



Fig. 6-1. Slope soaring is a wonderful sport that can be enjoyed at any time of the year. All you need is your plane, a radio, an appropriate slope, and a little wind. Many hours of great flying can come from this simple combination.

6 Slope Soaring

Slope soaring is the purest form of flying because you only need your sailplane, radio, a little wind, and an appropriate hill or ridge. The launch method includes simply throwing your sailplane over the edge and, in questionable conditions, using a mini-hi start. You can fly as long as your batteries hold out and you don't have to rely on warm temperatures to keep your sailplane flying as in thermal soaring. Some of the best slope soaring conditions I've encountered were during the winter.

It's easy to understand the magic that is included with slope flying. When the wind blows, air flows from a high-pressure area to a lower-pressure area. This air mass can reach several thousands of feet from the surface of the earth.

As it travels over a flat part of the land (such as the plains) the whole air mass moves parallel to the ground. When it travels over hills, the air contacts the rising terrain and bounces up until it's parallel to that surface. On a greater scale, if the slope is steep enough and high enough, a thick band of air (up to a thousand feet or more) can be deflected up to match the terrain's slope below. When this happens, a steady stream of rising air results, keeping slope-soaring sailplanes in the air. The sailplanes climb on this rising air just as well as they would on a heatgenerated thermal, fig. 6-2.

When enough altitude is gained, say 400 to 700 feet, you can explore for thermals outside of the ridge or slope lift area to gain more altitude. Often slope-soaring areas are adjacent to thermal-generating sites such as contrasting valleys and even housing developments. Sometimes the slope itself, especially areas with a southern exposure, can generate quite a bit of thermal activity.

Choosing a Site

Finding a good place to slope soar can be difficult especially in flat areas. Fortunately, where I live in Colorado there are many suitable areas for slope soaring. Assuming that you have some hills within driving distance, I will give you a few hints when choosing the best possible

place to fly.

First of all, you need to find a slope that ranges from about 40 degrees to a full vertical in slant. The slope should be at least 200 feet in height and 400 to 500 feet across. The larger these dimensions are, the better. Also the prevailing wind in this area should hit the face of this slope as directly as possible.

The top of the hill should be large and flat for 100 feet or so behind the slope. This area has the best shape and dimension for landing your sailplane. It should be free of obstructions such as trees or power lines, as should the slope and the area in front of the it. This is because the wind will develop turbulence behind any objects it comes in contact with. For example, if the wind hits a tall tree, it will curl down past the tree like a crashing wave and can continue rolling along for up to seven times the length of that tree. Needless to say this turbulence could re-kit your sailplane within seconds.

The ground should be smooth and, ideally, covered with light vegetation such as grass or softer weeds. Avoid rocks for obvious reasons. Prickly weeds and cactus cannot only poke holes in your plane's covering material, but at higher speeds can damage the underlying structures.

This site should have easy access for cars because of the preferred heights. Remember to ask permission before flying on private property. Most owners are nice about letting you fly on their land after you tell them about the safety and the basics of quiet flight. Many clubs across the country have secured fantastic slope soaring fields, figs. 6-3 and 6-4.

Slope Soaring Methods

Slope soaring is easy given the right conditions. You've already learned to select a good site. Assuming that you've found a good slope, determine if there is enough wind velocity. A lower speed is necessary to fly the lighter wingloaded sailplanes such as typical thermal ships. Any sailplane mentioned in the chapter on choosing a sailplane meets this criteria. Some of the more advanced slope

presented at the end of this chapter need more wind than these thermallers.

The easiest way to determine the wind speed is by using ears: When facing the wind straight on you should be to hear the wind. If it is less than howling but more faint, it should be at least 8 to 10 mph, enough to fly sailplanes. For more accurate readings, you can buy a mad-held wind meter at pilot shops, fig. 6-5. In addition to velocity, the wind should be fairly steady and not gusty. If the wind is off and on and variable, flying may prove infault: you may get a lot of exercise retrieving your plane the bottom of the hill.

Before launching your sailplane, figure out where you'll and when you've finished flying. Look for two sites, one on that area behind the slope and another on the slope or it. If other pilots are with you, agree on the landing and the approaches that you'll all be using. Don't fly wer any people (including pilots and spectators), cars, or

Before turning on your radio, make sure no one is on frequency; using a frequency pin is advisable. Turn on radio transmitter and receiver and make sure thing is working properly. Now it is time to launch.

There are two ways to launch your glider on a slope, appending upon the wind. If you know there is enough wind a easily fly, then a simple hand launching is all that is needed. fig. 6-6.

Besides using your ears and/or a wind meter, your plane an help you determine how much wind is available. Eviding your sailplane in one hand and your transmitter in the other, approach the edge of the slope. You should feel glider get lighter and want to pull out of your hand. If glider's weight feels about the same or is barely lifted, there probably isn't enough wind.

If the slope has enough lift to keep the glider aloft and wurre now able to launch it, use the throwing technique you searned when you were trimming your sailplane. Stand about 10 feet behind the rim of the slope, run forward a few seet, and throw the sailplane ahead firmly with the wings

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As the sailplane goes over the edge, concentrate on seeping the wings level. Soon after it travels forward another 10 to 20 feet, the sailplane will start to climb. Be sure to keep the glider's attitude level. In other words, if the mose of the glider goes up, use the elevator to push it back down. Now the entire glider will rise with the lift and remain at a good flying speed.

If you continue flying forward, you'll fly out of the lifting area, descend, and have to land. Stay in this band of lift to continue flying and climbing. The strongest area of lift on



Fig. 6-4. The top of this slope is large and flat. Unfortunately, there are a few rocks and cacti. Look for an area covered with tall soft grass instead.

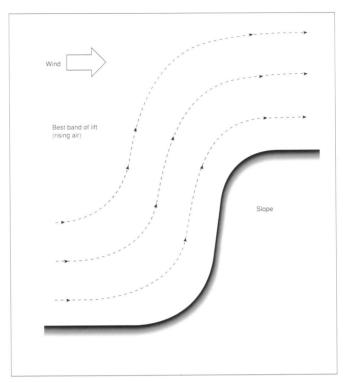


Fig. 6-2. As the wind hits the slope, it is deflected upward until it parallels the slope. This area of air movement is what provides your sailplane with the power to gain altitude.



Fig. 6-3. This is one of our slope-soaring sites. Notice how smooth the area in front of the slope is. This slope is several hundred feet high, faces several directions, and is easily accessed by the small road on the right.

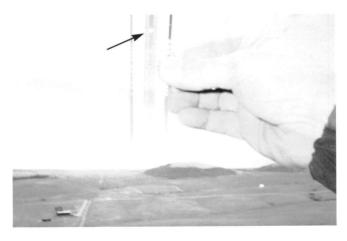


Fig. 6-5. This wind speed indicator is easy to use. Notice that the white ball (arrow) shows a wind speed of just about 8 miles per hour.





Fig. 6-6. This is the correct method for launching your sailplane. Firmly throw it straight ahead (or a little downward) to pick up enough speed to fly. Next fly straight out into the lift and begin performing Figure 8s.

any slope is typically well in front of the slope and above the top of the slope.

To stay in this area, fly parallel to the slope in the band of lift. To maintain a straight flight, you will have to crab the sailplane into the wind. In other words, the nose of the sailplane should be turned about 10 to 20 degrees into the wind to keep it parallel to the slope. This keeps the plane from getting too close to the side of the hill.

As you fly parallel to the slope, eventually you'll need to turn around and come back, but do not turn toward the slope. If you don't have enough altitude, a turn toward the slope could result in a high-speed banking crash. Always turn into the wind and away from the slope and assume another crab angle into the wind traveling the opposite direction. At the other end of the ridge, again turn into the wind. Make sure that these are gentle, shallow banking turns. You'll notice that you're actually making a large figure 8 with your flying pattern, fig. 6-7.

Continue this pattern in the band of lift and see how much altitude you can gain. Several hundred to a thousand feet can be achieved depending on the conditions and your flying site. Not all slope areas are uniform and smooth. Different areas can yield different amounts of lift. Once your sailplane is high enough, experiment with different areas. Fly around and look for thermals. Even greater altitude can be gained by combining these two forms of lift. If you start losing too much altitude, fly back to the lifting area you're familiar with and regain your altitude. Don't limit yourself to only one area of lift; experiment and have fun.

Hi-Start Launching

If you're not sure there is enough wind to fly your plane, try a mini hi start. This is essentially the same setup described in Chapter 4, except it's smaller in length. Mount the stake at or slightly below the rim of the ridge or slope and stretch the hi start until the tension feels about the same as a normal hi start, fig. 6-8.

Make sure the radio is on and properly working, and

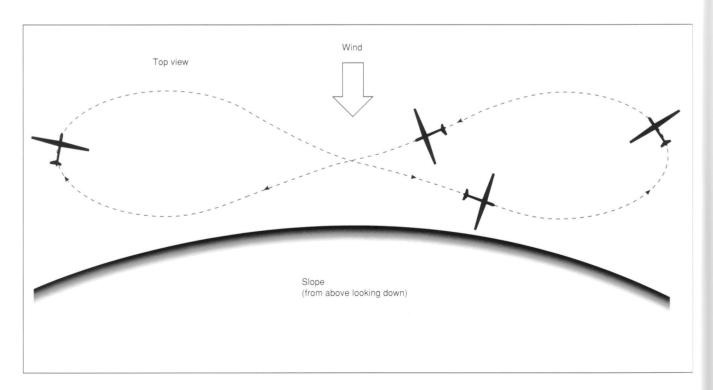


Fig. 6-7. Figure 8s. Fly these patterns to safely gain altitude while in slope lift. Notice all turns are away from the slope. If you turn toward the slope, the wind may quickly carry you behind the area of lift or into dangerous downdrafts.

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Fig. 6-8. You can use a short hi start at a slope. The tie down spot is just over the edge of the hill. This technique is useful when you are not sure if there is enough wind to keep your plane aloft.

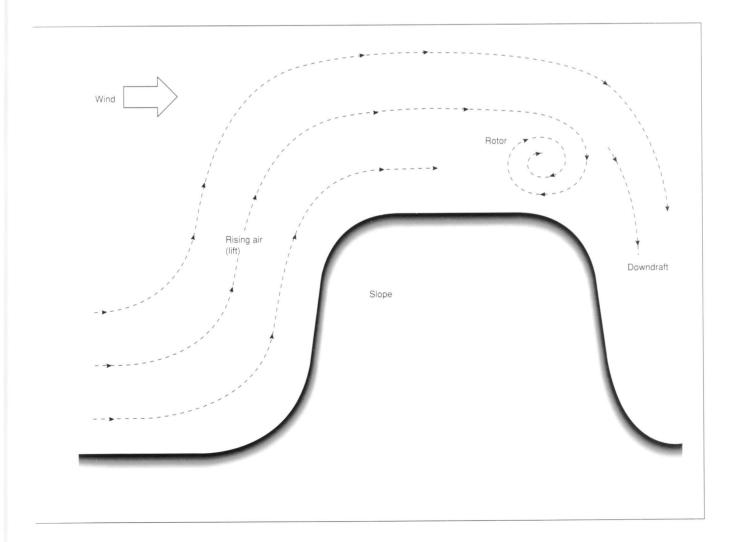


Fig. 6-9. As the wind follows the contour of the slope, dangerous rotors and downdrafts can occur. Beware of these areas because your sailplane can quickly become re-kitted!

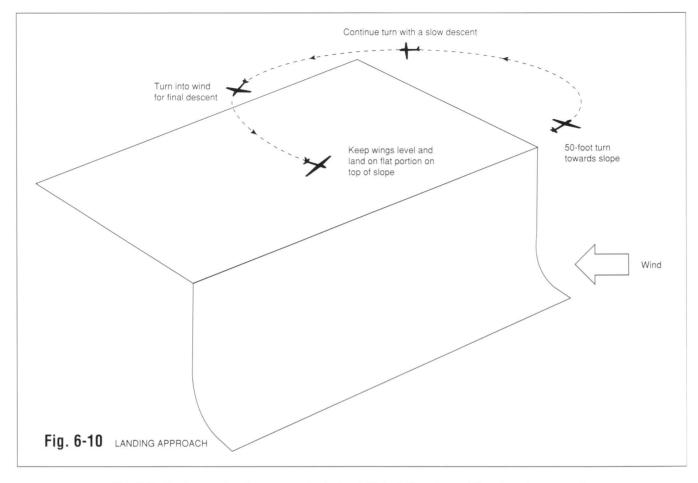


Fig. 6-10. Begin your landing approach at about 50 feet. Turn toward the slope in a smooth bank while descending. Finish the turn flying directly into the wind. Keep the sailplane's wings level and gently land using up elevator.

launch the plane into the wind. After you release the sailplane, fly into the band of lift and begin the figure 8. You'll soon know whether there is enough lift to keep you aloft. If so, continue the pattern and fly as before. If not, immediately land on the flat area behind the slope.

Landing

You can land your sailplane several ways. With luck, there will be a flat, smooth area behind the crest of the hill.

Before I describe specific landing techniques, you should know about the turbulent hazards you may encounter, fig. 6-9. If your flying site has a downslope behind your landing area, powerful, sailplane-eating downdrafts can occur. Just as lift is developed when the wind blows up a slope, downdrafts occur as the wind follows a descending terrain. On landing approaches, if you fly too far behind a landing area with a descending terrain, you'll soon discover how quickly your glider can drop. Be aware of where downdrafts can develop and try to stay clear of them.

The next danger, rotors, typically develops behind steep hills. The mechanism of development is similar to the airflow that is seen over the top of a stalling wing. Refer to the aerodynamics chapter and see how the sharper angle of attack causes the air to curl around and teak under itself.





Fig. 6-11. If your approach is too high, as in these photos, fly straight ahead over the top of the slope into the lift. After climbing to 50 feet, make another attempt to land.

Flying in low lift area turning into wind

Fly across the slope close to the surface

Wind

As you get closer to the slope, apply up elevator and gently land

Fig. 6-12. If you lose lift while flying, you may have to land below the top of the hill. In this example, turn away from the slope and fly across it close to the surface. As you get closer, add up elevator until the plane slows down and lands.

This also occurs at steeper slopes about 100 feet or so back from the rim. Rotors also can occur at any flying site with a mean slope to its rear. With higher winds, you'll encounter the markets and possibly a violent rotor. Again, while

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Eventually the plane will stall and land on the slope

Apply up elevator to fly parallel with the slope

Plane is low and the wind has slowed down or stopped

Fig. 6-13. If your sailplane gets very low, you can use this method to land it and have a minimal walk to retrieve it. The trick is to cause the plane to stall and reach the slope's surface at the same time. This will minimize its landing speed, causing the plane to land on the highest possible part of the hill.

landing keep your glider away from these disastrous areas.

Now that you know what areas to avoid, it's time to learn landing techniques. The easiest method is landing on top of the slope area, fig. 6-10. Remember to keep away people, cars, and any rotor- or downdraft-generating areas.

Start with your plane at about 50 feet above the top of the slope in the lifting band area. Now make a smooth turn toward the slope, which quickly should take you behind the rim of the hill and out of the effective lifting area. Complete your turn so the plane faces into the wind. It should slow down and become easier to fly.



Fig. 6-14. This sailplane has descended below the top of the hill because the wind slowed down. It was successfully landed using the technique in fig. 6-13.







Fig. 6-15. With practice, you can eventually land your sailplane in your hand. At this flying site, hand landings are much more desirable than hitting any rocks.

Keep the wings level and allow the sailplane to slowly descend on its own. As it reaches two or three feet above the ground, gently feed in enough up elevator to keep the plane about a foot or so above the ground. Keep the wings level and the nose into the wind. Soon, the sailplane will land gently.

On approach, don't land if the plane is too high, fig. 6-11. Simply fly out across the ridge into the lift and gain altitude. Make another approach at 50 feet; this time extend your turn out a little farther or begin the turn farther down the slope. Experiment until you get used to your sailplane's flying characteristics.



Fig. 6-16. These fliers are racing against each other. Each has a caller watching his assigned judge at the far end in the distance.

If you don't have a suitable place to land behind the hill or you're forced to land beyond the edge of the rim and don't want to walk to the bottom, there are two other methods of landing on the slope itself.

The first occurs across the slope, fig. 6-12. Get the plane in an area of light lift, usually a part of the slope where the wind isn't blowing directly into it. Let the plane descend gradually and fly slowly across the slope, just a foot or two above the ground. Gradually add up elevator until the glider is about to stall and then meets the ground.

The other type of slope landing is used when the wind is light and the glider has already fallen below the rim of the slope, figs. 6-13 and 6-14. Using this technique you can land the plane as far up the hill as possible to help keep your hiking distances to a minimum. It involves flying your glider directly into the slope.

As the glider approaches the slope slowly apply enough up elevator for the glider to fly parallel to the slope. Remember, a plane at this attitude will soon slow down and stall, precisely what you want it to do. You are new flying with the wind and your ground speed is increased. As you apply up elevator the plane slows, and if timed right, it will stall just as it meets the ground.

Only use these techniques if you have no other good places to land or if the wind has stopped and you must land, fig. 6-15. If the slope is smooth and free of rocks or hazards, use either of these techniques as described. If not, land below where the ground is smoother. A long walk takes less time than rebuilding a damaged sailplane.

High Winds

Occasionally you may find a howling wind. At the end of this chapter I'll mention some higher-performance ships that love to fly in these types of winds.

If, however, you have the usual thermal soaring ship. you have two options: Go home and wait for a quiet day or add ballast. With higher winds, to stay in the area of lift the plane has to be in continuous dive, putting stress on the wings. To cause a plane to descend faster and to have better penetration into the wind, add weight.

There are a few ways to add weight. At times I have used rocks found at the site that wedge perfectly into place in the fuselage over the center of gravity. Other planes, like the Spirit 100, come equipped with a small ballast box in which you can place rocks or lead. You also can purchase stick-on tire weights and cut them to length. Peel off the backing and tack them to the bottom of the fuselage. With trial and error you can find the right amount of weight for your flying conditions.

Sharing the Skies

Slope soaring is the purest of all flight. Natural lift generated by the wind striking irregularities in the earth



Fig. 6-17. This aerobatic slope soarer is making an inverted pass.

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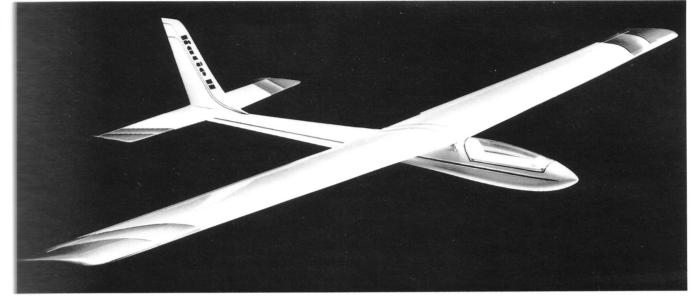


Fig. 6-18. Katie II. This sailplane by Bob Martin RC Models is a great aileron transition ship for most beginning to intermediate pilots. The fuselage is made of Duralene and is very resistant to damage

power sailplanes to great heights. While you are getting and up in this seeming miracle, don't forget about your fiving buddies on the ground. You can literally fly longer man your batteries can last, but someone sharing your frequency might not want to wait that long. In these cases, much to an agreement on flight times so all of you can enjoy the thrill of slope soaring.

Contest and Advanced Slope Soaring

Several clubs enjoy slope-soaring contests. There are two ppes: pylon racing and stunt flying.

Pylon racing involves racing from two to five sailplanes a time; they must fly a set number of laps between two pylons. The first pylon is located near the pilots and the other is at the opposite end of the slope. Each pilot has a caller who stands with him and watches a judge at the far pylon. fig. 6-16.

Each plane is assigned a judge who has a flag. When the fier's plane passes that pylon, the assigned judge drops his flag. The caller sees this and then tells the flier to turn. The turn at the closer pylon can be judged easily by the pilot turnself.

All pilots fly a predetermined number of laps between the pylons. Each plane is timed, all times or points won are added up at the end of the heats, and a winner is determined.

Another contest is aerobatics, set up much like the pattern contests that are flown with powered planes. A set pattern or combination of stunts is approved and all of the contestants fly this pattern in front of several judges.

Each maneuver is rated for symmetry, centering, and other aesthetics. Each pilot typically gets to fly the pattern for at least two to three different judges; again a winner is chosen using a point system.

As you can see, slope soaring can vary as much as the type of plane that you are flying. The slow, gentle slope soarers can be very docile and calming. At times, you can easily lay back on the slope and occasionally make a turn or two on the transmitter.

If the wind is stronger and you are so inclined, you can get a faster, more aerobatic slope soarer and fly at high speeds. Aerobatics including loops, spins, rolls, and even inverted flying are all possible, fig. 6-17. The only limit to slope soaring is your imagination. Get out and give it a try.

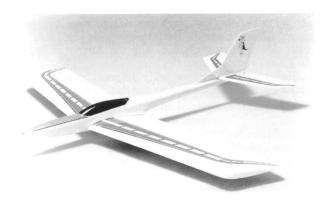


Fig. 6-19. Coyote. A highly aerobatic ship, this plane has a wide speed range that makes it even more desirable for novices to intermediates.



Fig. 6-20. Ninja. This aerobatic performer by Sig Models can be built in only a minimum of time. Don't let its low cost fool you; it is capable of many exciting aerobatics.



Fig. 6-21. Samurai. This sleek and highly aerobatic ship is as exciting as it looks. Its controls are novel and the wing panels are made to move independently for control.

You may not want to ever use a hi start again!

Slope-Soaring Sailplanes

As mentioned, any standard thermal type of sailplane that I recommended earlier flies well in slope lift. Other sailplanes, however, have more capabilities than the standard thermaller. I'll present four slope-soaring sailplanes suitable for a beginning to intermediate flier. Each has aerobatic capabilities but is still docile and easy to assemble.

Katie II. A wonderful slope-soaring sailplane for a beginner, the Katie II is produced by Bob Martin RC Models, fig. 6-18. It has a 72-inch-long high-lift wing that is made by covering foam cores with balsa sheeting. This model also features a Duralene fuselage made of strong plastic. This fuselage has a limited warranty against breakage under normal use including accidental crashes for one year.

The Katie II is special because it can fly as slowly as most sailplanes but is very maneuverable because it also has ailerons. Only two channels are needed, one for ailerons and the other for the elevator. It is a great transition ship that bridges the gap between standard thermal sailplanes and high-speed aerobatic slope soarers. In fact, you can even hi start the Katie II and catch stronger thermals. If you'd like to learn to fly basic aerobatics and also have the great slow-speed capabilities of a trainer, I'd suggest the Katie II.

Coyote. The Coyote, also produced by Bob Martin RC Models, has been a favorite slope soarer for modelers around the world for years, fig. 6-19. This model can fly well with wind as light as 10 mph and also in stronger wind

conditions

The Coyote, like the Katie II, has a Dura-duralene fuselage. Its foam wings are covered with 1/64-inch plywood wing skins, making it even stronger. Only two channels are needed, one for ailerons and the other for elevator control.

The wing is swept back, giving the Coyote a jet-like appearance. Construction is straightforward and easy. Like the Katie II, a detailed, step-by-step instruction booklet is included

It is a maneuverable model and is snappier in its aerobatic performance than the Katie II. In fact, if you lower the nose for only a few seconds, this plane will almost immediately reach high speeds. If you can fly the Katie II with good control, the move up to this faster ship should be no problem for the beginning to intermediate flier.

Ninja. This is a balsa, hardwood, and foam kit manufactured by Sig Models, fig. 6-20. It is designed for the flier who wants a quick-flying and aerobatic model that can be built in minimum of time. The fuselage is made of a sturdy but light plywood that literally locks together, resulting in a light but strong structure.

The wings are foam cores sheeted with balsa. Little shaping or sanding is necessary. Two-channel operation for the ailerons and elevator is all you need. The detailed instruction booklet includes photographs that can guide any modeler to success.

The Ninja's flight performance is outstanding, but wind speeds of 15-20 mph typically are needed to keep it aloft. The model is stable and if balanced correctly has no bad habits even for new pilots. The Ninja is aerobatic and will even please a more experienced pilot who wants to push it to its limits.

Samurai. The Samurai is also produced by Sig Models. fig. 6-21. Like the Ninja, it is designed by Mike Pratt. This model costs more than the Ninja but has several modern features that make it unique.

The easy-to-build Samurai features foam-core wings covered by pre-cut plywood wing sheeting. The fuselage and canopy are molded, high-quality fiberglass parts. A minimum of building is necessary. Again, a detailed, step-by-step booklet with pictures is included.

The model's appearance is striking. The narrow fuselage presents a low frontal area which significantly lowers the overall drag. The airfoil helps to keep the speed of the ship up even when you're going through several aerobatic maneuvers. The model has a distinctive, low-drag V-tail that can be made to be removable for easy transport.

Finally, the most advanced feature involves the wings. Not only are they removable, but the entire wing panels move! You can build either a pitcheron or wingeron design. The wingeron version needs only one servo to control the elevator and one stronger 65 oz/in or greater servo to move the wing panels. The pitcheron design uses two servos to move both wing panels. With this version you'll need a radio with elevon mixing abilities like the Airtronics Infinity or JR's X347 radio.

If you want something truly different in appearance and performance, consider adding the Samurai to your hangar.

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Fig. 7-1. This is the Goldberg Electra, which is basically an electric-powered Gentle Lady. It is stable and performs well in thermals.

7 Introduction to Electric-Powered Gliders

Years ago, electric motors were used to power a few existing radio control models. The power was a mere fraction of what their fuel-powered counterparts could generate. Since then, technology has rapidly moved forward produce more efficient and powerful motors, batteries, and propellers. As a result, many electric-powered models—especially gliders—have become popular.

Electric-powered planes have many advantages. They see easy to use and maintain. Starting an electric motor is simple as connecting it to a battery and flipping a switch. You don't have to fumble with fuel or fuel pumps nor set carburetor adjustments, and you don't run the risks that are associated with starting a gas engine.

There is no messy oil or unburned fuel to clean off your airplane when you are finished flying. Also, you don't have to lug a large field box full of heavy objects including fuel, an electric starter, and a starter battery.

Much less space is required to fly electric sailplanes; a moderate-sized park is about all you need. A small space to take off and land will suffice. These models are so quiet that people living close to their flying areas don't complain of the moise commonly associated with gas-powered models.

They weigh more than their unpowered counterparts sailplanes), but they have such a low wing loading that thermal soaring is easily achieved. There is no need for a hi start, winch, or other launching device either. One battery charge sometimes provides enough power to take the model to soaring altitudes three or more times. This means that when the model nears the ground, just start the motor

again and climb back up for another thermal hunt. This is easier than having to relaunch your sailplane using a winch or hi start.

Most model manufacturers have jumped into this popular sport; many companies that produce sailplanes now have electric versions available. These include the Goldberg Electra modeled after the Gentle Lady, fig. 7-1, the Great Planes Spectra which is a modified Spirit and many others. There are even many ARFs available, such as the Royal Electrosoar and Hobbico's Soarus, figs. 7-2 and 7-3. In Chapter 11 I'll discuss these and many other models.

Electric motors have been greatly improved upon. Simple "can" motors of any type can be found, but more powerful motors are available, including the popular cobalt. Also, power drive systems ranging from the simple direct drive to the more efficient gear-driven systems can be obtained from several sources. Propellers also have changed a lot recently. Everything from efficient, low-noise, rigid propellers to low-drag folding types designed especially for electrics have been developed.

Batteries come in a variety of sizes and types, from standard cells to the more powerful SCE and SCR types. Much has been learned about the proper care of rechargeable nickel-cadmium batteries. These include discharging, charging, cycling, eliminating memory, and storage. Chargers of many types and complexities have been developed to keep up with the demands of the electric modelers. I'll describe all of this in detail in the following chapters.



Fig. 7-2. The Soarus II by Kyosho has ailerons and is very aerobatic. It is sold as an ARF kit.

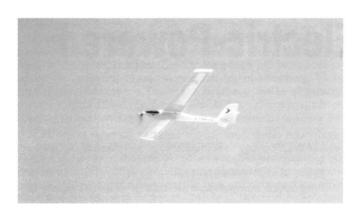


Fig. 7-3. Here is a nice view of the Soarus as it climbs to a good thermal seeking altitude.

Finally, special techniques — including tool selection, gluing, and aligning — for building sailplanes and electric gliders will be presented. Balancing and proper servo setup will help any beginning modeler build a true and straight flying airplane. Both radio and electric motor switch-mounting positions can give the modeler an advantage. For example, to save weight the power switch can be coupled to a third servo or even to one that is already in use.

As an electric-powered modeler, you will also need to know how to use a soldering iron. This can be useful when mounting a motor-saving fuse into your system or even when upgrading your system to a more powerful motor.

Though it may sound as if there's a lot of information to digest, nothing is complicated. I'll take you step by step through the material until you understand the concepts involved. Soon, you'll become a knowledgeable and confident electric sailplane pilot.



8-1. These are simple "can" motors used in model cars and manes. They are very inexpensive and provide a moderate amount of power and life expectancy.



Fig. 8-2. This is just a sampling of the many excellent cobalt motors that are available from Astro Flight Inc. These motors are incredibly powerful and easy to maintain.

All About Electric Motors and Power Systems

Electric motors have been used in models for many years.

a child going to slot car race tracks I'd be amazed at how
those little cars could move. Since then, the electric
has gone through many changes.

RC cars have been popular for the past several years. Improvements in motors and their components have been made to keep modelers competitive. Astro-Flight and others we improved the performance of their electric motors to such a level that their applications in high-performance racpattern planes, and other models are a reality.

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You'll be amazed at the wide variety and sizes of electric motors. Many classifications are used to describe the size motors.

The most accepted method is to rank a motor in relation its fuel-powered counterpart. In other words, an 05 electron motor is supposed to be comparable to an .05 or .049 engine; there are problems with this method. First, the entire motor and support system for an electric setup weighs more than a comparably sized glow engine and its fuel because nicad batteries weigh more than an appropriately sized tank of fuel.

Next, all 05 electric motors do not produce the same amount of power. A cheaper Mabuchi motor can't hold a candle to the amount of power that the same sized Astro-Flight cobalt motor can produce. This would be like comparing a standard .049 engine to a Cox Tee Dee .049 high-performance engine.

Because of the variety of motors, the costs of these motors also vary. Finally, the types of drive units — including propellers and gear-reduction units — can be different from what we commonly use on glow engines.

Motor Selection

In general, motor selection for the beginner is simple. Because electric-powered gliders have become so popular, many manufacturers have produced fairly complete kits, most with a can-type electric motor, fig. 8-1.

Most of these can motors are made by Mabuchi. Mabuchi has been around for a long time and has been able to produce many sizes of ferrite motors, which have a reasonable power output and are cheap. The main disadvantage is that they are sealed, prohibiting you from opening up the motor

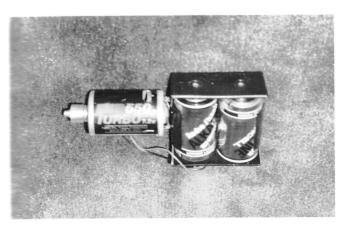


Fig. 8-3. An electric motor can be easily broken in by using this setup. 2D batteries in a two-cell holder can be connected directly to a new motor. When the motor stops, it will be properly broken in and ready to run on your model.



Fig. 8-4. Master Airscrew produces this complete unit called a Flight Pack. Each pack contains an electric motor, gear box, folding propeller, and spinner. These units are inexpensive and provide more power than comparable direct-drive units.





Fig. 8-6. Use rosin core solder such as this standard 60/40 type for any soldering projects.

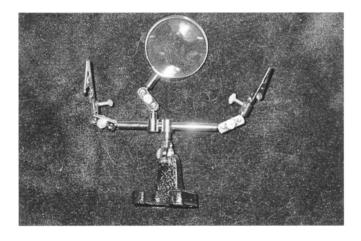


Fig. 8-7. These helping hands cost around ten dollars and are useful when you have a lot of soldering to do. Parts are securely held in place, leaving your hands free to hold a soldering iron, solder, and other parts.

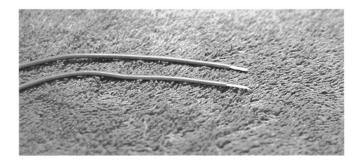


Fig. 8-8. Remove a small amount of insulation off the ends of each wire using a modeling knife or razor blade.

Fig. 8-5. Astro Flight produces many gear-driven packages such as this 05-sized unit. In addition to the motor's incredible power, the gear-driven assembly provides for an even greater efficiency that can take electric planes to great altitudes in matter of seconds.

to clean it or change the brushes when they wear out. When they do break or wear out, however, they are easy to replace at a low cost. By the time this happens, you may be ready to spend the extra money on a high-performance motor.

Cobalt Motors

Astro-Flight produces a large variety of high-quality cobalt magnet motors, fig. 8-2. Most can motors have inexpensive, moderately powerful ferrite magnets. Cobalt magnets are not only lighter, but they are more than five times stronger than other magnets. This feature alone brings up the motor's power significantly.

These wonderful motors also have ball bearings which improve their performance life. Other features including a better shaft alignment and clearance between the internal components also increase the available power. Finally, these motors can be opened for cleaning and repairs. Replacing worn brushes is quick and easy.

These motors initially cost more but when you consider the extra power, life, and repairability you will save money over the long term.

Motor Break-In

You should break in all can motors, fig. 8-3. The Astro Flight cobalt motors won't need this as they come ready to run. When you break in an electric motor, you are actually seating the brushes for higher motor output and increased life.

There are several ways to break in a motor. The most expensive is used by hard-core car racers, but you can buy an expensive unit that breaks in motors through many sources. This is only practical for those who use up many motors quickly, since there are easier and cheaper ways.

The simplest way is to hook up your regular harness and battery pack and run the motor without the propeller until it significantly slows down. The motor must run unloaded with nothing on the shaft, making it easier for the brushes to seat and resulting in less heat buildup.

The second method requires two alkaline D batteries. You can hook these up with small wires or purchase an inexpensive battery holder from Radio Shack. Attach an appropriate connector to this and then to your motor. If your motor has no connector, then simply hook the wires to the motor solder tabs. The motor runs until it stops several hours later. After your motor is properly broken in, mount it and prepare it for flight as recommended.

Gear Reduction

Over time, it was discovered that gear-reduced drive systems give more efficient thrust when used on sailplanes and other slower-flying models. These gear-reduction units typically run between 2:1 and 3:1 ratios; this means that a 3:1 gear reducer will turn a propeller one time for every three times the motor turns its output shaft.

The propellers are larger than those used for direct-drive applications. Even though these large blades turn more slowly, they produce more thrust during their revolutions, so the motor runs more efficiently and typically uses less electrical power with a gear reducer. This occurs because the motor uses less power when it rotates more freely.

If you put a propeller that's too large on a direct-drive motor, it will turn slowly, but will draw more electricity trying to overcome the added drag. As a result, it will overheat and quickly drain the battery, resulting in less run time. With the gear reducer, the motor spins faster and uses less energy to turn a larger propeller. The result is more thrust

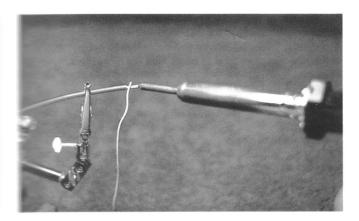


Fig. 8-9. Tin the exposed wire using a small amount of solder.
This is essential for preparing the wire for secure bonding.

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For our applications in electric sailplanes, we need a == r-reduction ratio of about 2.5:1 or 3:1. The Eclipse by Amonics comes with a gear-reduced unit. For other mod-I consider buying an Electric Flight Pack by Master Arscrew, fig. 8-4. The Flight Pack includes an 05 Mabuchi electric motor, a high-quality gearbox, a 12 x 8 folding promeller, and a black spinner. The whole unit is already mbled and comes with the needed tools. The motor also a built-in capacitor. Flight Packs are available in three ratios, 2.5:1, 3:1, and 3.5:1. I have used these units on Electra and have found the difference to be absolutely menomenal. Not only did the plane climb more quickly to attude, I could do this at least two to three times on a sineharge on my 1500-mah 6-cell pack. As of this writing, retail price of these units is \$39.95 but be sure to shop around.

Astro Flight also makes a gear-reduced unit that comes meassembled with its popular 05 cobalt motor, fig. 8-5. The mear reduction in this unit is 2.38:1; the reduction drive is furable. The timing is adjustable, the motor and gearbox me fully repairable, and phenomenal power can be expected. This unit costs more because of the cobalt motor and sturger gearbox components, but if you can afford one, I surely recommend it.

Soldering Techniques

The gear-reduction packs that I recommend will require you to know how to solder. In fact, as you get further into this hobby, you will soon find that soldering is necessary.



Fig. 8-11. These are two commercial fuse holders. The one on the left is an in-line type that comes with two wires soldered into a marness. The unit on the right simply clamps onto an existing wire and is tightened in place with a pair of pliers.



Fig. 8-10. Now take the two pre-tinned ends, overlap them, and heat them with the iron. The solder on the ends will melt and flow together. When it cools, a very strong shiny bond should result.

Installing battery connectors, new motors, switches, making new harnesses, installing fuses, and making custom battery packs all require good soldering skills. When using BEC (Battery Eliminator Circuit) speed controls, a bad solder joint can quickly cause a crash because of lost radio control.

With the right tools, learning good soldering techniques is easy. An expensive soldering gun with a light and all the fancy attachments will do fine if you already have one. Solder only "knows" one thing, and that is if it is hot enough to melt and flow. So a cheaper soldering iron such as those sold by Radio Shack will also do nicely. While you're there, buy some 60/40 rosin core solder, fig. 8-6.

My most invaluable soldering tool is called the helping hands, fig. 8-7. This is a stand made by X-Acto and others that has a heavy base to support movable arms that have alligator clamps attached. Some also have a magnifying glass installed so you can see finer work more clearly. Finally, you'll need a modeling knife and appropriately sized heat-shrink tubing. With practice, you will be able to make strong shiny solder joints with little effort.

First you must properly prepare the surfaces to be joined. Battery solder tabs occasionally can be corroded or dirty. A little polishing with fine sandpaper should get rid of any irregularities. Before soldering wires, remove about ½ of the insulation with your modeling knife, fig. 8-8. Cut deep enough to barely reach the wire underneath all around the wire. If you press too hard, you can actually cut off strands of the wire. Next pull off the insulation with needle-nose pliers or your fingernails. Finally, twist the wire strands with

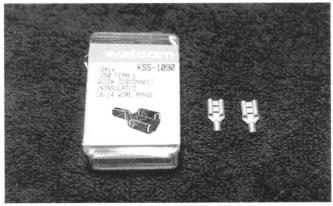


Fig. 8-12. These small No. 250 quick-disconnect pieces are easily soldered to wires. A blade-type fuse plugs into the ends. Soldering these units onto wires provides you with the lightest possible method of securing a fuse in a wiring harness.



Fig. 8-13. Many rigid-fixed propellers are available to modelers. These include wood as well as nylon types that come in two-, three-, and four-blade versions.



Fig. 8-14. These folding propellers are made by Master Airscrew. On the bottom propeller the blades extend while the motor is running. When the motor is turned off, the blades freely fold back (above), reducing the overall drag on the sailplane.

your fingers. To practice, buy spare large-gauge wire and prepare two ends.

The next step is called tinning, fig. 8-9. The surfaces that need to be joined will be pre-soldered or tinned. In the case of a solder tab, touch the soldering iron to the underside of the tab or connection and then put the end of the solder against the area to be soldered. The solder will easily flow onto the tab. Then remove the iron and the solder will quickly harden.

In the case of practice wires, heat the wires with the soldering iron and touch the solder to another part of the wire. Soon the solder will begin to flow onto the wire and if you look closely, it actually moves into the space between the individual strands. Remove the iron and the solder and let it cool, fig. 8-10.

Now it's time to actually bond your two surfaces. When you have tinned both of your two practice wires, put the two tinned areas next to each other as shown and heat these surfaces with the iron until both of the tinned areas have melted solder. The solder will quickly flow evenly between the two pieces. Remove the iron and let them cool. Don't move these two surfaces until the solder has completely solidified; otherwise, a bad joint may result. You should end up with a strong and shining solder joint.

Bonding a solder tab is essentially the same. Put the tinned end of a wire onto the prepared solder tab. Heat them until both surfaces have melted, then let them cool. When soldering battery tabs, be sure to heat it up only for as long as needed. Prolonged heating can damage the battery cell.

Fuses

When a motor is on and the propeller is not permitted to move, the motor is said to be stalled out. This can occur, for example, if the propeller contacts ground while running or if the propeller is caught on the side of the fuselage.

A stalled-out motor draws so much electricity into it in an attempt to move the propeller that the current draw will soon be high enough to burn out the motor, overheat and damage your batteries, or both.

To prevent this kind of damage, you should have a fuse somewhere in your electrical system. Most electric sailplane kits that I recommend already have a fuse holder and fuse installed. If yours doesn't or if you decide to make or modify your own power harness, take a few minutes to install a fuse holder.

You can do this many different ways, fig. 8-11. Each costs 50 cents to a couple of dollars, cheap insurance for your motor and battery pack. When you install a fuse, you may put it in any lead except one that is attached to a charging jack. This way, current is sure to run through the fuse when the motor is running.

When you have decided which lead to use, you can employ several different methods to install a fuse holder. The easiest is an automotive self-stripping fuse holder, available at Radio Shack. Simply place the lead into the unit, fold the other half over, and crimp it into place with a pair of pliers. Next, plug in a 20-amp blade-type fuse and vou're ready to use the system.

The next two methods involve a little soldering. An inline auto fuse holder is available at an auto parts store. The fuse holder has two leads attached to it. Cut your power harness lead in two and prepare and tin both ends, as well as the blade holder leads. Next, slip heat-shrink tubing over each power harness lead and push them at least a few inches away from the ends so they won't shrink onto the wires while soldering the ends. Solder both joints and, when they're cool, slip the heat-shrink tubing over the joints and shrink them down using your monokote heat gun.

This next method is my preferred choice: It is the cheapest way to go and adds the least amount of weight. Buy a small package of female quick disconnect No. 250 connectors to fit 14-to 16-gauge wires, fig. 8-12. These can be crimped onto your leads, but I prefer to solder them in place to avoid bad connections. Prepare the harness leads as before and then solder one of these connectors on each end. As you can see, the only added weight to the system comes from the connectors, solder, and the fuse itself.

Propellers

Many kits include a propeller with the motor, while others mention an appropriately sized propeller that you may use.

Let me first explain how propeller sizes are determined. Each has two numbers that describe its size: The first number relates to its entire length in inches. The second number relates to the propeller's pitch. Propeller pitch is the amount of twist found in the blade. The greater the twist or pitch, the higher the second number. The actual number of the pitch is the distance the propeller would travel in inches through a thick medium in one full revolution. So if during one complete turn, a 9-inch long propeller travels six inches ahead, its size would be 9 x 6.

Two types of propellers are available for use on electric sailplanes: a standard fixed propeller or a folding propeller. Each has advantages.

Fixed propellers have been around for a long time and have been used on gas-powered engines, fig. 8-13. They come in a variety of sizes and types. There are even those that work as pushers and have a reverse rotation. Others have three or four blades attached on one unit. Fixed-type propellers are cheaper and a bit easier to balance.

Folding propellers are becoming more abundant now that mice flying is more popular, fig. 8-14. Their main advants that when you turn off the motor, the relative wind the blades back and reduces the overall propeller drag a bare minimum. Less drag equals better flight performance. Another advantage is realized when landing. If a mice-pitch propeller is aligned vertically on landing, the motor will hit the ground and may break. In addition, as can bend the motor's main shaft, damage a gearbox or tear the motor from its mount.

You can easily see why I recommend a folding propeller.

Then though it costs a bit more, it will save you money on war and tear. Also, a folding propeller will give you meased flight times.

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ose ers 7pe Many good folding propellers are available. Graupner als a fine line of many sizes. Their shapes have been fined to give an even greater performance. The blades are the hubs and then taper toward the tip, giving a greater thrust efficiency. They can be purchased with a supper and hub assembly.

Master Airscrew produces two electric propeller sets. The is the big 12 x 8 folder that comes with the geared flight. This propeller can be purchased separately and is part for mounting on the Astro Flight cobalt-geared 05 parts. It also comes standard with the Airtronics Eclipse w

Master Airscrew also has an 8-inch feathering propeller with pitch that can be adjusted from 8 to 40 degrees at the mid. fig. 8-15. This propeller should be used with a direct give system. Its big advantage is that you can finely adjust the propeller to provide your plane with the maximum permance that you can obtain from your direct drive system. When the motor turns off, this propeller feathers and mean't fold. The blades remain where they stop but they with on their axes so little drag is experienced. This is the way real airplanes decrease their drag when gliding.

To get the most performance from your electric sailplane, with the manufacturer's recommendations unless you at an altitude higher than 3,000 to 4,000 thousand feet. In the altitude increases, there is less air to be pushed back the propeller so less thrust will be developed. In these meanings, start with a larger propeller.

For example, one electric glider I fly comes with an 8 x 4 propeller; and I fly at more than 6,000 feet in Colorado Springs. My test flight using this propeller resulted in a concolled flight into the ground at about 20 yards from my launch point. The motor sounded great but the electric saiplane had hardly any thrust. After trying several larger propellers, I found that a 9 x 7 propeller turned the apparancy underpowered plane into a good climber.

I discovered this size by trial and error. First I changed size of the propeller in pitch and went to an 8 x 6 and an 8 x 7 propeller. These both resulted in only a minimal climb at best but was certainly better than no climb at After these runs, I felt the battery pack and the motor; if they become hot during a run you'll know you have too much propeller on your ship. The additional drag of a large propeller will cause the motor to draw more current and heat Also with a propeller that is too large, the battery pack will discharge faster, which accounts for its heat buildup.

Try a larger propeller if these components remain cool to warm. At some point your climb performance will reach its maximum and the adding of a larger propeller will lead to a decreased climb and a warm or hot motor battery. Back off the propeller that you used before this last trial and you have your best choice.

When using the Master Airscrew adjustable propeller, simply change the pitch setting with each run until you find the optimum performance. Be sure to allow the motor and



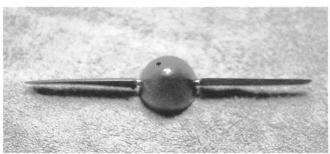


Fig. 8-15. This is the Master Airscrew self-feathering adjustable pitch propeller. The actual pitch of this eight-inch propeller is easily adjusted using an allen wrench. When the motor stops, the blades turn on their axes and feather cuts down on the overall drag.

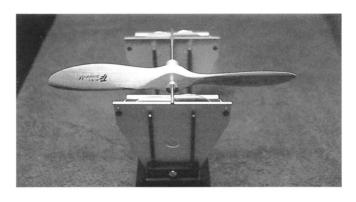


Fig. 8-16. This apparatus can balance any propeller. A balanced propeller greatly reduces the vibration and increases the thrust.

battery to cool down between runs and never run the motor with the best propeller on the bench. When the plane is not flying, the properly sized propeller will have additional drag on it, which can cause the motor and battery to overheat. The motor's armatures and brushes may become damaged if they get too hot. If you must check your system on the ground, run it for only a short time or use a smaller propeller.

Finally, a propeller out of balance can cause lots of vibration, resulting in airframe damage as well as radio interference and damage over time. Also when a propeller is out of balance, the motor can't achieve its highest rpm, fig. 8-16.

Your local hobby shop should sell many devices to help you balance your propeller. Mount your propeller on the balancer and see which blade drops down; this obviously is the heavy blade. Now, using a finer grade of sandpaper, sand this blade on the top side. Follow the contour of the blade so you don't change its shape. Sand a little at a time and recheck the balance frequently. Once the propeller doesn't move in, it is ready for use.

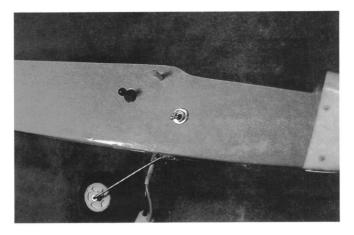


Fig. 9-1. The Electra features a harness that includes an on/off toggle that can be mounted externally. The disadvantages of this is that you have no in flight ability to control the motor and your motor battery's life can be greatly shortened. This switch can be internally mounted to a third servo to provide for motor control.

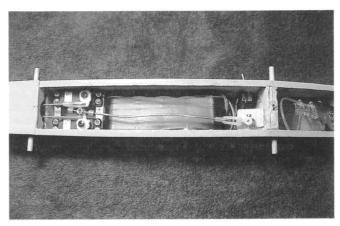


Fig. 9-2. The elevator servo can be connected to a toggle switch using linkages as shown above. Full down elevator control turns the switch on and full up control turns the switch off.

9

Controlling an Electric Motor

Several methods can be used to control an electric motor. The simplest involves a toggle switch on the outside of the electric glider to turn the motor on and off. Once the motor is turned on, it will continue to run until the battery is discharged. As you'll learn in Chapter 10, total discharging can damage your batteries and decrease their life.

As a result, I recommend that you use a type of motor control that will allow you to intermittently turn your motor on and off at will. With this, you'll be able to turn your motor off when you are high enough to thermal. This let's you save your battery power for another climb to altitude during the same flight and not damage your batteries in the process.

There are many ways to accomplish this goal, some inexpensive and requiring only a little time to set up properly using various linkages. Other, more elaborate systems, are more expensive. These speed controls can have any combination of on/off capability, BEC (Battery Eliminator Circuitry), built-in brakes, and others, including total proportional control. Read this section before you decide what method to use in your electric plane.

Fig. 9-3. Using a third servo as shown above, on/off control can be easily achieved. This is the method used in the Eclipse by Airtronics.

Simple Switches

Most electric planes I recommend come with a single on/off switch installed in a wiring harness. If not, refer to page 63 for instructions on making a harness.

The most common switch is the simple toggle switch as seen in the Electra and the Eclipse models, fig 9-1. I don't recommend using the switch externally for on/off control for reasons previously stated. There are several ways to mount these switches internally.

To save weight, more experienced modelers will connect these switches to existing servos. The elevator servo is typically used. A separate linkage that connects to an internally mounted toggle switch can work fairly well if used by an experienced pilot because some flight maneuvers are needed to activate the switch with the elevator servo, fig. 9-2.

Down control should turn the switch on, and up control should turn the switch off. When you land, you must apply up elevator for rounding out and flaring. If up control turned the switch on you wouldn't be able to land. The linkages

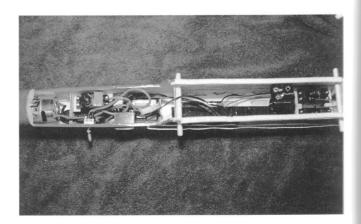
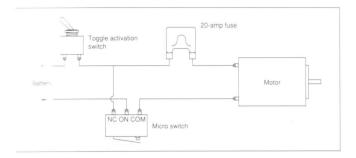


Fig. 9-4. A third servo mounted behind the motor in this Spectra is connected to a micro switch on top for on/off control. Note the externally mounted activation switch for added safety.



9-5. This schematic shows how to make a wiring harness amg a micro switch. The extra wire that connects the negative to the NC lead provides for a closed loop from the motor to when the switch is off. Dynamic braking is the result.

Fig. 9-6. The Airtronic's Eclipse kit comes with the above gear reduced drive unit. The supplied harness has a toggle on/off switch, fuse connecter, fuse, and battery connector.

should be set up so full down is on and full up is off.

When you've set up the proper linkage and direction, well need to know how to use this setup. The toggle switch should be off before you turn on your radio. Next make sure controls are properly working and that the propeller area is clear; give full down control to turn the motor on and the up control to make sure it goes off.

Now turn on the motor, launch, and climb like you normally would. When you are at altitude and are ready to stop motor, you'll have to execute a modified loop. Keep the mags level while the plane is still climbing. Gradually feed up elevator so the plane is almost going straight up. Then it almost stops, go to full up control to stop the motor. The plane will fall over onto the back side of a loop. Gently feed in enough up to level the plane without over-stressing the wings. Now you are gliding.

When you descend and wish to climb again, reactivate the motor at an altitude of 50 feet or greater. With the wings are gradually add up elevator as you did before. Watch as the plane climbs steeply and slows down. A few seconds before it stalls, give full down control abruptly and let the plane go back to a level altitude. Don't hold down elevator so that the plane goes into a high-speed dive.

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As you can see, this simple linkage installation of the elevator to a toggle switch requires fairly precise piloting skills. As a matter of safety, I would recommend that beginners are any of the following methods for motor activation astead. When you have more experience and confidence, you may find this method is reliable and gives a little added performance because of the lower overall weight.

Third Servo Activation

There are several ways to use an additional servo to activate an electric motor. A few of these methods are used in some of the models I recommend.

Toggle switch. In the Eclipse by Airtronics, the toggle switch is mounted to the back of a bulkhead, fig. 9-3. A servo mounted next to it so the wheel rests just below the

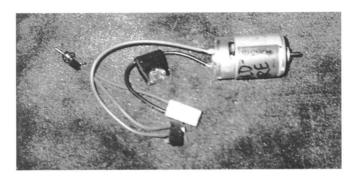
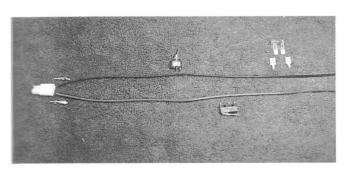


Fig. 9-7. The Spectra by Great Planes comes with the Goldfire direct-drive motor. The included harness has a fuse holder, fuse, toggle activation switch, micro switch, and battery connector. This is a great combination of components and is easy to install for third servo operation.

switch. Two screws are placed in the servo wheel and are tall enough to contact the switch. This servo is plugged into the throttle outlet on the receiver. The rotation of the servo is set up so that full throttle is on and idle is off. This method is easy to set up and use.

Activating switch. At this point I would like to emphasize the need for a system-activation switch in all electric models. This is an additional switch to the normal on/off switch. If your harness doesn't have one, add one. Buy a toggle switch at Radio Shack and solder it in any lead that goes directly to the motor. Before turning on your motor, make sure this switch is in the off position so the propeller won't accidentally jump to life when you turn on the radio when the servo or a gimbal is in the wrong position. Mount this toggle switch so its forward position is on and rearward is off. Now both this activating switch and the normal on/off switch must be on for the motor to turn on.

Micro switch. The next method for using a third servo



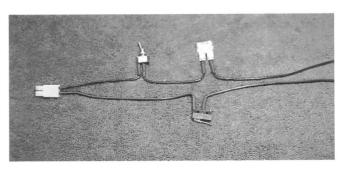


Fig. 9-8. A battery connector, two fuse connectors, and two switches can be easily soldered into two 11/2-foot long strands of 14-16 gauge wire to make a simple and safe wiring harness.

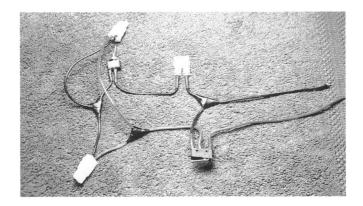


Fig. 9-9. This is what I call the ultimate harness. Two strands of $1^{1/2}$ -foot long wires have an activation toggle switch, micro switch with a dynamic brake wire, 20-amp fuse with soldered connectors, and a charging jack with battery connectors attached. This harness only took a little time and a few inexpensive parts to complete.

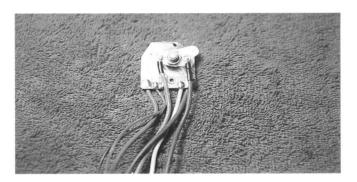


Fig. 9-10. This rheostat speed control came in an electric car kit. These controllers are bulky, fairly heavy, and heat up during use, meaning much useable energy is lost.

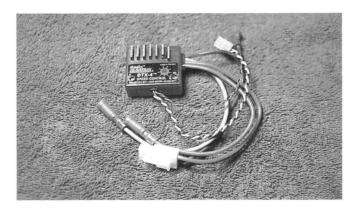


Fig. 9-11. This speed control can also be used in electric cars. It has BEC (Battery eliminator circuitry) and is capable of driving only one other servo. Don't use this type in sailplanes that typically use at least two or more servos.

involves a micro switch. It is available at Radio Shack and comes stock with Great Plane's Spectra kit, fig. 9-4. These switches have a small, bent, metal band. When it is pushed on, the other end of the band pushes a small button that causes the switch to activate. When the pressure is removed, the switch goes back to the off position.

Mounting this switch is easy. Place it on top of the servo so the servo arm can close the switch at one point. Simply mount the switch to the servo as shown using double-sided servo tape. An additional wrap or two of packaging or electrical tape can help to hold it in position. Now adjust the servo arm so it pushes the metal band when the throttle gimbal is at full throttle. The band should be released with a lower gimbal setting.

These are only a few examples for mounting toggle and micro switches to a third servo, and I'm sure you'll be able to adapt any of these to your plane. Be sure to have a toggle-activation switch mounted to the outside for added safety.

Braking. When you are using a folding propeller and an on/off switch is turned off, the motor can continue to turn, leaving the propeller extended. Additional drag is placed on the glider as long as the propeller is turning. You can install a simple brake in any of these simple motor wire harnesses that have a micro or three-way toggle-switch.

A motor that continues to turn because of the propeller actually generates a small amount of electricity, which we can use to stop the motor from moving when it is turned off. See fig. 9-5 for the wiring setup. The positive battery wire is connected to the ON or middle switch terminal. The positive motor wire is connected to the COM (common) terminal on the switch. Finally, the wire that causes the braking to occur is attached between the NC (normally closed) terminal and the negative wire.

If you are using a three-lead toggle switch, the setup is a little different. The positive motor lead needs to be attached to the central toggle lead. Connect the additional short negative motor lead to one of the outside switch leads. Finally, solder the positive battery wire to the last lead. When using the above two setups and either switch is on, the electricity flows from the battery, through the switch, and into the motor. When the switch is closed, a circuit from the motor gets completed through the switch itself, causing a closed loop. When the motor turns, the electricity it produces is fed back through itself. This current causes the motor to want to run backward, causing it to effectively brake and stop. If you are using a three-outlet toggle switch or micro switch, consider connecting it this way to add an inexpensive and effective brake.

Power harnesses. Most kits I recommend in this book come with power harnesses; some are shown in figs 9-6 thru 9-9. If your plane doesn't come with a power harness, you can easily make one with basic soldering tools, heat-shrink tubing, electrical tape, connectors, and two simple on/off two- or three-way electrical switches. Also, don't forget your choice of fuse harness.

Figure 9-5 shows the basic wiring for a power harness. The simplest harness has its leads soldered directly to the motor. Use servo connectors if you wish to easily change motors. You also need an appropriate connector on the battery lead so you can plug in your battery pack.

Use 14- to 16-gauge copper-stranded vinyl-insulated wire. Toggle and micro switches, sold at Radio Shack, come in various shapes and sizes. Remember to keep the weight down.

After you have all of the components and options for your harness, it's time to put it together. First cut two lengths of wire that will connect your motor and the battery. These should be approximately 1½-feet long. Next cut one of these wires where you want your switches to connect to. Strip ½-for insulation on all of these leads and tin them with solder. Solder all of these leads to the switches as shown. The red lead from the motor should connect to the common (COM) pole of the on/off switch you will be using. Connect the other end of the red wire to the ON lead of the switch, then connect the activation switch as shown. Attach your battery connector to the opposing ends of the battery leads.

At this point you can either solder the leads directly to the motor or use a connector. If you do this, you will have to solder short leads with a corresponding connector and to the motor. Now solder the fuse connector(s) into place and your harness is complete. Just make sure the polarity is correct when connecting the motor. If you use a three-way toggle switch or a micro switch, it's say to add a brake to your harness as just shown. Some modelers like the convenience of installing a charging jack their power harness, which can be done with any harness. Out two equal lengths of wire long enough to reach from the mounting surface of the plane to the battery leads. But the battery leads to about 1/4" without cutting the wire! Presolder these areas along with the ends of the charging make leads, then solder these ends onto the bared areas of the battery leads. Wrap the areas with electrical tape. Finally, attach the charging jack to the other ends of the new leads. Now you can charge your battery without removing it from your plane.

Speed Controls

Many speed controls are available today, mainly develued, used, and refined for model cars. The most basic rheotat types have been used for years in slot car racing, fig. 9-10. A wound bundle of wires is connected to one pole and a wiper arm to the other. When the arm contacts these wires, motor experiences varying amounts of resistance from the wires, and speed control from zero to full speed can be achieved. These units are typically large, heavy, and get hot.

Electric speed controls have been developed for cars and have been adapted for airplanes. These lightweight units can cost more than simple wiring harnesses and their accessories, but they have many advantages, fig. 9-11.

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I'll review an assortment of speed controls. The following brands are those I have used and trust.

Kyosho Auto Cut-off Relay with on/off motor control. This control comes complete and ready to hook up. All connectors to the battery (Kyosho) and the receiver (Futaba J or JR) are already installed, fig. 9-12.

A regular sliding on/off switch for turning the power on or off to this system is included. An additional push-button activation switch is standard and is easy to install. An infine fuse and harness is located in the red motor lead.

The entire unit is lightweight and will easily fit into an electric sailplane using double-sided servo tape. Any six- or seven-celled battery pack can be used. This system has BEC built in and will automatically shut down the motor at 4.2 volts, leaving you enough battery power to land your plane.

The motor control has an adjustable neutral trimmer that can be easily used to set your activating throttle position. You can only select full on or off with this unit, which makes it suitable for electric sailplanes. This Kyosho control is inexpensive, safe, and easy to use. Consider one for your next project.

Jomar Speed Control. Jomar Products is owned and operated by Joe Utasi, an electric enthusiast who has developed many great products for our sport, including speed controls. I'll describe two of these controls.

The Jomar on/off control. This inexpensive 1.2-ounce unit is perfect for most electric glider applications, fig. 9-13. It comes with battery and motor leads that you must add connectors to. A Futaba J receiver connector comes standard, but you can easily change it.

The unit features BEC so you don't need any receiver batteries. This alone already saves you weight, because most receiver batteries weigh more than this unit. The BEC is set up so when the battery runs low the motor automatically shuts off. When using two or three servos, you'll have about 20 minutes of radio time left before the battery becomes deeply discharged.

Although a built-in brake comes with this unit, the instructions tell you how to disable the BEC and the brake if you wish.

The unit plugs directly into the throttle portion on your receiver and gives direct on/off operation. The Jomar on/off control is intended for use in motors up to a standard 05 size. It is recommended that you use a 7- or 8-cell battery pack. This unit works well with a 6-cell pack, but the power

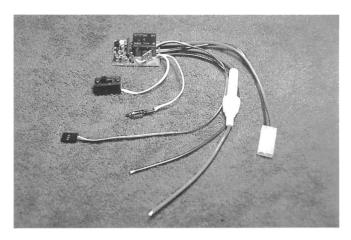


Fig. 9-12. The Kyosho on/off motor control with relay is light weight, inexpensive and comes with all of the necessary connectors

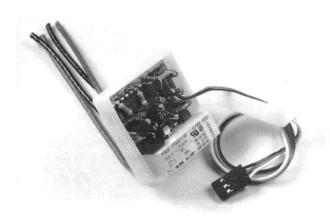


Fig. 9-13. This is Jomar's on/off control that weighs only 1.2 ounces. It features a Futaba J connector, BEC, and built-in braking circuit.



Fig. 9-14. This SM-4 Speed control by Jomar can be used with motors ranging from 05 to 40 in size. Full proportional throttle control is possible with this unit. Battery cell packs of seven to 21 can be used safely with this control.

left after the BEC turns on will significantly decrease your residual flying time. Add a separate activator switch to this system for extra safety. Consider buying this system for any of the standard 05-sized electric gliders. Its features, light weight, and economy make it a desirable speed control for the electric glider pilot.

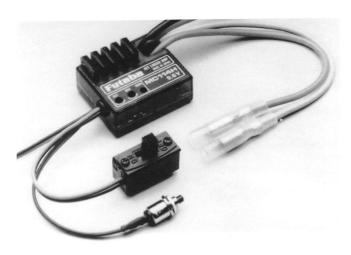
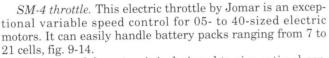


Fig. 9-15. The MC114H speed control by Futaba is designed for electric airplanes and helicopters. A safety activation switch and connectors come stock with this unit. BEC and full proportional throttle control are features of this wonderful light weight unit.



This state-of-the-art unit is designed to give optimal performance with only minimal power loss. A Futaba J and four servo connectors come pre-wired to the system.

This speed control is mounted to an aluminum heat sink and weighs only 1.5 ounces. Two adjustable pots for a neutral adjust and sensitivity setting are included. As with other speed controls, add an activator switch.

If you want a lightweight speed control that's adaptable to many motor and battery sizes, consider buying the SM-4 speed control.

Futaba. Futaba makes a variety of speed controls. In the radio section (Chapter 3), I already covered the 4NBL attack radio with the receiver/speed control combination. To review, this unit incorporates BEC and full proportional

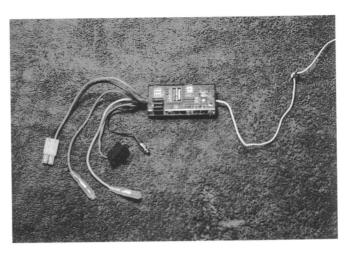


Fig. 9-16 The Futaba MCR-4A receiver/speed control unit was presented in the radio chapter. The speed control has BEC and full proportional throttle control. An activation switch and connectors are included.

speed control, suitable for any model presented in this book. The wiring harness also includes an externally mounted activating switch for added safety.

Futaba MC114H Speed Control. This speed control is designed for electric airplanes and helicopters, fig. 9-15. It weighs 1.66 ounces and has a J-type connector. This unit is perfect for any 05-sized motors and 7- to 8-cell battery packs.

BEC is included and up to 20 minutes of reserve flight time is available after the motor is cut off. This unit comes with all necessary connectors and even has the same arming switch featured with the MCR-4A receiver/speed control, fig. 9-16. Mount it outside your fuselage. When your battery is plugged in and the radio is turned on, press this button and the motor is ready to run.

This moderately priced unit is essentially ready to run out of the box. It is small, light, and will work well in almost any electric glider application.



Fig. 10-1. Reliable batteries will keep you smiling like this young pilot enjoying a day at the flying field.

All About Batteries and Chargers

The use and care of nicad batteries is probably the most complicated subject you need to learn about to safely fly electric gliders. Let's discuss it step by step.

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The battery was invented by Volta and was called the voltaic cell. Later, Faraday and others refined batteries to finally produce stronger, lighter and more efficient cells.

Plante produced the first rechargeable battery in 1859. This battery is still used today and is known as the lead-acid type. Alkaline storage batteries were developed soon after.

Finally, Jugner developed the nickel cadmium battery. Refinements to his design over the next several years finally led to the development of the modern nicad battery. In 1962, Sanyo developed the Cadnica brand which featured a fully sealed battery able to be used many times without any need for servicing. Thanks to Pat Takeda at Sanyo, most of the information as well as some of the technical illustrations in this chapter were drawn from the Cadnica Engineering Handbook.

Recent advances in this field have produced many types and sizes of cells. You can now match nicad battery packs to a certain type of motor and prop unit. The low internal resistance of certain cell types enables modelers to fast charge battery packs at the field in only 15 to 30 minutes. This feature also lets you discharge the cells at a higher rate without damaging them, so power output over time can be high. Finally, the cost savings related to being able to charge and discharge these batteries for well over 500 cycles is easily realized.

How Nicads Work

Although there are many sizes of batteries with varied

capacities and abilities, their internal structures are almost all the same. Figure 10-2 shows what a nicad cell looks like inside. Sheets of thin plates are rolled and then placed next to each other inside the cell. These rolls are compactly placed next to each other to increase the cell's efficiency. Also found inside are the positive and negative electrodes. A solution called electrolyte bathes the plates and helps the chemical reaction resulting in electrical production to occur.

At the top of the battery a resealable vent is used to dissipate any harmful pressures that may result from overcharging. A positive button is found on the top of the battery and a negatively charged nickel-plated steel case surrounds the remainder of the battery.

Nicad Life Expectancies

As mentioned, nicad batteries can last for well over 500 charge/discharge cycles if they are well cared for, fig. 10-3. Two types of battery failures can occur, one when there is a loss of electrolyte, and the other when an internal short or short-circuiting develops.

Under normal circumstances, electrolyte cannot leak out because nicads are sealed. Electrolyte can only exit a cell through its vent or if the seal is ruptured. The most common cause of the venting of electrolyte comes from over-charging a battery. After the battery is fully charged, continued charging causes a temperature increase. Gas inside the cell builds up from the heated electrolyte and at a critical point is released through the vent on top. This also may occur if you use the batteries when it's extremely hot or with extreme discharging. Repeated losses of electrolyte leads to the early retirement of nicad batteries, fig. 10-4.



Fig. 10-8. The Pro Tech 700 charger

cables into the unit backward. Most of these have a warning light and some may actually inhibit the use of the charger until the polarity is corrected.

Along these same lines, many units will only stay on a trickle charge rate and cannot be used for fast charging if the battery source is underpowered. For example, if you've charged several batteries on your car battery during a flying session and its voltage drops too low, special circuiting in the charger will not permit the faster charge rate from engaging until you recharge the car battery.

A few of the better battery chargers also let you charge more than one battery at a time. Others give you a large capability to charge many battery pack sizes. Everything from six-cell standard packs to over 18-cell packs can be charged with only one unit.

Many new chargers include a cycling feature. After hooking up your battery, simply turn the cycler on by pushing a button or flipping a switch. The charger then discharges your pack to the appropriate voltage level without allowing the cells to go to the damaging reversed state.

Safety and special considerations. Even though the high technology of some of these chargers may lead you to believe that everything involved with safely charging your cells is automatic, there are a few things you must remember.

Heat is your battery's biggest enemy. In general, battery heat reflects motor heat. I'll discuss this later in the motor section. To be brief, if after running your motor you find the battery is hot, let it cool down before recharging it. Once it cools to around body temperature, it's OK to charge it up again. If it's too hot and you put it on a fast charge, it may explode, causing serious injury including burns.

This same problem can arise if you charge battery packs with too much amperage. For example, if you take a standard radio receiver battery rated at 500 mah and fast charge it at 4 amps, you're flirting with disaster. Stick to the accepted charging rates and equations for the appropriate types of cells mentioned in this chapter.

If you have to store your batteries, discharge them and keep them in a cool place. When you're ready to use them again, you may need to cycle them one to three times to get them back to their maximum capacities. Check them intermittently for white dust around the terminals, a sign of cell venting; this can clue you in to the possibility of a battery that needs to be replaced.

Be sure to turn off the engine when using a car battery for charging. Most alternators generate more voltage than your charger may be rated for and can cause damage. If during a flying session your car battery's voltage becomes too low, disconnect your charger before starting your car. After the car battery is fully charged, stop your engine, reconnect



Fig. 10-9. The Pre Tech 706 charger

your charger, and continue as before.

There are a few additional items you need to know about battery care. If you decide to build battery packs, avoid combining different brands, types, and ages of ni-cads together. Also, never short circuit a cell because of the intense heat that may result. Never disassemble or break a nicad battery apart because the strong alkaline electrolyte can cause a serious chemical burn. Finally, never expose a nicad to an open flame because it can explode.

To summarize, when you buy a charger, read the manufacturer's instructions completely. Familiarize yourself with your charger's features and warnings. Avoid over-charging your battery packs. Also, be sure your packs are not hot before or even during the charging process. Damage to your cells and explosions resulting in personal or property damage must be avoided at all costs. Safe and fun flying can result from following these simple rules.

Charger Brands

Many good chargers are available at hobby shops and I'm not going to attempt to name all of them. I will, however, mention a few select chargers that I am more familiar with and that I can easily recommend for the beginner to intermediate electric pilot.

Pro-Tech. The Pro-tech line has been around for years and is the choice of many electric car racers. Pro-Tech has a large line of chargers with variable features; I'll discuss the 700, 702, and 706 models.

Model 702. This is one of Pro-tech's lowest-priced units but it has many features that you can use.

First, it can be run on AC or DC current. A cigarette lighter plug and standard electric wall plug are included. The unit has a switch that you use to determine the proper charge rate for a six- or seven-cell battery pack. An ampmeter in the upper left lets you monitor your battery's condition while the unit is charging your cells.

A 15-minute manual timer is located on the lower right face. After the timer has expired, the charge rate automatically goes to the trickle rate and an indicator light comes on Jacks on the lower left allow you to plug in a voltmeter to manually peak your cells during a charge. Finally, the unit has a charge/discharge switch so you can manually cycle your batteries.

Model 700. The next level of charger, it is a bit more expensive, but has all of the 702's features plus a few added benefits, fig. 10-8. It is a manual charger with a timer, and a current-adjust knob. A large LCD meter on the upper left face allows you to follow the amperage used during charging. You can monitor the digital voltage of your battery pack in hundredths by flipping a small switch. These two extra attributes can give you the manual ability to accurately

charge all standard six- and seven-cell SCE and SCR

Model 706. For only a few dollars more, you can purse this auto-peak charger with all of the 700's features more, fig. 10-9. First, it is a true auto-peak charger. For the peak charging voltage is reached and the voltage unutely drops, the fast rate is immediately discontinued the trickle rate begins. Special lights tell you when the state is a polarity reversal with your DC source input. Four car battery is low, the unit will not let you perform a charge. Finally, the unit will allow you to trickle charge pack and to fast or trickle charge another pack at the state.

Hobbico 930 charger. The 930, a new charger distributed by Hobbico, has many wonderful features and is easy to fig. 10-10.

First, it's an auto-peak charger that can handle from four- to seven-cell packs. This unit comes with connecting week with alligator clips that you attach to a 12-volt batteries. Also included are a charging jack for Kyosho batteries and an adaptor for Tamiya batteries.

The 930 has a large LCD readout that indicates charging emperage, battery voltage, and electrical source voltage. Two small LEDs are included, one for when the batteries being fast or trickle charged and the other for when the emperage switch is selected.

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ore ded ad a left argack xtra tely The charging rate can be adjusted between 0 and 5 amps. A 1-amp fuse is installed and a replacement fuse comes with the charger.

The 930 charger is easy to use: Simply attach it to your power source (car battery) and your nicad battery pack

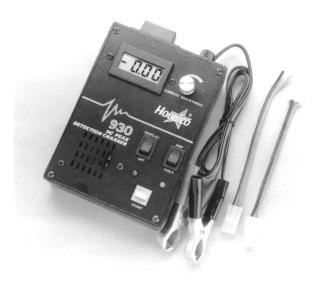


Fig. 10-10. Hobbico's 930 D/C charger.

using the appropriate connector. Activate the start switch and set the charging rate using the adjustment knob.

When the voltage of your pack has peaked, the fast-charging rate is automatically discontinued and a trickle charge begins. At this point, the charging LED will change from a steady red to a flashing red.

The reasonable priced Hobbico 930 charger comes with a one-year warranty.



Fig. 11-1. The Electra. This model by Carl Goldberg Models is basically an electric-powered Gentle Lady. The deluxe kit comes complete with an electric motor and power harness.

Choosing An Electric Glider

You need to consider many factors before buying your first electric glider, all of which are presented at the beginning of Chapter 2.

Take into account proven design performance, stability, durability, and kit completeness. I've reviewed most of the popular models on the market and I have flown all of the following models so I can recommend each one.

Read over the descriptions and attributes to choose the model that is right for you. Again, seek help at your local club and hobby shop if you need it. Also read the chapter on special building techniques to help you with your project.

Electra

The Electra is a Carl Goldberg Models two-meter electric sailplane, fig. 11-1. Put simply, it's an electric-powered Gentle Lady.

This all-wood kit builds essentially the same as the Gentle Lady. A detailed instruction manual guides any beginner to success using photographs for every small step.

The Electra comes with an electric motor and fused wiring harness. Mount the electric on/off switch inside and connect it to a servo as recommended in the motor control section. Of course, an electric speed control can be used instead.

The Electra is well designed. Access to the battery compartment makes it easy to replace a drained pack with a freshly charged pack. When you're comfortable flying this model, replace the motor with a Master Airscrew Flight Pack for a better climb performance.

Flying the Electra is almost as easy as flying its sailplane counterpart. Once you are at altitude, you'll find this model thermals well. In fact, I have almost lost mine on two separate occasions due to strong thermals. Because of the additional weight of the electric motor, propeller, and battery, the Electra flies faster than the Gentle Lady.

The Electra is an economical and easy-to-fly electric glider, great for any beginner.

Spectra

The Spectra, by Great Planes, is the electric conversion of that company's popular Spirit sailplane, fig. 11-2. The Spectra is a two-meter electric glider that requires at least a three-channel radio.

The kit is all wood and has the same construction techniques as the Spirit. The manual provides step-by-step instructions with informative pictures for easy building.

This deluxe kit comes with a powerful direct-drive Goldfire motor. The wiring harness includes a fuse, arming switch, and an activator switch. This is where the third servo is used. The instructions detail the process used to mount this switch to a servo, providing you with an easy way to control the motor without using a more expensive and possibly heavier motor control.

Access to the battery compartment is through the rear of the canopy. Vent holes are also provided in the canopy and at the front of the fuselage.

The Spectra is easy to fly and flies faster than its lighter sailplane counterpart. It responds well to elevator and rudder inputs. The Spectra also thermals well. The instructions recommend mounting a cobalt motor for increased performance. It would be difficult to modify the fuselage to accept a gear-driven motor.

Electrosoar MK III

The Electrosoar, an ARF electric glider produced by Royal-Air, basically is an electrified version of the Royal-Air Easysoar III, fig. 11-3.

As with the Easysoar, the Electrosoar is made of built-up balsa and hardwood parts covered with a beautiful heat-shrink plastic. The instruction book is the same for both planes and details pertaining to the electric conversion are contained in the appropriate places. The only modification I'd recommend is to see if your battery pack fits well before mounting the wheel. I had to build mine without the wheel to fit the battery. The Electrosoar comes with an electric motor, wiring harness, and folding propeller with the appropriate collet and attachments.

The wiring harness comes with a battery connector and on/off switch. The model is designed to have the switch mounted externally for operation, but mount it internally as described in the motor control chapter or use a BEC motor control unit instead. Later, you may want to upgrade your

sem to include a cobalt or a gear-driven unit for greater sormance.

The Electrosoar is a relatively inexpensive ARF electric moder that is easy to build and fly, great for any entry-level

Stratus 2000

The Stratus 2000 is an ARF electric glider available from sho, fig. 11-4. It has a 2-meter wingspan and requires at three channels for operation.

The wing panels are pre-built with wood and come covered with a heat-shrink plastic. These panels are easily med. The fuselage is durable plastic, while the tail section pre-built and simply bolts onto the fuselage.

Also included are a hardware package, an instruction manual, powerful Le Mans electric motor, folding propeller, and colorful decals.

The wiring harness easily connects to the motor. A fuse is salled along with connectors that are used to attach it to speed control. Radio installation is easy because of the sounting platforms and hardware included.

Flying the Stratus 2000 is easy. The high-lift polyhedral provides a reliable amount of stability. Most beginners enjoy the Stratus.

Wind Cruiser II

The Wind Cruiser, an ARF electric glider manufactured Hitec and distributed in the U.S, comes preassembled, meluding built-up wing panels that are already covered with meat shrink plastic, fig. 11-5. The fuselage is a durable, hard plastic and has a powerful direct-drive Mabuchi electric motor and folding propeller installed.

Assembly of this kit is easy and is directed by brief but emplete instructions. The wing panels need to be joined, and wing and stabilizer tips need to be glued to their respective places. The tail pieces easily bolt on to the rear of the fixelage. The hardware package includes all of the needed inkages, pushrods, and wing hold-down dowels.

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The already installed motor and servo mounts are set up readily accept Hitec's radio and speed control; any other adio and speed control can be used with little to no modifications. Install a fuse within this system.

You'll find that flying the Wind Cruiser is almost as easy building it. The flat-bottom polyhedral wing provides for a lot of lift as well as stability. The powerful motor/propeller combination will give you two to three climbs to thermal attitudes using most standard 6 or 7-cell battery packs.

The Wind Cruiser should be a consideration for any beginning to intermediate modeler who wants an electric glider that's easy-to-finish and fly.

Eclipse

Airtronics Inc. manufacturers the Eclipse electric sailplane, fig. 11-6. This glider is typical of Airtronics kits in high quality and completeness.

Construction is fairly simple because of the design. The ming is a polyhedral and semi-symmetrical. The wing has three parts or panels. The two outer panels simply plug into the main center section and are held in place by electrical tape that's wrapped around the seams.

Features that really caught my interest were the geardriven electric motor and Master Airscrew folding propeller. This power pack efficiently produces a large amount of thrust. With a standard 6- or 7-cell battery pack, two to three climbs to thermalling altitudes is possible.

The wiring harness comes with a fuse and an on/off switch. The instructions detail how a third servo can be used to control this on/off switch internally. No speed control is mecessary, but can be added.

Because of the semisymmetrical wing, this model flies faster than a similarly sized flat-bottom-winged model. The Eclipse is stable and really doesn't exhibit any bad flying

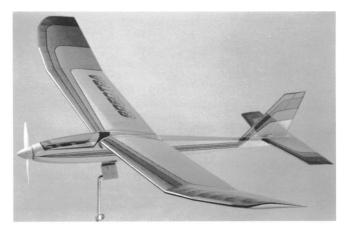


Fig. 11-2. The Great Plane's Spectra. This kit comes with an electric motor and elaborate power harness. It thermals well.



Fig. 11-3. The Royal Electrosoar MK III. This ARF kit is reasonably priced and ideally suited for any beginner.



Fig. 11-4. The Kyosho Stratus 2000. A beautiful ARF model, this plane comes with a powerful Le Mans motor



Fig. 11-5. The Wind Cruiser II by Hitec. Another ARF model, this plane is easy to finish and just as easy to fly.



Fig. 11-6. The Eclipse by Airtronics. This high-quality deluxe, all-wood kit comes with a gear-driven motor and large folding propeller for fantastic performance.

tendencies, so I'd recommend it to any beginning to intermediate modeler.

Soarus

The Soarus, an ARF electric-powered sailplane by Kyosho, is a good beginning to intermediate sailplane and gives a little higher performance than other ARF electric gliders, fig. 11-7.

It has a built-up wing covered with bright yellow film. The fuselage is made of a durable yellow plastic. Many colorful decals also are included.

The Soarus comes either with rudder and elevator or with ailerons and elevator. I prefer the aileron version myself because it has more aerobatic capabilities. After quietly climbing on thermals, some fast aerobatics really change the pace and your mood. This version of the Soarus can give you the best of both worlds in one neat package.

The kit comes with an electric motor, wiring harness, and a 7 x 3 folding propeller. All of the hardware is included, so you'll only need a battery, charger, and radio. Assembly is easy and quick. No experience is needed thanks to the well-engineered parts and the thorough instruction book.

Flying the Soarus is easy also. Its flight speeds are higher than a typical thermal ship, but if you can fly slower planes well, you should have no problem with this sailplane. To install the battery remove the canopy and slip it in. The battery compartment will easily accommodate any 6- or 7-cell battery pack.

Mini Challenger

Astro Flight's Mini Challenger electric-powered glider has a 60-inch wingspan and requires three channels, fig. 11-8. This plane is featured in two separate kits. The basic kit has all the necessary wood and hardware; the deluxe kit has all the basic kit contents along with a powerful Astro Cobalt 035 motor and a folding propeller.

Assembly is fairly simple, with full-size plans and instructions using pictures. You'll need to add a speed control and wiring harness with a fuse.



Fig. 11-8. Astro Flight's Mini-Challenger. A smaller ship, this model climbs like a tiger when using an Astro-Flight 035 motor.



Fig. 11-7. The Soarus by Kyosho. An ARF sailplane, this model comes in two versions. The type that features ailerons adds aerobatics to your thermal hunting.

Flying the Mini Challenger is pure fun. Because this glider is so light and the motor is so powerful, you can climb to extreme altitudes in less than one minute. One 5-celled 900-mah battery pack can provide enough energy to make these climbs two to four times.

This plane is good thermaller and has a nice glide because of its flat-bottom wing design. Due to its smaller wingspan, the Mini Challenger is maneuverable and responsive to control inputs. Because of its smaller size and higher wing loading, it flies faster than most two-meter-sized electric gliders.

If you are a beginning to intermediate flier and want something smaller but exciting in its overall performance try the Mini-Challenger.

Impulse

The Impulse, produced by Jarel Aircraft Designs, is a sailplane that performs well in many roles, fig. 11-9. Designed for the beginning to intermediate flier, it has many outstanding characteristics.

This model can be set up to slope soar, thermal, or as I have chosen, to be converted to electric power. The instruction manual describes how to build both configurations in detail. You should buy this model only after you have mastered flying with a more conventional type of electric or thermal sailplane.

The wings are made of balsa-covered foam cores that have wash-out built in. The fuselage is made of a stronglight plastic called Crash Guard. The company will replace any fuselage that has been damaged for \$10 when returned in its original box.

The Impulse has a V-tail and what is referred to as pod and boom fuselage. Each of these characteristics gives the Impulse low drag and an exciting-looking design. Construction is straightforward even though you've probably never built a plane that uses an aluminum pipe for part of the fuselage.

In all, this plane has an exciting, futuristic design, it's fully aerobatic, and it's capable of electric and thermal flight.



Fig. 11-9. The Impulse by Jarel Aircraft Designs. This is a highperformance electric sailplane suitable for beginners.



Fig. 12-1. Some people enjoy building their airplanes as much as flying them. Following the few special building tips I provide in this chapter will help you produce a better performing sailplane.

12 Building Tips and Techniques

In this chapter I'll present several special building methods that will make your sailplane or electric glider more efficient. All of the kits come with detailed instructions to help a beginner complete a plane. The areas that I will cover may repeat points covered in most of these instructions; some other items may be presented in only a few kit instructions booklets, but may be important. Take time to read this section before building your first plane. You may pick up a few points that will help with your immediate project and with any planes you may build later.

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Workbench

Before starting to build your new kit, you need to set up a well-lighted and ventilated work area. You will be using epoxies, paints, and other chemicals that have noxious odors that can cause harm with continued breathing. Many modelers build in their garage or basement. If you don't have a lot of windows or a garage door to open, install an exhaust fan or plan to do most of your gluing and painting outside.

You'll need a work bench. Everything from a pre-made expensive workbench to an old door placed across a couple of sawhorses works well if the workbench is straight and flat. Planes built on warped tables have warps and do not even come close to flying well.

If your shop is not already equipped with good lighting, there are several things you can do, including installing track lighting to having a couple of clamp-lights. I have one 4-foot long fluorescent lamp hung over my table, fig. 12-2. I also have a goose-neck lamp with a flexible neck at the other

end; this lamp is good for looking down fuselages and other areas that are hard to reach and light.

Tools

Many tools are available to RC modelers, but stick with the basics if you are just starting out, fig. 12-3. If you're not careful, you could easily end up with a thousand dollars or more worth of equipment!

You will need to buy only a few measuring tools to ensure straight warp-free building. A metal yardstick can help you

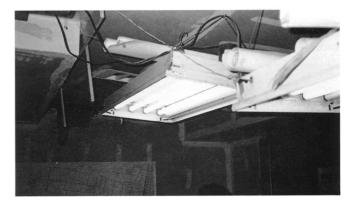


Fig. 12-2. Fluorescent lights are readily available and easy to set up, and they provide all the illumination you'll need.

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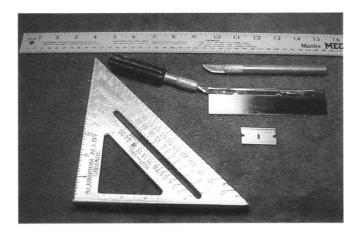


Fig. 12-3. These are a few of the assorted tools that you will need to build an airplane (from top): metal rule, square, modeling knife, X-Acto saw, and single-edged razor blade.

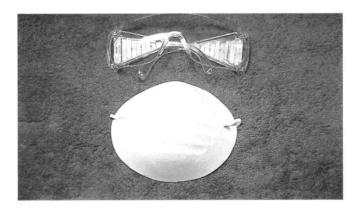


Fig. 12-4. Protective goggles and sanding masks are cheap protection against potential injuries.



Fig. 12-5. Many grades of CA glues are available for a variety of uses. Accelerators (left) can be used to instantaneously cure CA glues.



to cut true, straight edges on everything including wood, foam, and covering. Next, you 'll need a foot-long metal square to help you measure smaller parts and to check the alignment of tail surfaces and other areas.

To cut and shape various parts, you will need these basic tools. Single-edge razor blades are inexpensive but can be used to cut small wooden parts and covering material. An X-Acto knife with No. 11 blades also can serve this purpose. An X-Acto razor saw can be used to cut larger pieces of wood and hardwoods.

You can buy a small, single-speed electric hand drill for a few dollars at most variety stores; also buy a drill bit pack with common sizes. If you have a larger expense account, a Dremel tool with all the attachments is nice but certainly not necessary. Attachments can include everything from drill bits to sanders and routers in several shapes and sizes.

A sanding block will help you properly shape leading edges, sand wing panel ends flat, and perform many other tasks. Your block should measure at least 1-foot long by 3- to 4-inches wide. Several commercially made sanding blocks are available. Be sure to buy at least three different grades of sandpaper. These can be used on your sanding block and can be held in your hand for small work.

Now that you are ready to drill, shape, and sand wood. metal, and plastic parts, you need to think about safety. Wear safety goggles whenever you use a drill or any other high-speed power tools. Also wear a sanding mask when sanding any parts. This protective equipment costs little, is easy to use, and can help prevent serious problems, fig. 12-4.

Use a small hammer and T pins to help position your parts over the plans. To prevent your parts from being glued to the plans and the table, use a piece of waxed paper; one roll will last for several building projects. Masking tape is good for holding parts together as well as its primary importance in painting. Rubber bands and clothespins make effective modeling clamps and extra hands while gluing.

Speaking of glues, choosing the correct types can be difficult. Let's start with epoxies. Any standard five-minute twopart epoxy will work in most instances; occasionally you'll need a slower-curing 30-minute epoxy.

A few clean white foam coffee cups are great containers for mixing up these epoxies. A simple, long slender piece of wood can be used to mix the two parts together.

Cyanoacrylate glue (CA) basically replaced the slow-drying white glues of the past, fig. 12-5. It comes in a variety of thicknesses and brands; you'll need a medium-viscosity glue for building gliders.

Also buy a CA accelerator such as Zip-kicker. Once the glue is applied, simply spray the area and it will cure almost immediately. These glues provide extremely strong and light joints, so just barely coat the surface to be joined unless it is a larger area like a reinforcing bulkhead. This joint will be stronger than the wood itself. Excess glue just adds more weight and doesn't appreciably increase the joint's strength.

When using epoxy, CA glues, and even the accelerator sprays be sure to have proper ventilation. Everything from aggravating allergic reactions to serious dizziness and headaches can result if you're not careful. CA glues also are notorious for causing modelers to glue their fingers together or even to planes. De-bonders that usually contain acetone should be kept handy just in case!

An assortment of screwdrivers and pliers is useful. You can buy a small set of jeweler's screwdrivers at a minimal cost at Radio Shack and other variety stores. Also purchase a set of needle-nose and regular slip-jaw pliers.

Fig. 12-6. These tools can be used to make the job of covering your model easier. They are available at hobby shops. This heat sealing tool (left) is used to tack the monokote covering down. The heat gun (right) is used to shrink the covering down to remove wrinkles.



Fig. 12-7. The proper use of CA glues. First apply the thick CA glue to the wood surface. Next, position the part in its proper place. Then, spray the area with the accelerator and the glue will quickly cure.

The last items you will need are used to attach the heatshrink covering to your model, fig. 12-6. If you're on a tight budget and you have a lot of strength and endurance you can use an old electric iron. After about 10 minutes, you'll wearn for a smaller heating iron sold in hobby shops. The temperature is easy to set and the iron's special shape helps you seal the covering material in a variety of areas. Once the overing is tacked down, it will need to be shrunk tight with a heat gun. It looks a lot like a hair dryer, but don't use it on your hair! It gets hotter than a standard blow dryer and can interally burn your hair. Be careful using both of these tems; they can cause serious burns and start fires. Follow the manufacturer's instructions closely.

Building Techniques

Now that your workshop is ready to use, open your kit and read the instructions. Identify all of the parts and get a general idea where they all go. Don't modify anything in the kit: these are all proven designs that build easily and fly well. The following recommendations focus on a few aspects that may or may not be covered in your instructions. These important points should be followed when applicable to ensure you build a safe and successful model.

Strength. Your model's strength depends upon many factors. Some like the model's design and pre-formed parts, are beyond your control. However, you can control the quality of the wood in the kit, types of glues, and gluing techniques.

Inspect your kit closely. Although all kits presented here are of the highest quality, you'll occasionally find a defect: a piece may be broken, warped, or even missing. If you glue an imperfect part into a model it's difficult to remedy the problems it may cause. Simply replace the part by ordering it from the manufacturer or your hobby shop. Many parts can also be made with minimum effort.

When you know all the parts are present and undamaged, begin building the plane according to the instructions. As I mentioned earlier, use a medium-viscosity CA glue in most instances, fig. 12-7. First, put the two surfaces together, such as a wing rib and spar, and make sure there is no gap between them. Place a small amount of glue where the two surfaces meet and let it soak in. Spray it with a small amount of accelerator and let it cure. In seconds, you have a strong, gapless, lightweight joint. Taking care with each joint will give you a sturdy airplane that has gained minimal added weight from the glue itself. Remember that it's the lighter of two airplanes that stays aloft the longest.

Most beginners think that using lighter materials, cutting holes in various parts, and other lightening ideas will improve their plane's performance. This may be true for the first few flights, until the wings fold together on a hi start launch after modifying the ribs or the spar. This also is evident when an electric motor pulls away from the lighter balsa wood fire wall that was installed in the hopes of decreasing the plane's weight. My point is that you shouldn't use lighter materials that have inferior strength in exchange for the hardwood or thicker balsa parts that come in your kit.

So how can you save weight while preserving the strength of your plane? Along with good gluing techniques, I have a couple of other helpful hints. Buy lightweight material to cover your model. Econokote is durable, lightweight, and irons on at a lower heat than usual. Several brands of covering film are available in bright colors, including fluorescent. Check with your hobby shop to determine which is the best for your purposes. You can also make light, resilient, and efficient hinges.

Look at fig. 12-8 showing how to cover a horizontal stabilizer and its elevator. Position the monokote, stabilizer, elevator, and ½32"-thick spacer as shown. Seal the monokote to these surfaces and remove the spacer. Now flop the elevator down, cover the top of the assembly, and seal it all down.

You can use this technique on all hinged surfaces. When hinging ailerons, it may be easier to use strips of monokote after completely covering the wing and ailerons separately. Using a spacer as before, line up the parts as shown and cover these areas with a monokote strip large enough to attach to at least ½ of each surface. Fold the aileron down to its proper alignment with the wing and seal another monokote strip down over the top.

When you're finished, check the surfaces for easy and unbinding movement. You'll discover that the gap between these surfaces is small and that the hinge is strong and difficult to damage.

Alignment. I've seen many airplanes fly poorly after being built by an inexperienced modeler. The builders claim to have followed all of the instructions closely. The model may even be covered with a beautiful pattern. However, even after changing the balance, varying the control throws, and other attempts, the model just doesn't fly well. When I'm given such a plane to troubleshoot, I first I look at the alignment of the major portions of the airplane.

The fuselage, wings, and tail feathers should be free of any warps or twists. As I talked about earlier, if you build on a straight and flat table, all of these parts should be straight and without warps. When covering these parts, warps can be accidentally put in by uneven heating of the two sides of any airplane parts. Check for this carefully whenever covering your plane.

After covering, you are ready to join the parts. When attaching the tail feathers, make sure the parts are properly aligned with the fuselage. Usually the horizontal stabilizer is attached first. Make sure the fuselage platform where the

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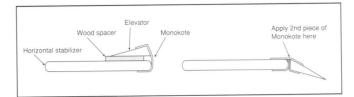


Fig. 12-8. To make monokote hinges, apply a strip of monokote up and around the two surfaces with a small wood spacer as shown. Next, extend the surface and flex it downward. Then, apply another strip over the top and seal it down. You now have a light, strong, and efficient hinge.

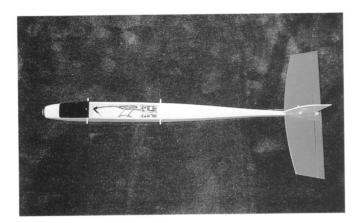


Fig. 12-9. When aligning the horizontal stablizer, make sure that the distances between both stabilizer tips and the nose are the same. The tips should also be the same distance above the flat surface that the fuselage is resting on. Now glue it into this position.

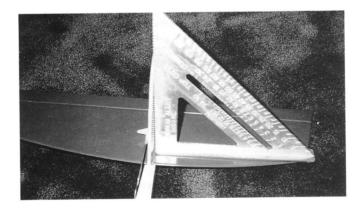
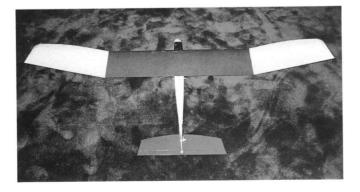


Fig. 12-10. When gluing the vertical stablizer into place, use a machinist's square to make sure that it is perpendicular to the horizontal stablizer. Repeat this process when gluing these two surfaces together.



stabilizer is attached is flat and parallel to the bottom of the fuselage, fig. 12-9. The stabilizer tips should be the same distance off your flat work area.

Check to see that the leading edges of the stabilizer tips are exactly the same distance from the nose. Use a metal yardstick or string with markings to set the proper alignment. When all of this is done, the stabilizer is properly positioned. Take a pen or pencil and trace the position of the fuselage into the stabilizer. Remove the covering material from the center section of the stabilizer and glue it into place using five-minute epoxy. Check these alignments once more while it is curing.

Now that the horizontal stabilizer is properly positioned, let's attach the vertical stabilizer, fig. 12-10. First draw a line down the center of the longitudinal or lengthwise axis over the horizontal stabilizer. Use a machinist square to make sure the bottom of the vertical stabilizer is perfectly flat. After you remove the covering where the vertical stabilizer is to be glued, use more five-minute epoxy to join the two. While this is curing, use the square to make sure the vertical stabilizer is attached perfectly vertically. You may want to use a few straight pins to hold it in place.

After this, the only thing left to align is the wing, fig. 12-11. Mark the center line on the front and rear of the fuselage saddle areas and loosely mount the wing in place. With the fuselage sitting flat on your bench, measure the wing tip distances on both sides. They should be the same. If not lightly sand the higher side of the fuselage wing saddle until they match

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Now check for proper horizontal alignment. Take the straightedge or another piece of string and check for equal distances between the leading edge of the horizontal stabilizer tips and the trailing edges of the wing tips. Once this is established, make corresponding marks on the wings across from the previous centering lines on the fuselage saddle areas. This will ensure that the wing is properly aligned each time you assemble your plane. Taking these simple steps will help you build an airplane that flies straight with a minimum of drag.

Balance. Balance is critical when building any airplane. All kits show the CG (center of gravity) of the plane on the plans or it is described as being a certain distance behind the leading edge of a wing. Follow these CG recommendations as closely as possible.

An airplane with its CG too far forward has a steep glide angle and needs a lot of up elevator to land. It also flies much faster than it should. A plane with its CG too far back usually crashes soon after launching. It becomes overly sensitive to control inputs and is unstable. In fact, a plane in this condition usually stalls easily at high speeds and may even enter a spin that is impossible to recover from. Given this information, you can see why it is so important to make sure the CG is correct.

First make sure that the wing balances laterally, which you can easily do before you cover it. Balance the wing at its center line. Sand the heavier wing tip or add weight to the lighter tip until you achieve the proper balance. After covering the wing, check it once more and correct the balance in necessary by pushing small wire brads into the lighter wing tip.

When you're ready to mount all of the radio and electronic equipment in your fuselage be acutely aware of the balance. Mark the CG location on the fuselage sides, test fit all of your equipment in the recommended areas, and check the balance. Move the respective components around until the

Fig. 12-11. Aligning the wing is easy. First, make sure the tips are equal distances above the floor. Now, position the wing so the trailing edge of the tips are equal distances from the leading edges of the horizontal stablizer's tips. Then, make marks on the wing and fuselage.

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Fig. 12-12. This simple device can be purchased or easily made to check your model's balance.

proper balance is achieved. Now mark all of these locations with a pencil.

Mount all components as recommended. Using Velcro to mount the receiver and any battery packs makes it easy to slightly change the CG later if it is needed.

Once these steps are taken, mount the wing to the fuseand check the overall balance. If a CG range is given on the plans, make sure that the actual CG is toward the forard portion of the recommended range for your first fights. Now it is time to test glide your new sailplane. Refer the instructions in Chapter 4 to properly adjust your trim and balance.

Battery cooling. The motor battery in an electric glider can generate a lot of heat. If it gets too hot, damage and decreased battery life can result. Proper battery cooling in your plane is easy to achieve.

Most of the models presented in this book include cooling vents or recommendations for making vents, fig. 12-13. Make sure these vents are cut out and free of obstructions. If your model does not include vents, you'll need to make some. Air should enter toward the front of the battery and exit behind or below it. These vents do not need to be larger than 1/2" in diameter. If they are cut out of plywood areas, the vents should not compromise your model's structural integrity to any great degree. If the vents are cut out of balsa parts, consider replacing these parts with plywood or provide a thin plywood reinforcement around the vent and the

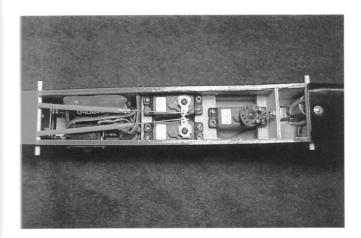


Fig. 12-14. Even though the push rods are not parallel to the servo sides, the servo arms are perpendicular to them at the neutral positions. This gives each push rod an equal amount of throw in both directions.

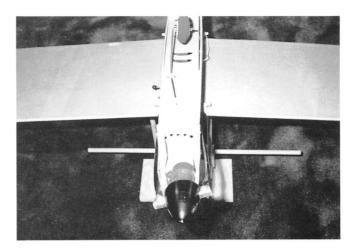


Fig. 12-13. This Electra has intake holes just above the motor. The battery cover has holes in it also (by the wheel). Between these two sets of vents, proper cooling of the motor and battery can take place.

adjacent area to increase the strength.

Another common problem is to use foam around battery packs. A lot of this foam padding use comes from engine-powered planes and the need to cushion everything from coarse engine vibrations. Avoid using foam in areas where ventilation is supposed to flow and cool the batteries — it simply is not necessary in electric planes.

Servo setup. Servos should be installed as shown on your plans. Turn on your radio system and make sure your trim tabs and gimbals are neutralized. The servo arms should be perpendicular to the control linkages to ensure equal throw in both directions, fig. 12-14. If they are not correct, remove the central screw, pull off the arm, put it in the correct position, and replace the screw.

Connect the control linkages to the arms and check for the recommended amount of surface throw.

You can correct surface throw that is too great in one of two ways, fig. 12-15. You can move the linkage on the servo arm to a hole closer to the center screw, or you can decrease the throw by moving the linkage attachment on the surface horn farther from the surface. If one of these maneuvers doesn't give you enough correction, try both. Continue making these changes until you find the proper amount of throw.

If you don't have enough surface travel, just the opposite changes can be made. Move the control on the servo arm far-

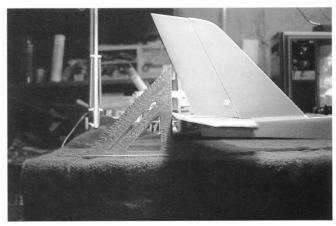


Fig. 12-15. A ruler or machinist square can be used to measure available surface throw. Note how it is used to measure the elevator's throw above.

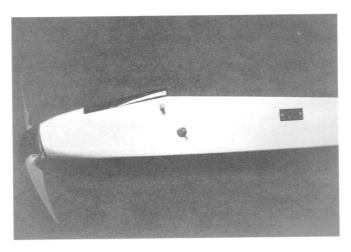
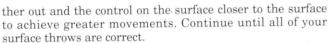


Fig. 12-16. The external switches should be set up so that the forward position is on and rearward is off. Both of these switches are off.



Finally, make sure all servos move freely without binding. If the servos buzz in any position, you need to check a few things. A bound-up servo can drain a battery quickly and decrease your flying time drastically.

Make sure your surfaces move freely and that the hinges don't bind. Next, check your control linkages and make sure they aren't binding up against a bulkhead, exit hole, or each other. When you find the problem, correct it and then make sure the servo is free in all positions.

Switch position. We need to consider two types of switches: radio and electric motor.

Switch problems can occur during launching or on landings, fig. 12-16. When launching your plane, you may accidentally turn off a switch and have terrible results. Similar-

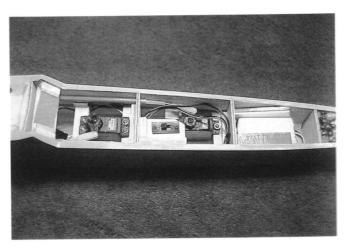


Fig. 12-17. This is a view of inside the Spirit 100's canopy. Notice how the radio switch is mounted inside. Inadvertent switch movement is virtually eliminated.

ly, while landing a switch may be held in an on position; this is okay for the radio, but it can cause your electric motor to burn up if it has no fuse. If it does have a fuse, this may blow the fuse and you'll need to go through the trouble and expense of replacing it.

Each problem can be prevented by mounting these switches properly, with the on positions forward. This way if your hand slips forward while launching, both switches will be pushed in the on direction. When landing, any obstruction on the ground can push the switches, especially the larger motor-control toggle switches, back into the off position.

When possible, mount these switches far forward on the fuselage out of the area that your hand may contact. In addition, if you have an easily removable canopy mount the radio switch inside so you can't accidentally turn it off during the launching, fig. 12-17.

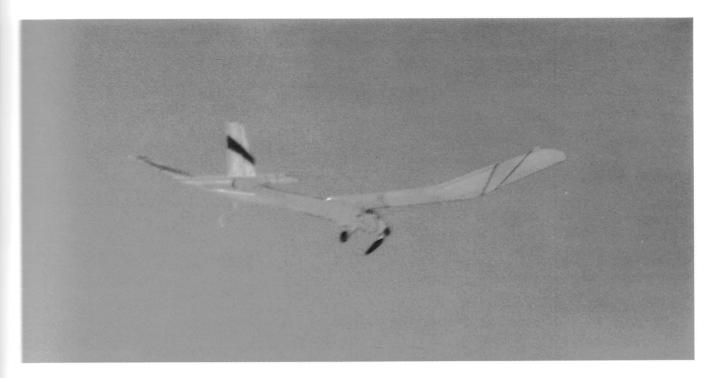


Fig. 13-1. T his Electra's motor has just been turned off and the large folding propeller is starting to fold back against the fuselage. Decreased drag and longer flights result from this.

13 Flying Electric Gliders

Flying an electric glider is like flying a combination sailplane/engine-powered plane. When the glider is at altitude, you can fly it exactly like you would fly a sailplane. Thermal soaring or even slope soaring is easy. When using the electric motor to climb, your glider essentially flies and responds like a powered airplane.

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Read my previous book, *Beginner's Guide to Safe and Easy RC Flying*, to learn all of the intricacies of flying with power. Most of the information in this book pertains to flying electric gliders.

Now it's time to talk about additional aspects of flying electric gliders including launching, trim changes, and other launch methods. Before flying your first electric glider, ask an experienced instructor for assistance. If you already have experience flying other models, simply adhere to the recommendations in my other book and the following.

The Toss

Launching your electric glider is easy. Make sure your radio system is on and properly operating. Have someone





Fig. 13-2. The first few launches should be performed using a helper. With experience, you will be able to launch your plane by yourself. After the motor and radio checks out, start your motor, and then firmly throw your plane into the wind with the wings level.

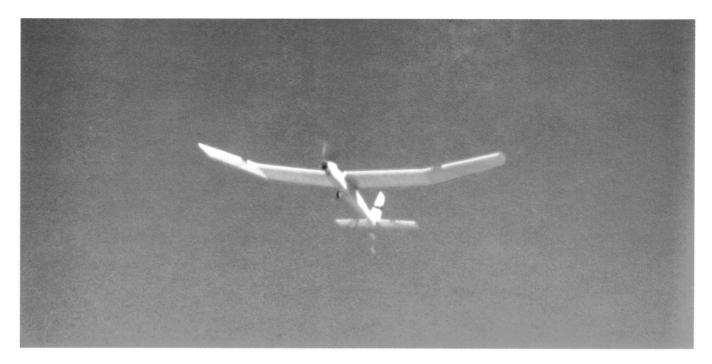


Fig. 13-3. As the plane climbs, the trims should be set to allow the plane to gain altitude straight ahead with good control. Don't bank more than 20 degrees at any time so no altitude is lost.

help you for the first few launches. This helper should hold the model around the center of gravity and face into the wind. Start the motor and make sure it is working properly. Next, signal your helper to run. After a little speed is built up, the model should be thrown wings level and straight ahead into the wind, fig. 13-2.

The model should start climbing immediately. Using the trim tabs, set the model on a shallow climb straight ahead. Make gentle turns, being sure not to bank the wings more than 20 degrees, fig. 13-3.

At Altitude

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When the model is at a high enough altitude (400-800 feet), it is time to turn off the motor, fig. 13-4. When you do. you'll notice a bit of trim change. Now use the trims to achieve a straight, flat glide, and go searching for thermals. Your ship is now a sailplane and should be flown exactly as described in Chapter 5. When your plane descends and is about to land, start your motor and climb again. You can do this as long as your motor battery holds out. Landings even-

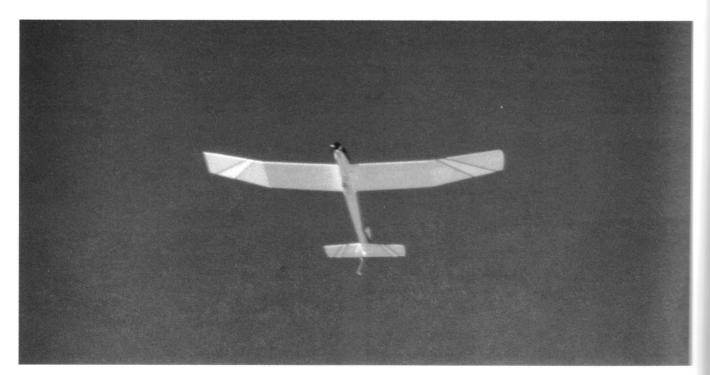
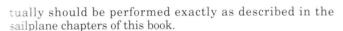


Fig. 13-4. When your plane is at the proper altitude, shut off the motor. Now trim the plane so it flies straight with only a minimum of descent. Notice that the propeller is motionless and folded back along the fuselage sides.



Fig. 13-5. Electric sailplanes can be easily launched using a histart. If one is already available such as at a soaring club, use this method to save battery power for extended flights.



Hi Start Use

If you have access to a hi start, you can simply launch your electric glider just as you would a regular sailplane, fig. 13-5. Once you have released it, fly around for thermals as before or, if you wish, start up the motor and get even more altitude! When others are flying their sailplanes and using a hi start, I sometimes use this method to gain my first bit of altitude and save battery power. When you have experience with your electric glider, consider trying a hi start for an added advantage.

Slope Soaring

as

You can easily use your electric glider for slope soaring, fig. 13-6. Often I've gone slope soaring and the wind has died down, causing me to land on the slope or at the bottom of it. When flying an electric on a slope and the wind dies, simply start the motor and climb for a safe landing on top of the slope

You also could use the motor for an initial climb above the slope when you're not sure you have enough wind to keep you aloft. This is easier than stringing out a short hi start as with conventional sailplanes.

Finally, imagine going out to your slope-soaring site and discovering there's no wind at all! The sun is shining and you know thermals are out there. No problem! Charge up your motor battery and go!

Electric power can provide you with a lot of quiet, clean fun in a variety of conditions. Its versatility is worth the extra effort of learning about its minimal intricacies. I hope you have as much fun flying as I have.



Fig. 13-6. Electric gliders are ideal for using at slope soaring sites. If there is little or no wind, you can still have a lot of fun!

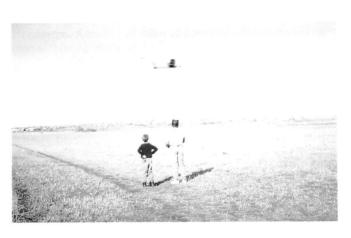




Fig. 13-7. After a little instruction, this 10-year-old boy successfully flew his first RC electric glider.

Glossary

Activating switch. An external switch that prevents the electric motor from accidentally turning on.

Adverse yaw. In an aileron-equipped plane, the nose of the plane may yaw away from a banked turn because of the drag of the aileron that deflects downward.

Aerodynamics. Science of air in motion.

Ailerons. Surfaces located to the rear of the wing's trailing edge that cause the airplane to roll.

Airfoil. Cross section of a wing from front to back.

AM (amplitude modulation). A type of radio modulation that causes the waves to get larger or smaller.

Angle of attack. Angle formed by the cord line and the relative wind.

Auto-peak. Usually refers to a type of battery charger that automatically shuts off when a battery has been fully charged.

Ballast. Additional weight in a sailplane to help it penetrate higher winds.

Ballooning. Rising of an airplane due to the aerodynamic forces that usually occur on landing.

Base leg. Part of the landing pattern flown before turning to the final approach. Throttle reduction usually occurs on this leg.

Battery cycling. The repeated charge/discharge cycles used to erase battery memory.

Battery memory. Refers to a battery's inability to take on a full charge because of insufficient discharging before recharging.

BEC (battery eliminator circuitry). Refers to many of the new speed controls that allow the radio and motor to be run on the motor battery alone.

Bernoulli's principle. As a fluid moves faster, it exerts less pressure. This is the basic principle that is involved with the generation of lift.

Capacity. The amount of charge or electricity a battery can hold

Center of Gravity (CG). Balancing point of an airplane.

Channels. 1. Can be used to designate a frequency such as channel 50. 2. May refer to the number of functions that a radio has — i.e. a seven-channel radio.

Charge cord. Connects a nicad battery to a 12-volt battery for charging.

Climb out. Process of gaining altitude quickly.

Control stick. Gimbal or lever on the transmitter.

Conventional landing gear. Consists of two main wheels and a tail wheel. This also is known as tail dragger.

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Critical angle of attack. Angle of attack at which smooth airflow over the top of the wing stops.

Cross wind. Wind that is blowing in a direction other than the longitudinal axis of an airplane.

Crosswind leg. Portion of the landing pattern between the upwind and downwind legs.

Cumulus clouds. Tall clouds that build up over areas of strong thermal lift and moisture.

Dead-stick. Term used to describe an airplane after its engine has quit.

Downwind leg. Portion of the pattern where the airplane is flying with the wind.

Drag. Property that results in slowing down an airplane. There are two types of drag: parasitic and induced.

Dual rates. Function found on certain transmitters that varies the amount of servo travel with gimbal deflection.

Electrolyte. A caustic fluid found in batteries.

Elevator. Tail surface that causes the airplane to pitch up or down when deflected.

Empennage. Combination of all the tail surfaces, including the horizontal and vertical stabilizers, rudder, and elevator.

Fast charging. A rate of charge between 2 to 4 C.

Final approach. Portion of the landing pattern between the base leg and landing.

Flaps. Surfaces on the wing that when deflected down cause increased drag and lift for slower flight. Some flaps may reflex up for faster flight.

Flare. Final amount of up elevator given immediately before landing.

Flat-bottom airfoil. High-lift airfoil found on most trainer planes and gliders.

FM (**frequency modulation**). Refers to radio waves being changed by the frequency only; the amount of waves per unit time.

Full-size airplane. A real airplane.

Fuse. A device installed in a harness that breaks the circuit in cases of an overload, thus protecting your motor.

Fuselage. Body or main portion of the airplane that all other airplane components are attached to.

Gimbal. Control stick of a transmitter.

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Ground effect. Reflection of air off a hard surface that is located within one wingspan length above the runway. Increased lift and reduced drag result when the airplane flies in this area.

Ground speed. Apparent speed that an airplane has as it flies over the ground.

Harness. A device consisting of wires, switches, and a fuse that connects the motor to the battery.

Heading. Direction of the nose of the airplane.

Head wind. Wind that comes from the front of the plane. A slower ground speed is the result of flying in to a head wind.

Horizontal stabilizer. Part of the airplane that the elevator is attached to.

Induced drag. Drag produced as a result of lift. Induced drag increases as lift increases.

Leading edge. Front edge of a wing or stabilizer.

Lean. When referring to mixture, less fuel-to-air ratio, which causes the engine to heat up and occasionally quit.

Lift. Force generated by a wing as it moves through the air, resulting in the airplane rising against gravity.

Linkages. Connections between movable surfaces, carburetor, or ground steering and corresponding servos.

Longitudinal axis. A line that passes through the center of the fuselage from nose to tail.

Matched battery packs. Each cell in the pack is matched to each other according to their charge and discharge characteristics.

Methylalcohol. Main component of model airplane fuels.

Mixture. Ratio of fuel to air in model engine carburetors.

Nicad (nickel cadium) battery. The most popular rechargeable battery used for radio control purposes.

Nitromethane. Volatile ingredient of model airplane fuels that provides extra power.

Overcontrolling. Common response of novice when flying radio control airplanes. This results from moving the transmitter gimbals farther than needed to maintain adequate airplane control.

Overnight charging. Charging at a rate of c/10.

Parasitic drag. Drag that results from resistance imposed by nonaerodynamic surfaces.

PCM (pulse code modulation). The most sophisticated method of altering a frequency to protect an RC model from recognizing and using other unauthorized radio signals.

Peak charger. Chargers that automatically shut off after a voltage rise and drop is recognized in the charging batteries.

Piggybacking. A method of launching a sailplane attached above a tug or larger-powered plane.

Pit. Area of flying field where all the pilots keep their airplanes and equipment when not flying.

Pitch. 1. Degree of nose up or nose down from level to the horizon. 2. Amount of twist of a propeller blade.

Pressure. Amount of force exerted by a medium (in this case air) on an opposing body.

Pulse. When using a winch, a pulse or intermittent use of the foot switch prevents overstressing the wings.

Quick charging. A rate of charge equal to c/3.

Range testing. A method used to test your radio's power projection before flight.

Receiver. Part of a radio system that collects and interprets the radio signals from the transmitter.

Relative wind. Direction that the air molecules strike the leading edge of a wing.

Rheostat. An older method of controlling an electric motor's speed that is inefficient and results in shorter run times and added power usage.

Rich. When dealing with mixtures, too much fuel-to-air ratio, resulting in less power.

Ridge lift. Lifting air that is generated by wind striking a hill.

Rocket-assist. A launch method that uses rocket power to carry a sailplane to altitude.

Roll. Effect of ailerons which causes the airplane to rotate around its longitudinal axis.

Rotation. Increase of the angle of attack on takeoff when up elevator is used, resulting in lift generation.

Round out. Maneuver that causes an airplane to level from a descent when only up elevator is applied. A loss of speed is the result.

Scale airplane. Model of a real airplane built to scale.

SCE. A type of battery with an increased capacity or endurance for its size.

SCR. A type of battery designed to release a lot of energy over a short period without being damaged.

Servo. Radio component that responds to the receiver's command, causing movement in a linkage that connects to a portion of the airplane.

Short. When dealing with nicad batteries, damage to the internal components from improper care can cause electricity to flow inside between normally isolated areas. This results in decreased battery performance.

Slip. Cross-control technique used when landing larger airplanes in a cross wind. It employs opposite rudder and aileron controls.

Speed control. A device used to control a motor's speed. Options include proportional control, BEC, and braking.

Spoilers. These surfaces are attached to the top of some wings and cause lift to be decreased because the airflow over the top becomes "spoiled." A rapid decrease in altitude usually results.

Spotter. Someone who stands with a flier and looks for conflicts with other modelers or airplanes.

Stability. Ability of an airplane to return to its original flight attitude

Stall. Loss of lift resulting from exceeding the critical angle of attack.

Surfaces. Another word used to describe aerodynamic parts, including empennage and ailerons.

Symmetrical. Usually refers to type of airfoil that has the same shape above and below the cord line.

Taxi. To drive the airplane on the ground.

Thermal. A body of rising hot air that can take sailplanes and gliders to great heights.

Thrust. Force generated by spinning propeller, which propels the airplane forward.

Timers. Many chargers have built-in timers to regulate the amount of charge delivered to a battery.

Towing. A method of launching a sailplane that uses a tug or powered plane to pull or tow a sailplane using a long line.

Trailing edge. Rear edge of a wing or stabilizer.

Transmitter. The part of the radio system held by the pilot. Radio waves are produced and transmitted by the transmitter.

Trickle charging. The slowest method of charging used to maintain a battery at its peak charge (c/50 to c/20).

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Tricycle. Landing apparatus that consists of two main gears and one nose gear that is usually steerable.

Trim tabs. Device on the transmitter used to adjust finely the servo's throw.

Tug. A term to describe a strong-powered plane that is used to tow or piggyback carry a sailplane to thermalling altitude.

Upwind leg. Part of the landing pattern flown over the runway.

Vent. A mechanism on a nicad battery used to release pressure (gas or electrolyte) when the battery gets too hot from charging or the surrounding area.

Vertical stabilizer. Part of the airplane the rudder is attached to.

Voltmeter. Measures the voltage of a battery. Some have an expanded scale so many different batteries can be measured with the same unit.

Weather-vaning effect. When a crosswind turns the nose of an airplane into the wind.

Weight. Downward force of an airplane resulting from the pull of gravity.

Winch. An electrically driven machine that is used to launch sailplanes.

Yaw. Effect or rudder control to turn the nose of the airplane left or right.

Manufacturers' Addresses

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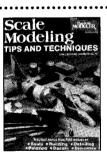
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