



Getting Start in RC Airplanes

Some Helpful Tips for New Members and Novice Pilots

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and

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Preface to the Second Edition

When I started to fly RC planes, LSK did not have a Novice Guide. Learning about RC, flight procedures, flight pre-checks, safety, equipment selection, etc. was hit or miss. Looking back at my novice days, I wish I had a guide that would have started me in the proper direction. I wrote this guide to give new LSK members and novice pilots that head start I didn't have. I hope you find this guide informative and useful. Happy flying!

-- John Willman - Lincoln Sky Knight Member since 1998

I found this excellent guide on the Internet while updating our LVRC website. I reached out and gave John a call, asking if I could update this document and share it with our club. John was extremely gracious and gave us permission to update and expand his introductory guide to RC airplanes. We both hope you find the information in this document useful while you take your first steps to the great hobby of RC Airplanes!

-- Alec Sonenthal - Las Vegas Radio Control Member since 2006

Welcome to the Wonderful World of Model Aviation!



This guide's primary function is to provide orientation and helpful tips to new members and novice pilots; however, anyone is welcome to take and read this guide. There is a lot of information in this document, but don't feel overwhelmed. Flying RC isn't rocket surgery! This guide is not all-inclusive, but it should provide you with a good foundation as you begin to enjoy your new hobby. There are many experienced club members that are more than happy to answer your questions. This guide is just one source of many for answers. Get involved, ask questions and begin the learning process by reading the Novice RC Guide.

What's in this Guide?

This guide contains five general sections which will provide you with basic information on RC model aircraft.

- **Frequently Asked Questions (FAQ):** The FAQ section answers common questions new pilots have about model aviation, such as how much does it cost, how long do planes fly, is it hard to learn how to fly, etc.
- **Getting Started:** The getting started section addresses what you need to begin and how to go about purchasing your equipment. Topics such as plane selection, radio selection and locating an instructor are covered.
- **Rules and Procedures:** The rules and procedures section address safety and describes how the typical RC fields operate. Subjects such as safe starting of engines and flight line communication are explained.
- **Building, Setup, Flight Tips and More:** This section covers some basic tips, ideas for second planes and basic flight tips. This section is not a substitute for an instructor, and should only be used to supplement your flying lessons. For safety reasons, you should not teach yourself to fly solo.
- **Jargon, Acronyms and Abbreviations:** The last section helps you learn the language of flight and RC modeling.

Frequently Asked Questions

Is it hard to learn how to fly?

Flying isn't easy, but it isn't hard either. While rare, some can fly without any instruction; however, it is more common that you will need some flight lessons. I haven't met a person yet that couldn't be taught how to fly. Some students can fly on their own after about 10 to 20 flights, others may need a whole season of instruction. But don't worry about how long it takes you to learn how to fly. Everyone learns at their own pace. Remember, club members receive free flying lessons!

Who are model pilots?



RC model aviation has no gender or age limits. Most flying clubs has both gentleman and lady pilots as well as pilots of all ages, from preteen to young at heart. Pilots as young as five years of age are not unheard of, and it is never too late to enjoy our hobby. Model aviation provides a pleasurable past time and social atmosphere. Model aviation has also been fundamental in providing early interest for the engineers and pilots responsible for the space and aviation industry today. Famous persons such as the Wright Brothers and Neil Armstrong owe their early interest in space and aviation to model aircraft.

How much does it cost?

Like any hobby/sport, costs can vary greatly. For a glow fuel powered RC plane, beginners should expect to spend a minimum of \$300 to get started and \$500 is more realistic. You'll need a plane, radio equipment, fuel, starting equipment, club membership and some basic tools. If you have budget constraints, it may be possible to start for less than \$300 if you purchase used equipment. Helicopters tend to be more expensive and you can expect to spend \$500 to \$750 to get started.

If you go with electric RC airplanes, the cost can be a little less. Compete, ready to fly airplanes, including batteries and radios, can start less than \$200.00.

What plane should I get?

If you haven't flown before, you need a trainer. Save that war bird or sweet looking aerobatic plane for a later project. Trainers offer a durability and gentle flight characteristic that are key to learning the basics of flight. There are many trainer planes available, either in kit form or ready to fly (no or very little building.) If in doubt, come on out to your club flying field and ask an experienced modeler for advice. For more information, please read the Plane Selection paragraph in the Getting Started portion of this guide.

What radio should I get?

First, you need a radio designed for model aircraft. You will need to purchase a radio that at a minimum supports the channel requirements of the plane/heli you wish to fly. For most trainers this is a 4-channel radio and for helis you will need 5 channels. But STOP! There are good reasons to purchase a radio that offers more features than you initially need. For more information, please read the Radio Selection paragraph in the Getting Started portion of this guide.

Should I join the AMA and a flying club?



Yes! You need insurance and a safe place to fly your plane. Most clubs will require you to belong to the AMA for insurance reasons. Chances you, your club will require a AMA membership in order to join the club. Club membership has many benefits, such as a safe flying site and new friends in the hobby. But most importantly for new pilots, clubs give you access to experienced modelers that are willing to help.

What weather can I fly in?

The perfect day is sunny, no wind and 80 degrees. Unfortunately that is never guaranteed! In general, planes can be flown year round, day or night, regardless of weather. However, as a rule of thumb you should avoid wet conditions as moisture can get inside your transmitter and short out the radio. Winds don't prevent flying, but high winds can make flying more difficult. In general, beginners should avoid winds over 15 MPH. Temperature also isn't a major factor, but extreme heat/cold does make flying uncomfortable for the pilot.

What is glow, glow engines, glow fuel?

While very large models will use engines that burn pump gasoline (gas), most model engines burn an alcohol-based fuel we call glow fuel. It is called glow fuel because the ignition source is from a glow plug as opposed to a spark plug. Glow plugs have a small coil of wire that glows orange hot, hence glow plug. Glow fuel typically contains alcohol (methanol), oil (either castor, synthetic, or a combination of both), and a percentage of nitromethane (used to increase performance, also just called "nitro.") Try to avoid calling glow fuel "gas" since it isn't gasoline, and some model planes really do burn gasoline... this helps avoid some confusion.

What about electric motors?

A growing segment of the hobby is using electric powered flight. There are new batteries and technologies out there making it possible to fly larger airplanes for longer periods of time.

There are also gliders (gravity powered) and turbines (jet fuel powered.) aircraft...something for everyone!

How far away does the radio work?

A standard 72MHz FM model aircraft radio has a usable range of about one mile. You'll lose visual contact with your model long before you'll be out of radio range. The new 2.4 mhz radios have even longer ranges. Again, you'll lose sight of it before you get out of range.

How long do flights last?

The limiting factor is fuel or batteries. Most planes carry enough fuel for 10 to 15 minute flights, and battery packs can last almost as long. Planes don't have fuel gauges, so most pilots time their flights and land after a certain number of minutes.

How often do planes crash?



Shhhh... don't say that word. OK, yes, the planes can and will crash. 99% of all crashes are due to improper maintenance and/or pilot error. With proper instruction, good maintenance, and flying lessons given by experienced instructors or fliers, your chances of having a serious crash during instruction and training are very small. After you learn the proper procedures and skills, you can have hundreds or even thousands of solo flights without a major crash.

Will a plane crash if the engine stalls or dies?

Probably not. The plane just turns into a glider at that point and you simply glide the plane back to earth and land it.

What happens when planes crash? Total loss?

Typically no. Most "crashes" are the result of hard landings. With a hard landing, you may have to tweak your landing gear or replace the propeller. A more serious crash may involve some minor repairs to the structure. Even if you have a serious crash, odds are that your engine and radio will survive. That would mean all you need is just a new trainer plane, which is about \$100. (The above picture shows a serious crash... note the engine and radio survived.)

Is flying dangerous?

When the AMA and club rules are followed, flying is very safe. Accidents are rare. However, injuries and property damage can easily occur if AMA and club rules aren't followed. Typically, most injuries and property damage are the direct result of flying at unsafe locations or not following the rules. At most flying fields, you will find a safe, AMA insured site with lots of instructors that help ensure flying is safe.

What are radio channels?

It depends on the type of radio you have

The word "channel" is used to describe two things in RC aviation. "Channel" can describe the frequency on which your radio operates, i.e., your radio might broadcast on channel 40. "Channel" can also describe the individual controls on a radio, i.e., my ailerons are plugged into channel-1. Confusing I know... Think of it this way. A FM radio station might be on frequency channel 106.3MHz and have two audio control channels, left and right speakers. It is the same idea with RC radios.

Frequencies

Older aircraft radios operate on the 72 MHz band. This band is divided into 50 individual frequencies for RC aircraft use. That means it would be technically possible for 50 planes to be flown at the same place at the same time... but that isn't recommended. At your flying site, for safety reasons, no more than six (6) planes should be in the air at any one time. Every airborne plane needs to be operating on a separate channel.

This is critical because if two transmitters are turned on at the same time on the same channel, the receiver becomes very confused and the plane will crash. For simplicity, the channels are assigned numbers that range from 11 to 60. Most radios can only be operated on one of the 50 frequencies. The radio will be clearly marked as to which frequency it uses. Be sure you know your Radio Channel as you will be required to use the frequency control board.

2.4 GHz Transmitters

Newer Transmitters use spread spectrum technology in the 2.4 GHz frequency for communication. Spread spectrum technology allows many pilots to transmit in the same band (2.4 GHz) in close proximity to each other with little fear of conflicts. Receivers in this band are virtually immune to most sources of electrical interference. Amateur radio licensees in the United States also have general use of an overlapping band in this same area, which exists from 2.39 to 2.45 GHz.

Individual controls.

Every radio has a certain number of individual servos or devices it can control. These are called channels (ch), not to be confused with frequency channels. For example, a 4ch radio can control four individual controls, such as rudder, elevator, aileron and throttle. Most RC aircraft radios range from 3 to 12 channels. Why the extra channels? More complex planes may use two elevator servos, two aileron servos, gear retracts, flaps, smoke, etc. To enable these extra controls, more channels are required.

Getting Started...Where to Begin???

Where to Start

STOP! Don't buy or do anything until you speak to several experienced pilots. Your club has many experienced pilots that are willing to help you with everything from equipment selection to flying lessons. You will need a special plane designed for flight training (often simply called a trainer), a radio system, tools, supplies and flight gear. You will also need some basic training on flying until you become experienced enough to fly solo. Each pilot you ask will probably give you a slightly different opinion, so it is a good idea to talk with more than one pilot to compare ideas. Besides experienced club members, another good source for information is a web-based forum called RCUniverse. The address is www.rcuniverse.com.

Should I Fly Glow or Electric?

This is a question that's been around for a few years, especially with the growing popularity of electric flying systems. For many years, nitro or glow engines were the only way to fly. These engines have been around for almost 100 years, and are well-proven for reliability and performance. From a "Traditionalists" point of view, nitro or glow is the only way to go.

But, the times, they are a changing...

With the advent of more powerful batteries, charging systems and related items, the move to electric is getting easier every year. Nowadays, you will see a pretty even split at the flying field.

Here are some observations and thoughts:

Getting Started

Electric - Electric is easier to get into, less equipment, faster setup at the field, no messy oil cleanup when you are done for the day. A definite improvement for the novice flyer.

Glow – There are just as many kits and trainers out there for Nitro.

Is Electric Safer?

Glow - With glow engines, usually an electric starter is used. If not, then a chicken-stick, or worse, flipping the prop by hand. All these methods have hands and fingers close to the rotating propeller. With an electric, there's no need to have your hand near the prop, it's always remote starting. Also, there's no needle valve adjustments required with electric planes, so there's no reason to have fingers near the prop.

On the other hand, an electric prop can hurt you just as quickly as a nitro prop...sometimes easier, since it can start up instantly.

Electrics are Cleaner!

Since electric planes don't use glow fuel, the plane isn't slimed with oil after each flight. Therefore, a larger variety of finishes can be used with electrics, including non-fuel-resistant paints.

Electrics Last Longer

Since electric planes don't use glow fuel, the wood doesn't get soaked with oil over time. Therefore, electric planes can last a lot longer than their glow-powered counterparts.

However, your nitro powered airplane can also last a long time if you take the time to clean it after each flight.

Improved Scale Appearance

This is a very subjective issue.

Since electrics don't have a cylinder head or muffler sticking out, scale subjects can be modeled more scale. Also, since the spinner of an electric plane never needs to be touched by a starter, scale appearance can be enhanced by painting the spinner (olive drab, for example), if the scale subject requires it. A starter would eventually wear the paint away.

Inexpensive to fly

Electrics can be viewed as less expensive to operate since fuel at \$25.00 or more per gallon doesn't have to be bought, and glow plugs will never burn out.

On the flip side, the newer batteries can be a little costly, plus the expense of a quality charger/balancer.

More reliable

There's no needle valves to tweak on electrics. You never have a poor engine run with electrics. You never have an electric motor go lean or rich. For multi-engine electric planes, you never have one motor quit, and the motors always run at the same RPM. Even counter-rotating props are possible with a simple polarity change.

Limited support equipment

When one flies electric, this is the stuff you can leave at home: Field box, almost all tools, bottle of glow fuel, fuel pump, starter battery, power panel, glow starter, engine starter, cleaning spray, paper towels. When one flies electric, all you need is the plane, battery or batteries, the transmitter, and the battery charger (which I attach to my car's battery).

Quieter

Electric planes are generally much quieter than internal combustion engines, either glow or gasoline. This is increasingly becoming an issue at flying fields. Many clubs must now follow noise level limitations. When people say "The future is electric", they may be right.

On the other side, nitro engines can sound quite awesome!

Indoor Capability

Because electric-powered planes are quieter and have no emissions, they can be flown indoors, and often are.

Plane Selection

You need a trainer. Trainers are inherently designed for the sole purpose of teaching the fundamentals of flying. Trainers offer stability often not found in other planes. Basically everyone learned how to fly with a trainer. If you are unsure of which planes qualify as a trainer, ask an experienced pilot.



Typical Glow Trainer - GP 40 ARF Shown



The SIG Kadet is a Typical Electric Trainer

You have several options with trainer plane selection, such as size and level of assembly. The common trainer sizes are 25, 40 and 60. The size refers to the suggested engine size, i.e., 0.25 cu. in., 0.40 cu in and 0.60 cu in. There are also electric trainers available. Things to consider with respect to size; larger trainers tend to cost more, but larger trainers also are easier to see and fly. For this reason, I suggest a 40-sized trainer (or the electric equivalent), which is a good compromise between size and cost.

40-sized trainers are the most common trainer size. You can select to build your trainer from a kit, or purchase a pre built trainer. A kit will probably take 100 hours for a first time builder to assemble. Pre built trainers are often called Almost Ready to Fly (ARF) or Ready To Fly (RTF.) An ARF typically will require some assembly, such as joining the wing halves and radio installation. Typical ARF assembly times are 20 hours. You can also purchase a Ready To Fly, or RTF plane. A RTF will be nearly fully assembled, include a radio and engine, and can typically be flight ready in about an hour.

If you have the time, some folks strongly suggest you build from a kit. Building will give you an in-depth knowledge of the inter- workings of your plane. If you want to get into the air quickly, we'd suggest an ARF. I'd avoid most RTFs unless you are under serious time/budget constraints. I'd also be careful about bundled systems that include the plane, engine and radio. While a bundled system may offer a good savings, be sure you understand which radio and engine is included before you purchase.

Engine Selection

RC Trainers are available with various motor types, from no motor (glider) to electric and glow power. The most common motor types are glow, but electrics are becoming more popular as battery technology advances. Electric motors tend to have higher initial costs as you must buy all of your fuel (battery) up front, but electrics do offer a quieter and less messy flight. If you are interested in electrics, ask around to locate experienced pilots familiar with electric planes. Glow engines offer the most bang for your buck and are the most common model aircraft engine type.



Typical Glow Engine - OS46FX Shown



Typical Electric Motor

Most likely your trainer of choice will require a glow engine. Your trainer will have a suggested size of engines, for example a 40-sized trainer may list suggested engine sizes of .35-.46 (2-stroke) and .40-.52 (4-stroke.) Any of the manufacturer suggested engine sizes will work well. Notice the different engine range for 2-stroke and 4-stroke engines. 4-stroke engines typically offer smoother power bands, can swing larger props, and are more fuel efficient; however, they can be difficult to set up and cost more than 2-strokes. As you progress, you will probably want a 4-stroke engine, but for now, only consider 2-stroke engines.

Consider looking at the better and larger sport 2-stroke engines. Some engines use bushings instead of bearings. Better engines typically use bearings. Why look at bigger and better engines? Your second plane of course! Purchasing a good engine for your trainer means you can use your trainer engine in your second plane! For the 40 sized trainer example I listed here, my suggestion is to use a bearing 0.46 2-stroke, such as an OS-46FX. If you are under budget constraints, I'd suggest a slightly smaller bushed engine, such as the OS-40LA. Kits and ARFs leave the engine selection to you. A RTF will include an engine.

Glow Engine Fuel

You will need some fuel. One gallon is enough to start as it will provide you with 10 to 20 flights on most trainers. All glow fuel is NOT created equally. The two key ingredients you need to pay special attention to are oil and nitromethane. Always follow the engine manufacturer's recommendation for oil and nitro. There are two basic oil types, castor and synthetic. Castor tends to make a mess on your engine and plane, but it has very good lubrication properties that can save engines from damage, especially when engines are run too lean (a common novice mistake.)

Synthetic oil leaves little mess on engines and planes, and lubricates better than castor under normal conditions, but it offers little to no protection during lean runs. Fuels often contain one or both of these oils. The amount of oil is important. Too little oil and your engine will not be lubricated properly. Your engine instructions should indicate the minimum percentage of oil, typically around 16%-20%. Be sure the fuel you purchase meets the type and minimum oil percentages. Nitromethane, or just nitro for short, is rocket fuel... no kidding. Nitro is added to model fuel for two reasons 1) it increases power and 2) it makes starting easier and idle more reliable. More nitro is good up to a point. Don't assume that your sport engine will produce monster power on a 25% nitro fuel... that won't happen. For engines to realize large power gains from high nitro fuel, they must be designed for high nitro use. A typical sport engine will have a suggested nitro range of 5% to 15%. If under budget constraints, get 5% fuel; otherwise, I'd suggest starting with 10%.

Glow Plug

Glow plugs are responsible for igniting the fuel-air mixture in your engine. Plugs are available for different engines and heat ranges. Be sure you know which plugs are recommended for your engine. It is a good idea to keep an extra plug in your flight box as they do wear out over time.

Introduction to Electric RC Batteries

Whether you are involved in electric or glow-powered flight, rechargeable batteries have a dramatic impact on the performance of your particular model. Combine the varying range of experience that someone might have before they even pick up a radio with the numbers of different battery types, chemistries, and capacity and it can be rather easy for someone to do the wrong thing when it comes to battery selection or maintenance. Quite often people may damage or otherwise reduce the life of their rechargeable cells before they even use them for the first time. While it may seem like there are too many different types of cells and it might seem confusing, knowledge is power.



These are three of the most common park-flyer battery packs. Each one has a slightly different capacity, size, connector, and chemical composition. You can see here how much smaller a comparable LiPo is versus a standard battery pack.

Choosing the Right Pack for You

Regardless of what type of model you will be using your particular battery in, there will undoubtedly be a number of different chemical compositions to choose from.

Nickel Cadmium (NiCd), Nickel Metal Hydride (NiMH), and Lithium Polymer (LiPo) cells are currently the most commonly used, but each needs to be charged, discharged, and stored differently. On top of that, each model may require a different cell count or battery configuration as well. To determine what pack configuration you will need, check the owner's manual of your particular model for more info. The battery you will need should be listed in the "Items Needed to Complete" section of your manual.

Battery Basics

One of the most common misconceptions about batteries and battery packs is that a battery pack is made up of one very large battery. Truth be known, a battery pack is actually constructed from a number of individual batteries, called cells, that have been connected together to work as a single pack. There are two ways that the cells can be connected together. The first is called “Series”, where the positive terminal of one cell is wired to the negative terminal of another cell. This method is used when you want to increase the output voltage of the total battery pack, as the individual cell voltages are actually combined to create one large voltage output. For example, a 6-cell NiCd or NiMH pack is made up of cells rated at a nominal 1.2 volts each. When wired in series, you take the individual voltage (1.2V in this case) and multiply that by the number of cells in the pack (6) to get the total pack nominal voltage. If you do the math, you’ll see that a 6-cell pack has a total nominal voltage of 7.2 volts. This is the most common cell connection method found in the RC hobby.

The second way to build a pack is called “Parallel.” In this method, you connect the positive terminal of one cell to the positive terminal of another, and do the same with the negative terminals. Unlike a Series connection that increases the voltage output of a battery pack, wiring cells in Parallel increases the total capacity of the pack. Much like the voltage calculation, but to figure out what the actual end result capacity will be, simply add the mAh rating (milli-amp hour) of the cells being paralleled together to figure out what the capacity of the pack is. If you are using 2100mAh cells in a 2-cell parallel pack (commonly referred to as “2P”), multiply 2100 by 2, and you will get a total capacity of 4200mAh. Just remember though, a Parallel connection does not change voltage, so while you can get 4200mAh out of a 2P pack, the nominal voltage will remain the same.

Battery Chemistry Class

Rechargeable receiver packs save you money in the long run and are generally lighter than equivalent alkaline packs.

Nicads



As mentioned before, there are three major chemistry types used in constructing a rechargeable battery. The first one is called Nickel Cadmium, or NiCd (pronounced Ni-cad) for short. While not as commonly used as they once were, there are still a number of NiCd packs sold and used each year. NiCd batteries are relatively inexpensive, but they have a number of negatives. NiCd batteries need to be fully discharged after each and every use. If they aren’t, they will not discharge to their full potential (capacity) on subsequent discharge cycles, causing the cell to develop what’s commonly referred to as a memory.

Additionally, the capacity per weight (also known as “energy density”) of NiCd cells is generally less than NiMH or LiPo cell types as well. Finally, the Cadmium that is used in the cell is quite harmful to the environment, making disposal of NiCd cells an issue. In fact, several countries in Europe have banned NiCd batteries for just this reason. This ban is what sped up the demand for alternative cell types, and the first to really answer the call was Nickel Metal Hydride (NiMH).

NiMH

NiMH cells have many advantages over their NiCd counterparts. With the removal of Cadmium from the cell, the NiMH cells were able to fill the need for industrial and hobby-grade batteries all over the world. NiMH cell manufacturers were also able to offer significantly higher capacities in cells approximately the same size and weight of comparable NiCd cells. NiMH cells have an advantage when it comes to cell memory too, as they do not develop the same performance issues as a result of improper discharge care.



LiPos



Lithium Polymer batteries have really taken a foothold in the air market due to their high capacities, high voltage outputs, and light weight. A LiPo pack can weigh as much as 50% less than a conventional can-style battery pack.

Lithium Polymer (LiPo) cells are the newest and most revolutionary cells to come to market. LiPo cells typically maintain a more consistent average voltage over the discharge curve when compared to NiCd or NiMH cells.

Add to that the higher nominal voltage of a single LiPo cell (3.7V versus 1.2V for a typically NiCd or NiMH cell), making it possible to have an equivalent or even higher total nominal voltage in a much smaller package. LiPo cells also typically offer very high capacity for their weight, delivering upwards of twice the capacity for sometime ½ the weight of comparable performance NiMH cells and packs. That's right, with LiPos you can often achieve higher voltage and power output, with more capacity, in a lighter weight package.

With all of these benefits, why aren't LiPo packs more widely used? With so much energy packed into such a small space, there are some important safety measures to take when dealing with LiPo cells. A LiPo cell needs to be carefully monitored during charging as overcharging a LiPo cell (to beyond 4.2v), or the charging of a physically damaged or over discharged cell (discharged to below 3.0v under load) can be a potential fire hazard.

Many LiPo batteries come with safe charging circuitry integrated into it. This circuitry prevents over charging, over discharging, and in some instances helps to balance the pack out. If your pack has a "Charge" lead on it, always charge through that connector.

Battery Chargers



While some battery chargers can charge either NiCd/NiMH or LiPo cells, chargers that do all three major chemical types are starting to surface. The Dynamite Vision Peak Ultra can charge your LiPo packs along with NiMH and NiCd batteries as well.

If you are going to go the LiPo route, use a charger that can correctly charge them (using a constant current, constant voltage method of charging as LiPo cells can not be “Peak Charged”), such as the Vision Peak Ultra (DYN4053) or the E-flite Celectra 1-3 Cell charger (EFLC3005). Not only must care be taken when charging LiPo cells, but when discharging them as well. You should never over-discharge a LiPo pack to below 3.0v per cell under load, and you must use an ESC programmed to provide the proper low voltage cutoff for your pack (for example, a 9v cut off for a 3 series LiPo pack). Also, you should never dead short a LiPo pack, even if only for an instant, as the large amount of energy stored in the small package can catch fire quite quickly as a result. While these seem like major deterrents to using a LiPo battery, these usage guidelines are quickly becoming well known as they are typically well outlined in the instruction manuals included with most LiPo packs, ESCs and LiPo chargers. However with all of their performance benefits, there is little doubt that lithium polymer battery packs are currently the future of battery technology for electric powered models.

Radio Selection

Radio selection is probably the most confusing aspect of RC for novice pilots. There are a lot of radio types and functions... I guarantee you will be confused. STOP!

At this point there are only a few basic things you need to know about radios.

72 MHz Radios

You will need a radio designed for model aircraft. In the past, it would have been on the 72MHz FM band and clearly marked for aircraft use. These radios, while older, are still in use, so please read this section carefully!

Don't buy a surface (car/boat) radio as these are not legal for aircraft use. Most entry level radios are sold as complete sets. They will include a transmitter, receiver, batteries, battery chargers, a power switch, wiring and servos... everything you need to get started. With a radio set, the transmitter and receiver will be matched on one of the 50 available aircraft frequencies, numbered 11 thru 60. Don't worry too much about which frequency channel you purchase. But, you may wish to ask which frequency channels are used most often at your flying site so you can avoid heavily used channels.

There are two basic radio types, non-computer and computer radios. Non-computer radios have limited setup features, while computer radios have advanced setup features. Advanced features allow for more detailed plane setup as well as the ability to remember settings for multiple models. Unless you are under budget constraints, get a computer radio.

Radios can be designed for sailplanes, powered planes, helicopters, or a combination of any of the above three. This is particularly true with computer radios. Some radios will only contain software for one craft type, while others may contain software for all three. While it is technically possible to program an aircraft radio for helicopter use and vice versa, it is much easier if the proper software is available in the radio. So, if you think you may wish to try your hand at a heli someday, consider getting a radio that supports both planes and helis.

Radios are available with a range of individual control channels, typically three to twelve. Most likely your trainer will only need four channels: aileron, elevator, throttle and rudder. However, your second plane will probably use five channels and you will want to start exploring more advanced radio features such as mixing. For this reason, I suggest purchasing a computer six-channel or above radio. However, if you are under budget constraints, a 4-channel non-computer radio will work just fine.

As for brand... There are some differences between brands, but the major five (Futaba, JR, Airtronics, Hitec and Multiplex) all make good entry level radios. You may wish to ask around to see which brands are in common use at your flying site. There are two reasons for this 1) During your flight lessons, your instructor may wish to "buddy box" the radios, which sometimes does not work between brands 2) If you need help programming your radio, it is easy to find help if you are using a familiar radio.

Spread Spectrum (2.4 GHz)

This is the latest and greatest technology available for RC airplanes. The transmitter checks which frequencies are available and only transmits on frequencies that are not being used by someone else. The transmitter continuously changes the frequency several times a second.

There is no doubt that Spread Spectrum is the future of this hobby. Eventually all RC airplane radio systems will be spread spectrum. Although Spread Spectrum is quickly gaining popularity, many people are still using FM radio systems. Radios aren't exactly cheap so most people will keep using the radios they have until they have a need to upgrade.

If money is no object than Spread Spectrum is definitely the way to go. But there is absolutely nothing wrong with getting an FM Radio. The prices are coming down due to the introduction of the spread spectrum systems.

Transmitters (Tx)

For the purpose of this page we'll focus on a traditional multi-channel (4 or more) rc airplane transmitter because that's the type you'll most likely use as you get in to the hobby, be it a MHz or GHz one.

Such a Tx consists of two control sticks, trims and switches and possibly rotating dials on the face and top of the transmitter body, so as to be within easy fingertip reach. These switches and dials are used for any channels over and above the primary controls, for example retractable landing gear and flaps – but they can of course be used for any purpose.



On a MHz transmitter there is also a collapsible **antenna** on top of the Tx, while a 2.4GHz Tx has a much shorter antenna which doesn't collapse – it's only about 6" (150cm) long compared to the 3' or 4' long MHz antenna. This difference in length is because 2.4GHz radio waves have a much shorter wavelength and so require a shorter antenna, and also because 2.4GHz technology is much more efficient.

Depending on whether or not the transmitter is computerized or not, there will be a LCD screen to display all the relevant information to the pilot - programmed settings, menu options, battery voltage, timer etc.etc.... If the Tx isn't computerized then there will be a simple battery voltage meter or indicator lights on the face of the Tx, and no LCD display screen. The majority of transmitters these days are computer ones, and only the most basic Tx's are non-computer. The main features of a 6 channel MHz computer Tx are in the above illustration.

Receivers (Rx)

The receiver is located inside the model and is directly connected to each servo, and the electronic speed control (ESC) in Electric Powered (EP) planes, by small wires. A thin single wire antenna extends from within the receiver to outside of the model, typically this is 2 or 3 feet long for traditional MHz receivers. As with transmitters though, there is a significant difference between the length of MHz and GHz receiver antennas; typically a 2.4GHz one is about an inch long!



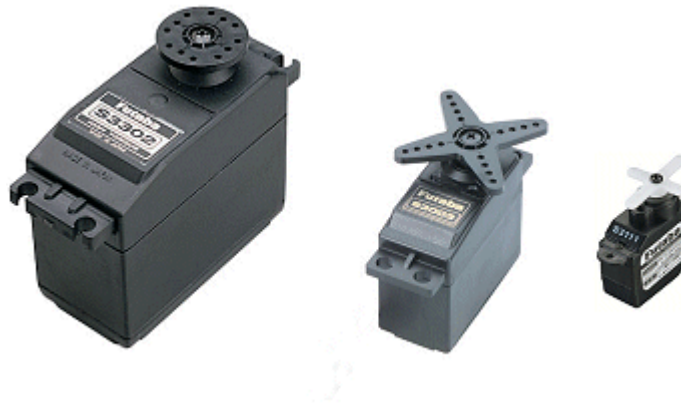
The long antenna of a MHz receiver should *never* be cut or looped up to reduce its length. By doing this the ability of the Rx to receive the radio signal from the Tx is *drastically* reduced and this usually has disastrous consequences. The model will very quickly fly out of radio range, and you'll lose complete control. Once that happens a crash or a lost airplane is inevitable!

In the same way as a normal radio or TV receives the signal from the broadcasting station, so a radio control Rx receives the signal that is emitted by the transmitter when you move a stick or flick a switch. These signals are then passed through to the servos, or ESC, which respond appropriately.

The number of connection slots on a receiver depends on the number of channels *i.e.* a 5 channel Rx will have 6 slots - one for each channel plus one for the battery pack connection. More complex receivers will have more slots.

Servos

As previously mentioned, the number of servos in an rc model varies according to the number of channels that the radio control gear has and the model requires.



A servo generally consists of a printed circuit board (PCB), an electric motor, a feedback potentiometer and a set of either nylon or metal gears that may or may not be ball-raced, all housed within a plastic casing.

The central shaft on which the gears sit is splined and exits through the top of the servo casing; the servo horn (output arm) is connected to the shaft and is held in place by a small screw.

The feedback potentiometer is connected between the PCB and the gears and is also driven by the motor, and works on the basis of error correction. The signal from the receiver is interpreted by the PCB which in turn tells the motor in which direction to move; this movement continues until the potentiometer reaches the new position according to the most recent signal, at which point the motor stops moving. As the pot turns so do the gears and hence the shaft and horn as well.

The horn is directly connected to the model's control surface by some kind of control linkage (a rigid metal wire rod or Bowden cable, for example), so any movement of the servo horn results in direct movement of that surface, be it the ailerons, elevator, rudder or whatever.



Servos typically have three (sometimes 5) fine gauge wires connecting the PCB to the receiver - a positive, negative and signal wire which are generally colour coded according to manufacturer. The wires run in to a plastic connector, the 'flat blade' type (shown right, in this case the Spektrum/JR type) being very common, which is pushed in to the appropriate channel slot of the receiver. Note, though, that there are some compatibility issues between manufacturers although most connectors of this general type can be modified if necessary i.e if you want to mix one brand of servo with someone else's receiver.

Servos come in various sizes and strengths, from tiny 'feather-weight' ones to giant 1/4 scale ones (so called because they're commonly used in 1/4 scale aircraft). 'Micro' servos have become increasingly common in recent years as rc models have become smaller and smaller, these typically weigh between 5 and 10 grams although that is a generalisation.

Digital servos are now commonplace where servos were traditionally analogue; digital servos offer faster response times (latency) and more holding power i.e the strength to hold a large control surface against the airflow, without failing. Obviously the strength of servo motor and gears also plays a large part in this too!

Servo strength is measured in terms of **torque**, expressed Oz/in (ounces per inch) or in kg/cm (kilograms per centimeter) depending on where you are in the world. Either way, the torque rating states how much force the servo can exert at a given distance out from the central shaft - for example, a 1.6kg/cm servo can exert 1.6kg at 1cm from the shaft. The further out from the shaft you go, the weaker the torque and for that example if your linkage was 2cm out from the servo shaft then the force would be approximately halved.

Another servo rating you'll see is servo **speed** and this lets you know how fast a servo shaft takes to rotate through 60°, in tenths of one second. The type and number of servos you will need depends entirely on the model you have, and what you want it to do.

Building Tools & Supplies

Even if you purchase an assembled RTF, you will need some basic building tools at some point. I've listed some of the tools and supplies you will probably need. This is not a complete list and as you progress, you may find the need for additional tools. Most pilots build up their shops slowly over time as they determine which items they need on a regular basis.

Basic List

- Building/Work area - You need a large flat surface. Hobby Knife, i.e. Xacto
- Straight Edge Ruler, Protractor and Triangle Square
- Various sand papers - 80grit to 220 grit
- Razor Saw
- Hand drill and bits from 1/32" to 1/4"
- Various Glues - CyA (super glue), Epoxy (5min and 30min) Covering Iron
- Hex Ball Drivers
- Small Screw Drivers
- Blue (medium) thread locking compound
- A Typical Model Builder's Workshop
- Various RC parts, such as extra fuel tubing, screws, wheel collars, props, etc. Prop Balancer

Advanced List

- Specialized Building Area - Many build a perfectly flat work bench. You need a flat surface to accurately build.
- Dremel or other rotary tool and bits - Advanced wood working tools, T-Bar sanders, razor planes, balsa strippers, etc - Power cutting tools, such as a table saw, jig saw, band saw, drill press
- Foam working tools such as a Hot Wire foam cutter
- More glues, such as aliphatic resin (wood glue), silicon, Goop, Polyurethane, etc. Trim Iron and Heat Gun - Soldering Iron, Flux and Silver Solder
- More advanced Measuring devices such as a CG balance jig, Throw meter, incidence meter
- More RC parts, extra gear sets for servos, more screws, extra servo horns, etc.

Field Equipment



When you visit the field, you will need some basic tools as well as some specialized starting and testing equipment. You will need a way to carry your stuff. You can purchase or make a flight box. A flight box typically includes a place for a starting battery, tools and basic gear. You may also wish to consider getting a fishing tackle box. A tackle box will often have many small sealed compartments that are perfect for storing small spare parts, such as screws, wheel collars, extra glow plugs, etc. I've listed some of the tools and supplies

you will probably need. This is not a complete list and as you progress, you may find the need for additional tools and equipment. Most pilots start with basic tools and slowly build up their flight gear and replace basic items with more advanced items.

Basic List

- Fuel and manual fuel pump
- Basic Glow Plug Booster (heater)
- Chicken Stick (Used to flip the propeller when starting engine) Glow Plug Wrench, extra Glow Plug
- Hex Ball Drivers & small screwdrivers Small Wrench (For checking prop nut) Extra propellers
- Battery Tester - This is one item many leave off the basic list. I cannot stress enough that you **MUST** check your flight battery before EVERY flight... you need a battery tester.
- Wide clear plastic tape - for field mending small holes in covering
- Extra wing bolts or rubber bands
- A flight timer (if not built into your Tx)

Advanced List

- Fishing Tackle Box with various of spare parts
- Advanced or Smart Glow Booster
- Power Panel
- Remote IR Temperature Gauge
- Electric Starter
- Field battery chargers

Sample Field Boxes



Getting Ready to Fly!

Where to Purchase Equipment

There are three basic sources of purchasing equipment. Local hobby shops, mail-order/web stores, and used equipment (either locally or via the web such as e-bay.) Unless you are under strict budget constraints, I suggest avoiding used equipment unless you seek expert advice on what you are purchasing. However, there are a lot of good deals on used equipment for the savvy shopper. Local hobby shops give you the advantage of seeing before you buy, in addition to being able to take the item home today.

Mail-order and web stores tend to offer the largest selection and the best prices. Most of us tend to purchase a little from all three sources. Just a word of caution: Often sales clerks know little about the items they are selling unless they are also model hobbyists. Please seek the advice of several experienced pilots before purchasing. For mail order, one of the best places sources for entry level equipment is Tower Hobbies: www.towerhobbies.com. **The final word on equipment selection and where to buy: It is your money.**

Learning to Fly



Your top priority is to locate an instructor. There are many experienced pilots that are willing to help you learn how to fly. There are a few pilots that managed to solo without the aid of an instructor, but most will tell you that if they had it to do over again, they would have found an instructor. Your instructor should take you through the basics of model flight, from safety concerns to takeoffs, flying around and landing. Everyone learns thru different methods and at different speeds. If you are uncomfortable with your instructors methods, don't hesitate to locate another instructor.

We have included some pointers in the Basic Building, Setup and Flight section of this guide. I would however like to stress that the included tips in no way substitute for an instructor. In addition to field instruction, consider getting a flight simulator. There are several computer programs for the PC that simulate RC flight. These range in features as well as price, but most start around \$200. I realize this sounds like a lot, but consider the following: One of the keys to learning to fly RC planes is stick time. A simulator is an excellent practice tool that can be used night or day, regardless of weather. As you become more experienced, the simulator will also be a good tool for learning harder more complex maneuvers. If the simulator prevents just one crash, your money ahead.



Rules and Procedures

It is everyone's responsibility to follow and enforce the rules. Following safe starting and flight line control procedures is key to a smoothly operating flying site.

This section is a must read for all new pilots. Model aircraft can be potentially dangerous. The AMA and club rules and procedures are in place to help ensure your modeling experience is safe and fun.

Safety and the Rules



RC planes are not toys. OK, they kinda are, but they should not be treated as such with respect to safety. RC planes, even trainers, can cause serious property damage and personal injury, including death. When the rules and proper safety checks are followed, RC planes are very safe.

There are two sets of rules you need to follow. AMA rules and club rules. If you don't know what the rules are, **STOP!** Locate, read and be sure you understand

the rules. You can find a copy of the rules at your flying site and on the AMA web site (www.modelaircraft.org)

The full AMA and club rules tend to change slightly every year so I did not include them in this guide. However, I'd like to point out some of the basic rules that do not change from year to year.

1. Don't drink alcohol before or during any modeling participation
2. Don't fly in front of spectators until you have proven your plane is flight worthy
3. Don't fly unassisted in front of spectators until you become a qualified pilot
4. Never fly behind the flight line.
5. Always write your name and AMA number on your model (can be on inside.)
6. Always range check your radio before flying for the day
7. Obey any flying site rules
8. You must use the Frequency Control Board at flying site.

If you travel to other flying sites, be aware that not all clubs use the same rules. Be sure you know, understand and follow any rules at flying sites you may visit.

Common Sense

In addition to written rules, there are some common sense rules you should follow. While these aren't written in stone, using common sense makes the flying site more pleasant. Everyone has a different grasp of what constitutes common sense, so I will give some examples. If you plan on breaking-in or otherwise running an engine for an extended period of time, please move to the end of the pits as it is less disruptive. Don't let your children have free run of the field. Don't pit in such a way that blocks access for other pilots. Etc.

Pre-flight/Post-Flight Checks and Engine Starting



You should treat your model no different from a full scale plane. Like a full scale plane, you should perform pre-flight safety checks before EVERY flight. Many planes are lost due to problems that would have been detected in a pre-flight check. Don't become a member of S.A.D (Society of Airplane Destroyers!) Pre-flight checks are designed to verify the safety and proper operation of your plane's critical systems.

An experienced pilot that properly performs pre-flight checks will have a ritual they perform before each flight.

Watch an experienced pilot and notice how they check their plane before every flight. To start, you may wish to write down your pre-flight checklist. Eventually, you will automatically perform the pre-flight checks without the need for the list.

Pre-flight checks aren't written in stone as each plane may have different items that need special attention during the pre-flight. Listed below are general pre-flight checklists that would apply to most glow powered trainers from assembly to taking the runway to landing.

FUNDAMENTAL PRE-FLIGHT RULE: Do not fly your plane if you detect a problem!

I know this sounds simple, but some pilots will fly their plane even if they know something is not quite right. DON'T DO IT! You will lose planes this way and endanger your fellow pilots. If you detect a problem after you are airborne, YELL OUT! An experienced pilot will join you at the flight line to determine the best course of action. Depending upon the problem, sometimes it is not safe to attempt to land on the runway, i.e., control problems.

Sample Pre-flight Checklist

Before leaving home

Checks to perform before you even get to the field. There is the obvious non- safety related stuff like don't forget your plane, fuel and radio, but there is one important safety check.

1. Verify your transmitter is off. As you drive up to the field, you could unknowingly shoot down a fellow members plane.

Plane Assembly

When assembling the plane at the field, you should perform a series of checks designed to inspect and verify the structural integrity of your model. If you leave your plane assembled between flying sessions, you should periodically disassemble the plane to perform these checks.

1. Check all internal structure for cracks and other signs of stress.
2. Verify that internally mounted radio gear and linkages are properly secured. Don't forget to verify servo arm screws are in place!
3. Check internal wiring for loose connections or worn wires
4. Check fuel tank and fuel hoses and look for signs of leaking fuel

Fully Assembled Ground Check



Once your plane is assembled, you need to check the entire plane, concentrating on removable parts, control surfaces, engine, prop and anything else that could come loose like screws. It is best to start at one location and move around the entire plane. I start at the nose of the plane and work my way around. Some items are to be "tug" tested, such as engines and control surfaces. Other items require visual inspection such as verifying screws are in place.

Occasionally, items that are visually checked, such as screws, should actually be tested, i.e., get out your screwdriver and check for tightness.

1. Check engine, spinner and prop to ensure they are secure. If necessary, remove the front of the spinner and check prop nut for tightness. Don't forget to check muffler bolts and the screws that hold the engine mount to the fire wall.
2. Check that the wing, canopy, cowl, or any other removable part is securely attached. If your wing uses rubber bands, be sure you used good clean rubber.
3. Check landing gear, wheels and wheel collars.
4. Check all control surfaces and verify that hinges, clevises, etc. are secure.
5. Verify that all covering is firmly attached, particularly at seams.
6. Check the structural integrity of the entire airframe, look for cracks, dents, etc.

Pre Ignition Check

These checks are typically performed just prior to moving your plane to the starting area. When flying more than once, you should repeat these steps before every flight.

1. Fuel plane and/or verify that fuel has been added.
2. Check battery status in plane.
3. Verify your radio frequency and double check that YOUR card is attached to the frequency control board on the proper frequency. Remember, NEVER turn on your radio until you have properly secured your frequency on the control board.
4. Range check your radio. Always follow the suggested range check procedure for your radio. You should occasionally perform this test.

Always secure your channel before turning on your transmitter. Perform two tests, one with the engine off and one with the engine on. If you notice a large separation in range between the two tests, i.e., more than 20%, STOP! You have a problem.

Engine Starting and Takeoff Checklist

This list represents your last chance to find any problems before you take to the air. When flying more than once, you should repeat these steps before every flight.

1. Remember, be sure your card is on the Frequency Control Board before you turn on your transmitter. Verify you have the proper model memory selected (if using a computer radio) and that both your TX and RX are on. Also verify that you have all switches and trims on your TX in the proper position for starting/takeoff if applicable.
2. Verify the plane is properly responding to your control inputs. Don't just check for movement, be sure the movement is the proper direction. Don't forget to check the throttle movement.
3. Clear the area of loose items and verify what is in the extended prop blast area. Are there models you could blow over or slime with exhaust? If necessary, move your plane.
4. Verify your plane is properly secured, either by another person or a mechanical device.
5. Holding your plane by yourself is NOT properly secured.
6. Notify persons in the immediate area that you are going to start your engine.
7. Follow the starting instructions for your engine. Pay careful attention to anything that could be sucked into the prop such as loose clothing, transmitter straps, booster cables, etc. Always adjust your engine from behind the prop.
8. Once started, move your plane to the flight line. Do NOT taxi unless you started in the staging area. If you started in the pits, have another pilot carry your plane to the staging area.
9. Verify once again that all control surfaces move the proper direction... this is your last chance!
10. Check that runway is clear and no planes are on approach. Follow the field procedures for taking the runway. Details follow in the Flight Line Procedures section.
11. Start your flight timer and Enjoy your flight!

Post-Landing Checklist

Yes, there are some checks you should perform after you land.

1. Check your fuel level. If you are getting too close to an empty tank, shorten your flights.
2. Re-Check your battery. I know you will check it again before your next flight; however, certain battery problems are easier to detect immediately after heavy use. This is why it is a good idea to check your battery just after you turn the RX off.
3. Be sure your TX is off and remove your card from the Frequency Control Board so others can fly on your frequency. Remember, after flying, NEVER turn your TX off until your engine is off and you have retrieved your plane. Glow engines have been known to restart themselves when warm.

Crash/Hard Landing Checklist

If you have a hard landing or crash, even if everything looks OK at first, you need to be very careful as damage can be hidden. You should perform the following after every accident.

1. Disassemble your plane to the point where you can check the entire structure. This may mean removing items like cowls you typically don't remove between flying sessions.
2. Reassemble your plane and follow the above checklists. Pay special attention to items that may have hidden damage, such as loose equipment, stripped gears in servos, cracked wood, chipped props, etc. Be sure you range check the model.

Additional Engine Safety Tips



- Don't hand start engines. Use a "Chicken Stick" or electric starter. I know most engines can be finger started, but believe me, even a really small prop hurts really bad.
 - Don't stand in the prop arc. By this I mean don't stand on edge, i.e., left or right side of the prop. If the prop fails, it may hit you.
 - Always point your plane away from spectators and other pilots when starting.
-
- Don't stand in front of the plane with engine running above idle. If the plane breaks free of its restraints, it could strike you. Always move behind the plane when advancing the throttle.
 - Never make engine adjustments in front of the plane. Even small 40 sized engines can produce more than one horse power. You don't want that delivered to your fingers.

Flight Line Procedures

No flying club has a control tower. The only time you will see marshal controlled flight lines is during larger contests and events. For day-to-day flying, it is everyone's responsibility for ground, departure and approach control. This isn't complicated... simply announce your intentions and verify there are no conflicts before proceeding. Watch and listen to other pilots to see how this works.

The basic flight line rules are:

1. Always follow the flight pattern. In other words, all takeoffs and landings are performed into the wind. On calm days or crosswind days, verify with other pilots which direction they have been flying.
2. Dead stick landings are always given the highest priority.
3. Takeoffs are always given the lowest priority.

An Example of Flight Line Procedures

I'll start up and move my plane to the flight line. I'll then shout out to pilots in the air to verify it is OK for me to take the runway. I do this by shouting "OK to take off!?" Most pilots will shout back that it is OK... some just nod. I will verify everyone heard me and responded. I will also double check the pattern direction at this time and verify no one is on landing approach. If everything is fine, I'll announce "Taking the runway!" and taxi my plane from the flight line onto the runway. Once I am airborne and beyond the edge of the runway, I'll announce "Runway Clear!" Simple huh? It is often hard to hear with all the noise. Now don't be shy, belt out your intentions!



Landing is similar. Announce your intention to land. "OK to Land!?" Assuming it is OK, Pilots should shout back that it is "OK!" Then, you should verify you have the right to the runway by shouting "Landing!" Once down, announce "On the Runway!" Quickly remove your plane from the runway and announce "Runway Clear!" If you overshoot the landing, be sure to tell the other pilots that you need to go around to try again. Also, if your plane stops on the runway, be sure to tell pilots your plane is on the runway and you need to retrieve it.

What to do if there are conflicts... Simple, just be sure to communicate with your fellow pilots. If you are on the runway ready to takeoff and someone shouts "Deadstick" or "Landing", be sure the other pilot knows you are on the runway.

Retrieving “Lost” Planes

At some point, we all have to retrieve a downed plane. Maybe because we crashed, or ran out of fuel, or simply missed the runway. Below are some tips and safety concerns.

1. Take a horizon landmark fix on where you last saw your plane. For example, “It landed on a line toward that big tree.” This is key to finding a downed plane.
2. Once in tall grass and corn, it is very hard to tell where you are. Have one person stay in the pits that knows the location of the horizon landmark. They will be your “eyes.” Use 2-way radios or cell phones so the “searchers” in the field can keep in contact with the “landmark eyes” back in the pits.
3. It’s always a lot further out... I don’t know how this illusion works, but believe me, your plane is a lot further out than you initially think.
4. ALWAYS inform pilots when you intend to cross the runway.

Just Me, Myself and I

Flying at a field with no one else there can be dangerous. Consider what would happen if you are struck by your plane and become injured. For this reason, flying by yourself is not recommended.

Building, Setup and Flight Tips

Because a novice RC pilot should not attempt to instruct themselves to, actual flight lessons are not included in this guide. This guide offers supplemental information for your instructor given flight lessons.

Fundamentals of Flight

Understanding how and why planes fly isn’t required to become a RC pilot; however, it is strongly suggested. It is much easier to learn how to fly if you have a fundamental understanding of what makes planes fly. You should have a firm grasp of lift, thrust, drag, airfoils, how CG effects flight, angle of attack, stalls, flight controls, etc. I have not included a detailed section on flight theory as there are many good sources for this information on the web and in books. For information specific to RC model flight, look for the Harry Higley’s series of books on the subject which can be found at your favorite hobby source or on Amazon.com. For more advanced model flight theory, I suggest reading RC Model Aircraft Design by Andy Lennon.

Building Tips

1. One of the most important parts of building is ensuring your plane is built straight and true. Planes that are true fly much better than crooked planes. One key to building straight is having a flat work surface.
2. Another very important part of building is keeping everything light. Excess weight kills plane performance.
3. Don't bother modifying your plane unless you really know what you are doing. Stock trainers fly just fine and modifications are not needed or recommended.
4. Straight and True Models Fly Better
5. A scrap piece of ceiling tile is a good building surface that you can secure parts to with pins. Use wax paper or plastic wrap to prevent gluing parts to the building surface.
6. Double check everything before gluing. Double check everything before gluing.
7. 100% Silicon caulk works well for securing fuel tanks and fuel lines. You may need to lightly roughen the tank with coarse sand paper for a better bond.
8. Be sure your plane balances where the plans indicate. You will hear that it is very bad to be extremely tail heavy... this is true. But the same can be said for being extremely nose heavy.



Radio Installation Tips

1. Servos have a rubber isolation pad and brass eyelet used for mounting. Always use the isolator pads and eyelet. The eyelet is inserted such that the flange side is toward the mounting surface.
2. Servo mounting screws tend to strip easily at the head. For a much better screw, look for socket head servo mounting screws. One readily available brand is DuBro ("socket head servo screws")
3. Velcro straps that can be found at hardware stores in the electrical department are perfect for holding receivers and batteries in place. Be sure to still wrap your receiver and battery in foam. Small pieces of these velcro straps are also perfect for bundling wires for a tidy installation.
4. Use thread lock on any metal to metal connections. Do not use thread lock on metal to plastic connections (the locking compound melts many plastics). I suggest regular strength (blue.)

Engine Mounting Tips

1. Always use thread lock on metal to metal screw connections. I suggest regular strength (blue.)
2. You can insert T-nuts (blind nuts) into most plastic motor mounts by heating them with a soldering iron and pressing them in place. To do this, first drill the engine hole pattern on the mount. Then press the t-nuts into the holes on the bottom of the mount rails.
3. Engine soft mounts more than double life span of your plane and radio.

Covering Tips

1. The gas produced by covering adhesive is directly related to the heat used. If you are fighting bubbles, lower your iron heat.
2. Plastic coverings will stretch when pulled as heat is applied.
3. Covering takes time to learn how to apply well. Consider getting a book that explains covering techniques, such as the Harry Higley's series.

Plane Colors

1. Select colors that are easy to see in various sky conditions. Try to select colors of different shades or intensities as many colors blend at long distances. For example, light blue and light green will blend to a light grey at a distance, while dark red and light yellow will be easy to distinguish at a distance. I personally think that bright yellow is the easiest color to see in both sun and clouds. Watch other planes to see which colors you can see best.
2. There is no need to mark the left and right wing differently for orientation. It won't help you keep orientation.
3. However, you should mark the top and bottom of the wing differently for orientation reasons. Use bold patterns as small or fine patterns cannot be seen at a distance.

Engine Tips

1. Read your instructions for starting and tuning your engine. The answer to your question is probably in there.
2. Remember, engines only need three items to run 1) fuel, 2) compression and 3) glow. For a stubborn engine, verify fuel is making it to the carburetor, that there are no air leaks, and that your glow plug and booster are working properly. Store fuel properly in a well sealing container (nitro-methane is hygroscopic meaning it readily absorbs moisture). Factory sealed containers will remain potent for many years. Once opened for use- **minimize** "open" fuel container time.

Propeller Tips

1. Proper propeller selection can make a world of difference in plane performance. There is often a wide range of props that will work with your engine. Try experimenting with different props to see which ones you like best.
2. Typically, high pitch props produce more speed, while higher diameter props produce more thrust.
3. Do not over prop (to high pitch and/or diameter) your engine. This is very hard on engines.
4. The same can be said for under propping.
5. Always balance your props.
6. There are various prop styles. APC props are typically the most efficient and I consider them to be some of the better props available. However, to start, I'd suggest using a less expensive composite prop, such as a Mater Airscrew. Always keep a spare prop in your flight box.

Novice Flying Tips

1. Don't be embarrassed... we all started at the same place.
2. Relax... you'll be fine.
3. Most pilots tend to over control the plane. It doesn't take much stick movement to get a response from the plane. Use light and smooth stick movements. Don't jab the sticks.
4. Don't fly too high or too far out. While there is safety in altitude, if you get too high or too far away it is hard to see your plane. If you have a hard time seeing your plane, immediately tell your instructor.

Buddy Boxed” radios

1. Don't fly directly overhead. It is easy to lose orientation not to mention your neck will cramp if you are directly overhead.
2. Never take your eyes off the plane. Typically this happens when the student talks to their instructor. I know it is common courtesy to look at someone when you talk to them, but don't do it in this case... watch your plane.
3. When first learning to fly, use elevator for speed control and throttle for altitude control. This may seem backwards at first, but you really need to think this way, especially during landings.
4. Planes don't turn like cars. Planes turn by changing some of the wings lift to a horizontal force.
5. Turns are performed by 1) establishing a bank with aileron and 2) use elevator to increase the wings lift to perform the turn. You can't just hold the turning inputs. You must fly the plane. If you start banking too much, relax the aileron input. Not turning fast enough, add more elevator, etc. Concentrate on performing both left and right turns while maintaining a constant altitude and airspeed.
6. Orientation - many new pilots become confused when the plane is heading toward them. You can try to imagine you are inside the plane... this works for some. Or, when the plane is coming toward you, if you place the aileron stick under the low wing, this is the proper direction to roll to level. Think of it as propping the low wing up with the aileron stick. After awhile, you will automatically make the proper corrections without needing to think about it.

Solo Check List

Your goal is to fly solo, that is, fly without the aid of an instructor. Every instructor will have their own unique teaching techniques, but you should at a bare minimum know and master the items on the following lists before you fly solo.

Knowledge Requirements

1. Understand the AMA and club rules.
2. Understand how to perform pre-flight checks.
3. Understand the flight pattern and flight line procedures

Flight Skill Requirements

1. Be able to safely start and properly adjust your engine
2. Smooth and straight takeoff in either direction
3. Be able to fly a figure eight pattern without losing altitude or large changes in speed
4. Be able to induce and recover from stalls and spins
5. Be able to approach and land from either direction

The first time you manage a flight on your own is a good reason to celebrate! Congratulate yourself... you deserve it! However, consider not leaving the nest right away. Many pilots get into trouble quickly after their instructor leaves. Wait until you have a firm grasp on solo flight before thanking and parting company with your instructor. Once you start flying on your own, consider asking a fellow pilot to "spot" for you when you fly. Having an experienced pilot close to you is nice if you should start to get into trouble. Don't be embarrassed to ask for a spotter. In fact, at most contests and events, spotters are required for EVERY pilot, regardless of pilot skill.

Special Interests and Second Planes

After you learn flight basics and you master your trainer, you will desire a second plane. Generally, your second plane should stay in the 25-60 size range. You should again seek the advice of experienced pilots. There are many planes of various performance and design to choose from. Much of your decision on a second plane will depend upon what sparks your interest. There is no rule that says you need a special interest, but most pilots eventually tend to concentrate on one or more special areas of RC. Below are some of the more common special interests. This list is not all-inclusive. For a full listing of special interests, visit the AMA web site at www.modelaircraft.org. Your club has members that participate in nearly every special interest area of model aviation. Ask around to find out who does what and to get more information.



Sport Flying: Most pilots fall into this category. They fly for the sheer thrill of flight. Hey, who can blame them... flying is FUN! While sport pilots don't compete, they typically enjoy basic aerobatics. Sport planes come in all shapes and sizes. Some are simple aerobatic planes while others may be modeled after full scale planes. Most sport planes are in the 25-120 size range and have moderate performance.

Aerobatics: Competition aerobatics is the pursuit of performing aerobatics precisely. Aerobatics offers an endless challenge for pilots. Many clubs offer an aerobatic contest (pattern contest). There are various levels in a contest such that pilots compete against other pilots of similar skill. There are high performance planes designed specifically for aerobatic competition, but you can use any sport plane to fly aerobatics.

Combat: Combat involves lightning reflexes and glow fuel in your veins. At a combat meet, pilots attempt to "shoot down" other planes by cutting an "enemy's" paper streamer with their propeller. For safety reasons, there are special combat planes that should be used.

3D/Fun Fly: 3D is an offshoot of precision aerobatics and what some call fun-fly. Often aerobatic pilots are 3D pilots and vice versa. 3D describes special aerobatics that occur at stalled or very slow flight speeds. Special planes are typically required for 3D.

Helicopters: Helis are increasingly popular with many RC clubs. While not really a special interest offshoot of model planes, helis do offer unique fun.

Scale: Scale planes are designed to look like their larger counterparts. Scale planes vary in detail, with the better models being nearly indistinguishable from the real thing.

While many scale pilots are master builders, you can purchase pre built scale ARF planes! Part of the challenge and fun of scale planes is flying them in a realistic manner.



Jets: Ok, this won't be your second plane, but there are real turbine powered model aircraft. These planes look, sound and smell like real jets because they are real jets! Occasionally, a turbine will show up at your flying field.

Giant Scale: Any plane at or more than 1/4 scale or 80" wing span is considered giant scale. Bigger planes tend to fly better and there is something magical about commanding a large plane. If you have a desire for large planes, make gradual steps to the size you would like to fly.



Gliders: Sailplanes, gliders and the like offer very quiet and clean enjoyment. Many clubs have active groups of glider pilots..just ask around!

Travel and Events

Once you solo, the whole world of RC is available to you! Many RC pilots enjoy attending events and traveling to other fields. Events can range from competitions to fun-fly social events. Clubs offer many events throughout the year. There are also many events at neighbor clubs within an hours drive. Some pilots travel because they enjoy attending competitions, while others travel to events for a unique a fun filled day flying. Traveling to events is fun... you'll make new friends, experience a new flying site, and typically there is plenty of good food at events. Of course, spectators are always welcome at any event

Jargon, Acronyms and Abbreviations

Learn the language of flying models...

3D - A type of aerobatic flight that is performed while the airplane is at high angles of attack (also called high alpha), stalled or at zero airspeed.

Aerobatics - combination of the words Aerial and Acrobatics

Aileron - A control surface located on the (outboard) wing trailing edge. Used to control roll.

Air beater - a helicopter

Aircraft ply - a very strong plywood rated for aircraft use, typically 3 to 7 layers.

Airfoil - Cross section of a lifting shape, i.e. wing

Airfoil - flat bottom - An airfoil with a noticeably flat bottom side. These airfoils typically generate high lift but also have high pitching moments that cause the plane to balloon as airspeed is increased.

Airfoil - symmetrical - A airfoil where the top and bottom sides are identical in shape. This type of airfoil is used for high performance aerobatic planes and has little to no pitching moment.

Airfoil - semi-symmetrical - A cross between a flat bottom airfoil and a fully symmetrical airfoil. Typically used on aerobatic trainers.

Aliphatic Resin - wood glue, such as Titebond II or Elmer's ProBond Wood glue

Anhedral - Wing (or stab) configuration where the tips are lower than the center of the wing. Anhedral reduces roll stability. This is the opposite of Dihedral.

AOA - Angle of attack, the angle at which an airfoil travels thru the air, see also incidence. Increased AOA's generate more lift, until the airfoil stalls. Past the stall, increasing AOA reduces lift.

ARF - Almost ready to fly, a plane that requires little assembly

Ball link - Same as Clevis, but uses a ball and socket instead of a pin. A ball link is commonly used to connect push rods to control horns.

Balsa wood - wood that comes from the Balsa tree, very strong and light

Biplane - A plane with two primary wings

Boost tab - Part of a control surface that is forward of the hinge line. Boost tabs reduce loads on the servo by applying a force in the same direction as control surface movement.

Burn holes in the sky - flying with the sole purpose of just flying around and having fun.

CA - Superglue (cyanoacrylate). Very fast and strong adhesive. CA comes in various types for different uses, such as thin, medium, thick, foam safe, etc.

Canard - A stabilizer that is placed in front of the primary wing

Carbon Fiber - fibers made from specially prepared carbon, used in composites. Can be found in various forms, tows, weaves, mats, etc.

Castor - A oil made from castor seeds used to lubricate some model engines.

Center of Gravity - Balance point of plane, see also Center of Mass. The balance point of planes is a critical measurement. See also Nose Heavy and Tail Heavy.

Center of Mass - A point in all three axis which describes the center of mass of a plane

CG - Center of Gravity

Ch. - Channel

Chord - Length wise direction of a airfoil (fore/aft.) Often measurements are listed with reference to the chord,. For example, your CG may be at 25% chord

Clevis - Pinned device used to connect control rods to servo arms or control horns.

Cloth & Dope - covering that uses a cloth and a nitrate dope to seal the weave.

Control Horn - A device mounted to a control surface to which a force is applied (typically a Control rod) that moves the control surface.

Composite - A composite item is made from two or more materials that when combined make a final material that takes on a whole new set of properties. Such as a carbon fiber plate that is made from carbon fibers and epoxy.

Coupling - Where one control surface effects a movement typically controlled by another surface. For example, ailerons are used for roll, but may cause the aircraft to yaw.

Crystal - A crystal oscillator that sets the transmitter and receiver tuned frequency. Often, these are user changeable. It is illegal for users to change crystals in transmitters. You may change crystals in a receiver. Also written as XTAL.

CyA - See CA

Datum - an imaginary and often arbitrary straight line along the length of a fuselage used for reference.

Dead Stick - Engine flame-out

Dihedral - A wing where the tips are higher than the center. Dihedral is responsible for roll stability. The opposite is anhedral.

Down Thrust - Engine/prop is angled down. This is typically done to offset "ballooning" on certain plane designs.

Drag - A friction force that offsets thrust

Dumb Thumbs - a pilot error

Elevator - Control surface attached to the horizontal stabilizer, used to control pitch.

Epoxy - A two part adhesive (resin and hardener) Very strong, can be found in different working times, 5min and 30 min are most commonly used.

Fiberglass - fibers made from glass, typically woven into a cloth and used for composites.

Fin - Vertical non-moveable part of the tail. Rudder attaches to the fin. The fin is responsible for spin and yaw stability.

(On) Final - final approach to runway.

Flaps - Movable high lift/drag devices at the trailing edge root of the wing. Flaps are located toward the root of the wing. Ailerons are toward the tips.

Flight line (#1) - a staging area between the pits and the runway

Flight line (#2) - A Do Not Pass Behind line. Typically this is a line that runs parallel to the runway that extends out infinitely.

Flair - A nose high attitude used to bleed speed just before landing

Flight Box - A utility and tool box that houses a RC pilots starting, test and maintenance gear

Flying Wires - A system of open air wire supports, typically found in biplanes or turn of the century scale models.

Four-stroking - with respect to 2-stroke engines, a condition where a rich mixture setting causes every other stroke to not fire, hence the engine is 4-stroking.

Fuse - Fuselage

Fuselage - Structural part of the plane that typically houses equipment.

Glow Booster (or just booster) - Battery device used to preheat a glow plug. Once the engine starts, heat from combustion will keep the plug glowing without the need for the battery booster.

Gravity Gust (Gravity Surge) - Joke for a plane stalling and dropping like a rock, i.e. I must have flown thru a gravity surge.

Hanger Queen - A plane that is rarely flown, typically do to the excellent condition of the model and the pilot does not wish to risk the plane in the air.

Hanger Rash - Damaged caused to a plane while on the ground or during storage and transport.

High Wing - Wing is attached to the top of the fuse above the CG

Hit - Radio Interference

Incidence - The angle of attack of a surface with respect to the planes datum. For example, plans may indicate that the incidence of a wing needs to be positive 1 degree with respect to the datum.

Inside Maneuver - Any maneuver where a pilot would experience positive G's. Opposite is Outside Maneuver. See also Positive Maneuver.

Kevlar - Dupont brand name for a very tough light weight fabric. Generic name is Aramid. Kevlar is often used in composites to make them tear resistant.

Laminar Flow - A smooth airflow that is very low drag.

Lean - An engine setting where the air/fuel mixture has too little fuel. A lean engine can overheat, shutdown, or backfire.

Lift - Airfoils generate lift when moved thru the air. Lift is what counters gravity in planes.

Light Ply - a hybrid plywood that is very light and reasonably strong.

Low wing - Wing is attached to the bottom of the fuse.

MAC - See Mean Aerodynamic Chord

Mean Aerodynamic Chord - The average, or mean chord of a wing. This has more meaning when talking about tapered or swept wing.

Midair - a collision that occurs in flight

Mid wing - Wing is attached mid-fuse

Mix - The automatic combination of controls. Can be done mechanically or electronically. For example, aileron stick movement may be mixed with rudder such that the rudder also moves when you move the ailerons.

Monoplane - a plane with one primary wing

Negative Maneuver - Any maneuver where a pilot would experience negative G's. Opposite is Positive Maneuver.

See also Outside Maneuver.

Nose Heavy - A condition where a plane's balance point is too far forward. Nose heavy planes are difficult to fly because the stab/elevator must work very hard to keep the plane level.

Outside Maneuver - Any maneuver where a pilot would experience negative G's. Opposite is Inside Maneuver. See also Negative Maneuver.

P-factor - describes a propeller torque effect that causes yaw issues on takeoff. This effect is more pronounced on "tail-dragger" aircraft.

Pilot - Look in mirror

Pilot Station - designated area for pilots to stand when flying **Pits** - Where one assembles, fuels and works on their plane.

Polyhedral - A wing with multiple dihedral steps

Polyurethane Glue - Very strong slow set expanding glue.

Positive Maneuver - Any maneuver where a pilot would experience positive G's. Opposite is Negative Maneuver. See also Inside Maneuver

Prop - Propeller

Prop Nut (#1) - Nut used to hold prop onto the crank shaft of the engine

Prop Nut (#2) - fool

Propeller - Rotating airfoil used to generate thrust

Propeller diameter - the diameter of the prop (tip to tip), i.e. a 12"x6" prop has a 12" diameter (diameter is always listed first)

Propeller pitch - the AOA of the prop blade, i.e. a 12"x6" has a 6" pitch (pitch is always listed last). In theory, a 6" pitch prop should move forward 6" for every revolution.

Pull-Pull - A control system that uses cables to pull a control surface both ways.

Pusher - A plane where the prop faces rearward

Push-Pull - A control system that uses a rigid rod to move control surfaces

Rekitted - crash, i.e. plane was turned back into a kit

Rib - Component of a wing that forms the airfoil shape.

Rich - An engine setting where the air/fuel mixture has too much fuel. Rich engines produce low power and can flood/flare out.

Right Thrust - Engine/prop is angled to the right. This is typically done to counteract torque effects.

ROG - Rise off ground

Root - Part of the wing closest to the fuselage

RTF - Ready to fly

RX - Receiver

Rudder - control surface attached to the fin, used for yaw control.

Servo - A closed loop control device that moves to a commanded position. You command servos to move from your radio.

Shot Down - Crash due to someone turning on a transmitter on your frequency while you are flying.

Short kit - partial kit, you will need to supply a lot of the parts

Slats - High lift devices that are installed at the leading edge of the wing. Can be fixed or retractable.

Solo - flying by one's self... , i.e. a newbies first flight without help from an instructor is a solo flight.

Spar - Key structural component of a wing that runs span-wise.

Spinner - Cosmetic cone placed on the front of the engine.

Stab - Stabilizer

Stabilizer - horizontal non-movable part of the tail. Elevators attach to the stabilizer. The stab is responsible for providing pitch stability.

Staging Area - An area close to the runway where running models wait for runway clearance

Stall (engine) - Engine flame-out

Stall (flight) - Wing at too high AOA for a given airspeed. Technically, a stall requires flow separation. What this means to the pilot is that lift is greatly reduced and drag is greatly increased when wing are stalled.

Stratosphere - Joke for where some pilots like to fly, i.e. really high

Starting area - where one starts their engine. Some fields have specific starting areas, others allow starting at the flight line or in the pits.

Synth - See Synthesizer

Synthesizer - A module that replaces crystals such that a TX/RX can have a user selectable frequency. This feature is only found on higher end radios.

T-Tail - A tail that has a very high stabilizer, making the tail look like the letter "T"

Tail dragger - landing gear consisting of mains and a tail wheel.

Tail Heavy - A condition where the plane's balance point is too far aft, tail heavy planes are difficult to impossible to fly because they are unstable in pitch.

Three-point-landing - A landing in a tail dragger where all three wheel touch at the same time.

Throw - The amount of control surface movement, typically measured in degrees.

Thrust - A forward force that propels the plane, it is offset by drag

Tip - Part of the wing furthest from the fuselage.

Tractor - A plane where the prop faces forward, i.e. the plane is tractored (pulled through the air).

Trike - landing gear consisting of mains and a nose wheel.

Trim - To trim a plane is to adjust it for hands off level flight

TX - Transmitter

V-Tail - A non-conventional tail in the shape of a "V"

Wing - Primary lifting device

Xtal - See Crystal

YAW - rotation of the aircraft around its vertical axis