you when it moves again during a flying manoeuvre. If you do need to adjust, add weight to the nose, something like fishing shots, plasticine, or even modeling clay. Add just a little at a time, checking the center of gravity after each addition. (Or, you can move the engine more toward the front by adding washers to the engine mounting bolts.) If you do not want to crash and ruin your plane, this is a crucial step.

Following the Manual

For your full pre-flight check, always refer to the manufacturer's recommendations. At first, this will take time, but as you do it over and over, you'll soon have the entire process memorized. This step is essential when flying model airplanes.

Some of the things you'll be checking include the following: looking at the wings to make sure they are fastened securely; making sure the control surfaces move correctly and freely; and ensuring that the engine operation and radio gear are okay.

Getting Airborne

Other important safety considerations have to do with checking the flying qualities of your model – before you commit yourself too far.

Test Glide

A test glide can be very useful for sailplanes, airplanes without undercarriages and smaller models that can be hand launched. The test glide is designed to assess the glide characteristics of the plane, so you know what to expect if the engine should unexpectedly run down. If your model is suitable then you should certainly perform a test glide when you first complete the construction and whenever you have made any changes – particularly to the *CG*. If your model is too large or you may damage an undercarriage for example, then building a straight ahead, hands off, flight period into a cautious first test flight will achieve the same objective. To carry out a test glide, work over a long area of grass, so if something happens, your model will not be seriously damaged.

For the pre-flight check, turn the transmitter on first, followed by the receiver switch. Then, pull the transmitter antenna out so that it's completely extended. Next, make sure the rudder or elevator is working properly, moving in the correct way then centre it in a neutral position. No need to start the engine, remember you're checking the gliding characteristics.

Now hold your airplane facing away from you, at head level and into the wind. Very gently launch the plane from your hand, making sure it is level or pointed slightly downwards. If the plane is right and ready to fly, it will gently glide to the ground after a short, smooth flight.

Powered Flight

Once you've checked everything for the flight, you are now ready for the real test and the first real launch. This can be done in one of two ways. Either you can perform a hand launch, which is just like the Glide Test listed above, or, if your model is able, you can have it take off from the ground either reasonably smooth grass or a prepared runway if you're lucky.

Ground Roll

If you take off from a ground roll, allow the plane to get up enough speed on the ground prior to giving it

the “up” signal. The goal is to make the plane climb at a small angle using wing lift, rather than trying to drag it abruptly into the air on engine power, which can cause you to lose speed and stall.

Once the plane is out of your hand or off the ground, hold the transmitter with both hands and put your thumbs on the sticks. Ensure that you have gained enough height to be able to maneuver safely. Next, bank the model airplane gently using aileron, so you become accustomed to the way it will behave under your touch. Power plus elevator are used to control altitude as needed. Keep your movement very smooth, gradual, and slow and avoid moving the sticks to the maximum positions.

Obviously, if there are people around, you want to keep the plane a safe distance from them and at a safe altitude. However, make sure to never let the plane get too far out of your sight. Finally, always keeps the transmitter antenna pointing up at a 45-degree angle or more.

Taking Off

The way you take off will depend on a number of things. For example, if your model plane is designed with an undercarriage and you’re flying from a flat, smooth surface, then you would do better taking off from the ground instead of using a hand launch. To do this, go through all of your pre-flight checks and then set the plane on the runway facing into the wind.

Next, stand directly behind the plane. Turn the engine on to full power, allowing the airplane to accelerate while on the ground. If necessary, use the rudder to keep the plane headed straight down the runway. On or very close to the ground it is not possible to use aileron to control direction. Just as with a full size plane, the model will gain speed and eventually lift off the ground.

Lift off

When the plane starts to take off, give it just a little bit of up elevator. Typically you see beginners make the mistake of climbing too steeply, which causes the plane to slow down, stall, and crash. A gradual climb, as stated before, is much better. So go light on the up elevator.

Launch

If you plan to hand launch your model plane, be sure you never throw it angled up. Instead, it should be thrown firmly - but not too hard - with the nose pointed straight ahead. You want it in a nice stable flying position while you get your hands back on the transmitter box.

Trimming the Plane

The word “trimming” refers to the adjusting of your airplane controls during a flight so that the plane flies straight and level without you making any control inputs. Sometimes a model airplane will want to veer in one direction or another because of the motor’s torque or perhaps some distortion or construction defect is affecting the aerodynamics. This may not be critical but you’ll need to learn about this characteristic of your plane, and fast, so you can compensate for the defect and fly it properly.

The small trim tabs located on the transmitter are used to fine-tune the controls and these may vary from one transmitter model to another. Once the trim tab has been moved, allow your model plane to fly on its own for about 10 seconds to check that it is flying straight and level. Keep on making small adjustments until you get it right.

High Turns

After take off, never try to turn until you know the model airplane is high enough. Generally, you should climb straight ahead before making very gentle turns.

Gentle Turns

Before you try to land your plane, I recommend you practice some gentle turns when high in the air. By doing the turns high, you'll have lots of altitude available to correct problems if they develop and if you keep them gentle then you have a better chance to recover things if they start going wrong and you can safely develop a better understanding of how your plane will respond to your controls. Now, if the plane begins to stall, simply give it a little more power and some down elevator and you'll have no problem bringing it under control.

Disorientation

Because you're not sitting in the cockpit of your model facing the direction of travel it is easy to become confused about which control input you need to use to turn your model in the direction you want. If your model airplane is flying directly toward you, the control movements you make will produce movements by the airplane that appear to be opposite to those you intend. Movements to one side or the other are completely reversed when the plane is flying directly towards you. The key is to turn your body a little to envision left or right from the plane's viewpoint. This way, you'll not get confused about how to turn your plane.

Landing Spot

Avoid trying to land in a particular spot. Instead, allow the model airplane to glide to the ground, its nose pointed straight ahead. Remember to use a large field, especially for a first flight, so that you'll have a better chance for a successful takeoff and landing.

Landing

To bring your plane in, start by lining it up with the place where you want it to land, either grass or a runway. Then reduce the power, without turning the engine completely off. Use just enough engine power to maintain a gentle rate of descent while keeping the airplane in the landing attitude (that means wheels down - not nose down!), keep the plane in a straight line, allowing it to descend gently towards the ground using either the ailerons or the rudder depending on your model and your instructor's teaching method. Remember that the amount of engine power you need will vary according to the strength of the wind you are flying into - and that can change from day to day.

Some model airplanes have an elevator control. In this case, you can adjust the height, but if your plane doesn't have this feature, don't worry, the engine will do the same thing if you power up gently to help slow the descent down. Otherwise, it's best to use the elevator to pop the nose up slightly as you touch down - this drains excess speed from the plane.

If you're uncomfortable with the landing approach, increase the power again and circle around to make another attempt, lining up again with the runway or grass. With full size airplanes they just call it a "missed approach". Like the professionals you'll do far better to make several attempts rather than to crash your plane. However, make sure you do not run out of fuel or battery power before you land.

Washout

Washout is the desirable and intentional warp seen in the wing near the wing tip. Typically, the warp would be at the outer 20% of the wing. Washout is good because it helps the outer parts of the wing fly straight during the start of a stall. In other words, the plane will stall straight ahead rather than rolling to the side or back.

Yet you want to ensure the wing is not warped more than the intended washout. To check for warping, you can attach the wings to the plane and then set the plane on a table. Step back to look at the rear of the plane at eye level. You want to be able to see just a little of the bottom of the entire wing and it should be

symmetrical on both sides. If you see more, then you can go through the testing process to see if your plane is still controllable and try to 'trim out' the defect as described under 'Trimming', but your model will never be as efficient or controllable as it could be. If the defect is too extreme to trim out then you must remove the warp prior to flying.

Field Safety

You should keep a first-aid kit handy on the field, just in case. Additionally, you may want to wear eye protection (even when working on building a kit). A small fire extinguisher is advisable, as is hearing protection. Most importantly, never rush yourself when it comes to getting your plane up in the air.

We've talked about the high RPM of 2 stroke engines and the torque power of 4 strokes so don't imagine that a few human fingers are going to get in their way too much. You would be amazed at how many flyers get in too much of a hurry and, without thinking, reach through a whirling propeller to adjust the needle valve. Many people have lost fingers this way. The same thing goes for the area alongside any rotating propeller. A propeller can fail catastrophically if it has been damaged or indeed for other reasons. When it fails it is likely to disintegrate and at high rpm the pieces will travel far and fast in the plane of the propeller. That means if you draw a line from one tip of the propeller to the other – then extend it out on all sides. So this should always be an area that both you and any spectators should stay away from both for your own airplane and from your friends who may be working on their planes in the pit area alongside you.

For electric models, an electric motor will continue to try to rotate even if it is obstructed. So if the propeller is stopped by some obstruction and you remove the obstruction then the prop is going to rotate again in a flash and if your fingers are in the way you will get one or even several whacks and, yes, they draw blood. Treat any electric motor still connected to its main battery as being 'live'.

Never point your plane in the direction of people in the pits. While this might sound like common sense, you would again be surprised at how many times this happens. The plane should always be pointed away from people and toward the flight line. Stay oriented. Always fly your airplane in front of you. Do not fly behind yourself so you have to swivel around to watch your plane and lose track of the location of the flight line and pits.

Then make sure the engine can be completely shut down using the transmitter. This requires you to set the throttle linkage up properly so the throttle is able to go below a high idle.

It is important to remind yourself that each time an adjustment is made mechanically to the throttle; you need to ensure the plane is being held very securely. Many modelers make up restraining yokes they can dig into the ground with two padded forks sticking upwards either side of the fuselage and just in front of the horizontal stabilizers. That way they can roll the model forward so the stabilizers are up against the padded forks and the model cannot move any further forward while they have both hands available for any adjustments or tests they need to make. The alternative, of course, is a helpful friend.

Next you want to start the engine, making doubly sure the throttle is working as it should, and that you can shut the engine down with the transmitter, the way it is intended to be done.

After you have started the engine and the propeller is spinning around, move behind it whenever possible. You never know when your restraining forks – or your friend – may fail in their task. It has been known.

Another important flying tip: you should get into the habit of pulling back on the throttle immediately anytime you run into control problems – and get the nose down. Remember, you don't need engine power for your model to fly – you have tested that your model will glide – but you do need flying speed and you wont get that with the nose pointed upwards. Flying speed gives you control, the most important requirement, if you've had an engine failure and as long as you have control and stay above stalling speed you'll have more time to determine and fix the problem. Otherwise half throttle is usually more than enough as you are learning to fly.

Those "'Oh dear!..." moments

Unfortunately, crashes happen. Bad ones can do significant damage both to your airplane and your wallet, so they're best avoided if at all possible. If you can see that a crash has become inevitable then try to minimize the damage by stopping the engine (can minimize damage to engine and prop). This is especially important with electric motors which will continue to draw power even when the shaft is stopped leading to damage to the motor, controller and/or battery, all of which could be avoided by switching it off.

While this advice can help you learn how to fly safely and with confidence, which will head off most crashes, they will still happen. So understand that routine maintenance and repairs, fixing (and sometimes trashing) planes and replacing parts as you go, is just a normal part of the game, and is to be expected. Remember, you are not going to make mistakes, just learn another lesson! Usually, the bigger and more expensive the lesson the less likely you are to repeat the mistake.

Field Equipment

After you've purchased your model airplane and started flying, you'll need what is called "flight line equipment." This includes things such as fuel, a fuel pump, equipment for starting the engine and so on. Typically this field equipment (with the exception of fuel) will be only a one-time purchase.

The glow fuel has a percentage rating that indicates its nitro-methane content. For a trainer plane this will normally be between 10% and 15%. Be sure to follow the manufacturers recommendation and to use quality fuel with a blend of synthetic lubricants and castor oil, as this will protect your engine. People often go with a cheap fuel, thinking they are saving money, only to find the moisture in the fuel causes rusting, ruining their equipment.

Other field equipment commonly required include a power panel, 12-volt field battery, *DC* battery charger, glow plug clip, glow plugs, and propellers. Some experienced modelers reckon it's a good idea to take along a refuse bag in case you find yourself leaving with more pieces than you arrived with!

If you bought your airplane *RTF* then you may well not need this equipment as everything will be supplied in the box. If you build your airplane from a kit then you will probably find that you will accumulate most of these tools and equipment as you go along. Then you just need a convenient box to put them all in.

Lots of modelers build their own field box tailored specifically to their own requirements with slots for fuel, tools, starter and batteries according to the type of plane they favour.

Tools

Whether a beginner or an advanced flyer, you'll always need to keep a few things around to help you keep your model airplane in top working condition. Among them: masking tape, pliers, sandpaper, a cordless drill, T-pins, a hobby knife, and a variety of screwdrivers. Keeping these handy in your field box will allow you to take care of problems that develop in the field.

Other things to keep around include covering, an adhesive backed fabric or plastic; pushrods to link the radio-system servos to movable parts of the model; a control horn; hinges; foam rubber; wheel collars; wheels; wing seating tape; spinner; fuel tank; tubing; filters; an engine mount; and various engine

accessories.

Of course, these things add up which is why it is always worth keeping components from your old models. One day you will be able to reuse them.

Final Tips

Some last thoughts on flying that might help you save the day...

- If at any time your airplane is not doing what you want, cut the engine and plan to land. Take the urgency out of the situation and turn your airplane into a glider. In most cases this simple step will reduce the possibility of any serious damage.
- If your model airplane is coming toward you, your turns will be back to front. When first starting out, you'll be unaccustomed to the way things seem to work in the opposite direction but, over time, it will all fall into place.
- Make sure that ***all*** the radio gear batteries are fully charged prior to flying. Just one dead battery will cause a problem.
- When flying model airplanes, every flyer needs to leave his or her pride at the door. This is a hobby of focus; when a person becomes proud, mistakes happen that can lead to disaster. Remember, the people at clubs, and your instructor, will help you and answer questions - all you have to do is ask. All of them were beginners just like you at one time. It is perfectly fine to be the beginner.
- Be smart, use common sense, and most of all, have fun.

10 Questions & Answers

The flying of model airplanes is a remarkable hobby that offers tremendous challenges and unsurpassed amounts of pure fun. I've tried to give you a general background as I see things. But in this chapter, we'll turn it round and look at some of the most common questions asked by people interested in getting involved with this unique pastime.

How Do I Start?

This is always the number one question. The best way is to locate *RC* enthusiasts in your area. You can check with local hobby stores, look in the yellow pages, or scout around on the Internet. Using a search engine such as Google.com, type in "*RC club*," or "*RC* flying fields," followed by the state city in which you live. Look for the national association for your country. They will usually have a comprehensive list of clubs in your country.

Once you locate a club, schedule a time to meet with the owner and other members and ask to watch them flying. You'll probably be surprised at just how friendly and encouraging these people are - common flyer traits which should make you all the more excited about becoming one.

How Much Does It Cost?

The number two question. Remember that you yourself control the expense. If you fall in love with the hobby, you can go completely overboard. However, just as with most leisure activities, you can generally adjust for your budgetary constraints.

Although the startup can seem a little high, remember that these are only one-time fees. After you have your plane, engine, and so on, the ongoing costs are very affordable, unless you want something bigger, faster, and better every year. Otherwise, the engine and radio controller will last for years if cared for properly.

You can learn an enormous amount about aerodynamics and have great fun as well by building paper and card models for almost no cost – and power them with rubber bands.

The *RC* toy planes described earlier came in around the $40 to $70 range.

For a typical glow or gas powered *RC* trainer startup package, you can expect to pay the following (in US dollars):

Equipment	Cost
Mid-Size RC Trainer Model Kit	$100
.40 Cu. In. 2-Stroke Engine	$130
4-Channel Radio System	$200
Accessories, glue etc.	$55
Fuel plus Basic Fuel Equipment	$40
Total Startup	**$525**

Don't forget that if money is short then you can still start flying for less than $40

How Far Will It Go?

Many people are initially interested in how far model airplanes can fly. This of course depends on the model and most importantly on the size of the fuel tank, but for most of the current *RC* planes, you can fly between one and two miles. Even so, flyers rarely do so - simply because the plane will fly out of sight, making it impossible to control.

Think of it this way: a model airplane with a wingspan of six feet will all but disappear around half a mile away. Therefore, you'll find most flyers keep their planes - at a max - somewhere between 200 and 300 yards distant, so they have full control.

How Fast Will It Fly?

A standard trainer plane typically hits max speed somewhere around 45 miles per hour. However, if you want to purchase a more advanced stunt plane, then speeds of 80 to 100 miles per hour are realistic. Some racing models can reach 140, 160, or even upwards of 200 miles per hour!

Can I teach myself, or do I need an instructor?

Although some people successfully teach themselves to fly model airplanes, we highly recommend you work with an experienced instructor. It takes time and patience to learn to fly, something you'll not master overnight. An instructor can guide you through the proper steps slowly and correctly - so you'll be able to enjoy flying and not worry about crashing the airplane.

A recent development is the availability of flight training simulators so that you can practice on your computer just like a video game. But it must be the proper software for *RC* training purposes – be aware that the common flight simulator video games are no use for this purpose. Any software representing the type of airplane you intend to fly will be useful to develop your general skills though it is preferable if it is for the specific model you intend to use. Some models kits even include the relevant software.

With or without the advantage of software training, go with a qualified and reputable training instructor. This is extremely important, because the first time you take control of the *RC* plane, you'll probably feel overwhelmed, especially since most airplanes have a mind of their own.

An instructor will help you maneuver, and handle unexpected turns or trims and you will have the confidence of knowing that they are properly approved by the club or the national association.

Everyone make mistakes the first time they take the controls. Don't panic and don't beat yourself up over it. Instead, listen to the instructor, learning from what he does. Remember - learning to fly a radio-controlled model is not impossible, or even exceedingly difficult, but it is unlike anything you've done before, so it does take time.

The key to success at this hobby is to pay attention and listen carefully to the instructor. Even if you feel nervous or awkward, if you keep your mind on the task at hand, it won't be long before you completely understand the ways of flight.

How Hard Will It Be to Build?

As mentioned earlier, you can build your own model airplane, and the process is not difficult. If you don't want to build and just want to fly then most *RTF* or *ARTF* kits involve easy-to-follow steps that take anything from a few minutes to a few hours to get through. Building a full kit plane is a little more challenging but still

not terribly hard. Just be sure you check the package to understand what it contains. You'll generally be required to purchase things like glue, radio, engine, wheels, covering material, and fuel tank separately, but not always. To make the process of building your model airplane easier and quicker, start with a flat building board, one that you can push pins into and large enough to build one-half the wing at a time.

Then you'll need a modeling knife with sharp blades, a razor saw, a small screwdriver, T-pins, needle nose pliers, a drill and twist drill bits, a soldering iron with rosin-core solder, a sanding block, various grades of sandpaper, and a heat sealing iron.

What Should I Look for in My First Plane?

In the beginning you want a trainer model airplane. Although this is not necessarily the prettiest plane on the market, it is built specifically for those learning to fly for all the reasons already discussed.

Always choose a high-wing plane for your first model and something reasonably large – say 3ft/1metre wingspan - they are much more forgiving of pilot error. As you build up skill and confidence with the trainer plane, then comes the fun part of going out and buying other planes you've researched for weeks.

What's the Best Kind of Radio?

People always want to know what kind of radio to choose. This choice can be a little daunting at first because there are so many choices, ranging from a very basic model to one that is completely over-the-top. However, when first getting started, you don't need the fanciest radio system available.

Instead, we recommend you go with a basic, four-channel radio system that is specifically designed for beginner flyers with a trainer, or sport, *RC* plane. The result will be a good quality system that is dependable and easy to learn. If you are going to learn with a club instructor then check the type of buddy box system they are using and buy the same type to ensure your equipment is compatible. After working with your first one for a little while, you'll soon have the necessary skill and confidence to move up to a more sophisticated model.

Do I Need a License?

People often ask if a license is required to fly a model airplane. The answer to that question is no – but you are expected to use lots of common sense and you'll be required to abide by some strict regulations that are enforced by your national government. For example in the USA the Federal Communication Commission (*FCC*) is involved with the flying of model airplanes (and their radio devices), just as they are with full-size passenger planes. As always the simplest way to deal with all the regulatory requirements is to join your local club.

If It Stalls Out, Will My Plane Crash?

Most people think that once a model airplane engine stops, the flyer no longer has any control over the plane. In truth, although the plane's engine is not working, the radio system is still perfectly functional, as it is powered by the on-board battery. Therefore, when this situation occurs, all you need to do is glide the plane in for a safe landing. With some models you can even restart the engine.

Members of the Large Model Association of the UK with their twin-engined scale models of the DC3. Formation flying is another skill you can learn.

Happy Landings!

As you have learned in this book, building and flying a model airplane involves learning and practicing new skills. It is an exhilarating experience that everyone of almost any age can enjoy. The reasons people love it are many and varied: some build and fly planes to get away from their hectic life, while others simply enjoy a good challenge - and getting together with like-minded people. Some prefer just to build and some prefer just to fly and some like to do both.

We've covered a bit of the history of this fascinating sport, the different types of models, of engines and fuels, a bit about radio control. Then we went on to look at the parts of an airplane and basic aerodynamics and then some starter tips on flying to help you get up and flying with the best just as soon as possible – and hopefully without writing off any of your financial investment in your models.

Neither building nor flying model airplanes is very difficult, but it is a learned skill. By working with a reputable instructor, you'll soon be on your way to becoming an expert flyer. And if you're a builder then take note of all the wise old experience that exists in your club and through various other sources, especially these days on the internet. I'm confident the information provided in this book will start you down the runway toward an amazing hobby you'll absolutely love.

You can also follow my blog at www.modelairplanesecrets.com/blog/ as I wander around the internet picking up useful information on model airplanes to satisfy my own curiosity.

Once you've decided on the model plane you want and have located an instructor, the fun begins. The greatest thing about flying planes is the fine balance of skill, challenge, and risk. And every time you conquer a challenge there are new horizons to aim for. You'll watch your skill level improve quickly and, before long, you'll probably be involved with a fantastic model airplane club where you can have great fun with people just like yourself and be building fantastic models yourself.

Remember, there are tons of additional resources available at your local library, bookstore, or on the Internet. So, while I've done my best to provide you with a broad view of aero modeling, you have many ways to find the answers to any questions I didn't answer. Do your homework, and the sky's the limit!

Thank you for allowing me to introduce you to the world of model airplanes. I truly wish you much success, and years of happy flying and safe fun.