

BUILDING AND FLYING

RC Sailplanes and Electric Gliders

BY ROBERT T. MOTAZEDI

- ❖ **Getting started**
- ❖ **Buying the right plane and radio**

- ❖ **Building tips not found in kit instructions**
- ❖ **Flying techniques anyone can master**

About the Book

This book is a comprehensive guide to getting started in radio control sailplanes and electric gliders, one of the fastest growing facets of the radio control hobby. From the ground up, it explores in careful detail every stage of building and flying motorless and electric-powered radio control aircraft.

This book:

- Explains in easy-to-follow terms the aerodynamic forces that influence sailplane and glider flight, helping you understand why your plane does what it does once airborne
- Tells you what equipment you'll need to build and fly your planes
- Helps you choose the sailplane or electric glider that's best suited for you
- Provides no-nonsense tips for choosing radios—and motors, batteries, and chargers for electric gliders
- Includes special building techniques that will help you overcome the gaps in most kit instructions.
- Examines in depth sailplane launching, thermal flying, and slope soaring
- Describes in step-by-step detail how to fly electric gliders
- Includes a glossary and numerous illustrations, helping you put into practice what you learn in the book

Building and Flying RC Sailplanes and Electric Gliders will help make sure you build your sailplane or electric glider right the first time and it will help you fly your plane with confidence — and skill — your first flight and every one after that.



About the Author

A family practice physician in Colorado Springs, Bob Motazedi has flown just about every type of machine with wings or propellers, from full-size aircraft to gas-powered radio control planes to RC helicopters. He's been flying sailplanes and electric gliders for more than 25 years and teaching others how to for almost as long. Thousands of novices learned how to fly gas-powered radio control aircraft in his first book, *Beginner's Guide to Safe and Easy RC Flying*.

BUILDING AND FLYING

RC Sailplanes and Electric Gliders

RC PERFORMANCE SERIES NO. 12

BY ROBERT T. MOTAZEDI

KALMBACH  BOOKS

A special thanks to: Ray Cruz, John Killan, and Steve Cabbage for building several models for this book; Bob Day and his wonderful staff at Bob's World of Hobbies in Denver for their continued support; Anna Gosnel and my wife, Vicki, for the typing of this manuscript; the several manufacturers (listed at the end of this book) that supplied models and equipment for review; and finally to my family and friends for giving me the encouragement to pursue my dreams.

Cover design: Lawrence Luser
Book Design: Sabine Beaupre

© 1993 by Robert T. Motazedi. All rights reserved. This book may not be reproduced in part or in whole without permission from the publisher, except in the case of brief quotations used in reviews. Published by Kalmbach Publishing Co., 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187.

Library of Congress Cataloging-in-Publication Data

Motazedi, Robert T.
Building and flying RC sailplane and electric gliders / by Robert T. Motazedi.
p. cm. -- (RC performance series ; no. 12)
Includes index.
ISBN 0-89024-179-1
1. Gliders (Aeronautics)--Models--Radio control. 2. Airplanes--Models--Radio control. 3. Flight. I. Title. II. Series.
TL774 .M68 1993
796.1'5--dc20

93-28719
CIP

Contents

Preface	4
1. What You Need to Know About Aerodynamics	5
2. Choosing Your First Sailplane	14
3. Buying the Radio	20
4. Launch Methods	28
5. Thermal Flying	38
6. Slope Soaring	44
7. Introduction to Electric-Powered Gliders	53
8. All About Electric Motors and Power Systems	55
9. Controlling an Electric Motor	60
10. All About Batteries and Chargers	65
11. Choosing an Electric Glider	70
12. Building Tips and Techniques	73
13. Flying Electric Gliders	79
Glossary	82
Addresses	85
Index	86

Preface

Welcome to the wonderful world of silent flight. Radio control sailplanes have been around for many years and recently their popularity has increased. Many new and innovative sailplane designs have become available. In addition, various launch systems have been improved upon as well as created. Best of all, electric power has improved to the point where we can now keep these aircraft in the air longer and still retain the mystique of silent flight.

I have been flying and teaching others to fly radio control airplanes for more than 25 years. I also teach full-size airplane flying. I have developed special methods to help my students become safe and skillful pilots. After prompting from students, friends, and my family, I wrote *Beginner's Guide to Safe and Easy RC Flying* (Kalmbach 1992), as well as this book.

There are several advantages in learning to fly with sailplanes or electric gliders as opposed to the more conventional gas-powered airplanes. First, they are more economical. More costly equipment like fuel, electric starters, and many other items are not necessary for silent flight.

Sailplanes and electric gliders typically fly slower than gas models, which means they're safer. These slower planes give the novice more time to think and react when learning to fly. Also less space is required when flying sailplanes. A paved runway is not needed. An unoccupied field of soft grass measuring a quarter mile square is best.

Over the years, model manufacturers have improved the quality of their kits and designs. All the electric-related equipment and supportive supplies have been improved upon dramatically. These improvements include more efficient and powerful motors, batteries, and electric chargers. Electric speed controls originally designed for electric cars have been adapted for model aircraft. The increased popularity of electric-powered models is a result of these design improvements. This book covers all of these aspects in detail.

The first chapter discusses the basic theories of aerodynamics. The knowledge gained from learning about aerodynamics will help any student of model or full-size airplanes become a safe and competent pilot. Aerodynamics can be confusing, especially to the newcomer, so this subject is divided into easy-to-understand bits of information that make sense.

It has always been difficult for a novice pilot to choose his first sailplane. Many models are not suitable for the beginner. I'll discuss many good entry-level sailplanes in detail.

Radio control equipment will be covered next. After reading about several excellent systems it should be easier for you to decide which radio is best for your modeling needs.

Both thermal and slope soaring will be discussed in later

chapters. Also the various launch methods including hi starts, winches, glow-powered pods, towing, piggybacking and rocket-assist methods will be explained.

Finally, the last half of the book will be devoted exclusively to electric-powered gliders, which is the final method of launching gliders. Here, I present many excellent models acceptable for use by the novice pilot.

Many new electric motors are now available. I highlight every aspect of motors including efficiency, magnet types, ball bearings and geared-drives. And I present examples of several motors and drive systems. This discussion will include various propeller types and their peculiarities. The novice pilot should be aware of the different batteries, chargers, and speed controls that are available. Various batteries along with their special properties will be made clear to all. Peak-charging, cycling, balancing, and other topics related to charging will be discussed. After reading these sections, you will be able to make an intelligent purchase next time you visit your local hobby shop.

I also cover special building techniques. Several building methods will enhance any model you purchase. Achieving low overall weight while retaining strength and good alignment will be the goal. There are efficient ways to balance the airplane without adding weight. Special needs of the electric glider such as cooling accommodations and motor switch mounting will be covered too.

Special flying techniques of these models will be followed by safety issues, including proper model and equipment care, radio frequency considerations, club and open field safety, the American Model Association, other clubs, and personal safety.

While reading this book you'll encounter unfamiliar terms, so I've provided a glossary. Consult it as often as needed so that all points are clear before you go on to more complicated material.

Many people have attempted to teach themselves to fly models. This almost always results in a lot of frustration and expense, so students should seek the help of a qualified instructor. Referral sources include local clubs, hobby shops, and other modelers. Once you obtain a name or two, arrange to meet with them. Watch how they fly. Are they safe pilots? Do you like them? These are all very important considerations when it comes to choosing an instructor. Remember, you will use what you learn from your instructor and this book for as long as you remain in radio control modeling.

If you follow this beginner's guide, proper equipment selection and proficient piloting can be yours. A sense of confidence and safety awareness will automatically follow.

I hope all of you end up enjoying this wonderful hobby as much as I have.



Fig. 1-1. For you to get the most from a complex sailplane like this Spirit 100, you need a good understanding of aerodynamics. This chapter tells you everything you'll need to know.

1 What You Need to Know About Aerodynamics

No one should attempt to fly any kind of plane — including a radio control one — until they know at least the basics of aerodynamics. Pilots need to understand the forces that affect a plane in flight and for that reason I devote this chapter to explaining basic aerodynamics.

Aerodynamics as a whole can be complicated, so it is easier to understand the concepts when they are divided into separate components. Each component is then related to other aspects with which you're already familiar. In this way, you will truly be able to understand how a sailplane flies.

The Sailplane and Electric Glider

Most sailplanes consist of a fuselage, wing, and empennage (tail surfaces). In some instances, sailplanes also have ailerons and spoilers. Electric-powered sailplanes also have an electric motor and propeller, fig 1-6.

The fuselage or body is the main structure of the airplane and all other parts are attached to it. It also carries most of the radio components and linkages. The electric motor and propeller are usually found in the forward section of the fuselage.

Lift is generated because of the shape of the wings and how they affect the air that flows across them. I'll discuss this in more detail later in this chapter.

Electric motors provide a lot of thrust when turning a propeller. These motors are quieter than the conventional glow engines and operate efficiently, powered by a large rechargeable nickel cadmium battery.

The empennage or tail surfaces consist of four parts. The

parts directly connected to the fuselage are the vertical and horizontal stabilizers. The rudder and elevators are attached to them respectively.

The rudder causes the model to yaw or turn its nose one direction. In sailplanes, rudder application also results in a turn in that same direction (left rudder results in a left turn).

The elevator causes the nose of the model to pitch up or down. Up elevator causes the nose to raise in flight. Down elevator similarly causes the nose to pitch downward.

Ailerons are hinged to the back side or trailing edges of the wings. These surfaces are used to roll or turn the model. Most entry-level sailplanes do not have them, so the pilot uses the rudder for this purpose instead.

Some advanced sailplanes also have spoilers, small surfaces located on the tops of the wings that rotate when they are deployed. They disrupt the airflow over the wings and result in a loss of lift.

Flying Forces

A flying electric-powered sailplane has four forces acting on it: thrust, weight, drag, and lift, fig. 1-7. Varying any of these forces will cause a change in the plane's flight path. Let's discuss each factor in detail.

Thrust is fairly easy to understand. As the motor turns the propeller, air is forced backwards, creating thrust. This causes the airplane to be propelled forward.

Weight is the effect of gravity on a flying model. Gravity is constantly pulling the plane downward toward Earth.

Drag, as the name implies, is the resistance that the



Fig. 1-2. The Spectra, produced by Great Planes, is an electric-powered sailplane. Because of its electric motor and propeller, it has all four forces of flight exerted on it.

airplane must overcome to be propelled forward. Two types of drag affect airplanes.

With parasitic drag, as its name implies, any projection on the airplane that alters its shape, including microscopic pores on the covering, can slow the plane down, fig. 1-8. Other sources include the radio and motor switches, motor, and propeller. The drag produced by these increases as the airplane's speed increases.

Induced drag is a by-product of lift. As a wing develops

more total lift, some of that lift pulls the model rearward, causing it to slow down in its forward direction. As lift increases, the induced drag also increases (This will be shown later in fig. 1-14.)

Lift, the fourth force, is usually the most difficult to understand. Many years ago, a mathematician named Daniel Bernoulli discovered that the pressure of a moving fluid varied with its speed. For example, if a fluid is forced to move quickly through a tube, the pressure it exerts on



Fig. 1-3. This beautifully finished Sophisticated Lady by Goldberg Models features a T-tail. This allows the horizontal stabilizer and elevator to be up and out of the way of potential ground obstacles.



Fig. 1-4. An instructor is demonstrating the proper method for launching an electric-powered sailplane. Later in this book, you'll learn how you can launch a sailplane yourself.

the tube is less. Because of the shape of the wing, the air that flows over the top of the wing flows faster than the air that flows beneath it, fig. 1-9. This results in less pressure on the top of the wing and comparably more pressure below. The wing is then pushed upward by the higher pressure below.

To understand this better, let's look at what is occurring at the molecular or microscopic level. Molecules are constantly in motion and they are always bouncing off of

each other. The rate at which they bounce determines how much they push on their surrounding areas. This pushing process is called pressure, fig. 1-10.

If you put more molecules in a container with other molecules, you can see how more individual pushes will occur during a given time, increasing pressure. Another good example of this occurs when you blow up a balloon. An uninflated balloon has the same number of air molecules in it per area that the surrounding area has, fig. 1-11. When



Fig. 1-5. Marilyn, only four, has already flown several times with only minimal help. She's holding a Hawker by Cox Hobbies.

you blow up the balloon, you are forcing more molecules together into the space. You can quickly see that the pressure inside the balloon rises, causing it to expand.

Let's use these concepts to see how lift is generated from a wing. For this example, we will use a high lift airfoil or wing cross section. Most trainer planes use this type of airfoil, fig. 1-12. Now imagine using a piece of salt water taffy that is exactly the same size as the flat or lower surface of the airfoil. The molecules in this taffy are densely packed, representing higher pressure.

Now take the same piece of taffy and stretch it so it fits evenly across the top of the airfoil. At a microscopic level, the molecules are stretched farther apart. This is low pressure, right? If you're not sure, refer back to fig. 1-10.

Let's apply all of this to a sailplane, substituting taffy for air molecules, fig. 1-13. The same thing happens to the molecules of air that move across the airfoil's surface. Since they have farther to travel across the top, the molecules have to spread out, creating lower pressure on the upper surface. The relatively higher pressure below pushes the wing up. You can also see how the molecules of air have to speed up to travel that increased distance over the top, satisfying Bernoulli's principle.

These are the basics you need to know about the generation of lift. Note that some of this lift is directed rearward. This is the induced drag that occurs when lift is being produced, fig. 1-14.

Another important principle of lift development is related to speed. As the speed of the sailplane increases, the volume of air that flows across the wing per unit of time also increases. This results in more lift because of the increased pressure difference above and below the wing, fig. 1-15.

Basic Flight

Understanding the four forces of flight should help you comprehend what happens during various phases of basic flight. When there is no change in altitude or speed, you need to balance all four forces (refer to fig. 1-7). Lift must be just as strong as weight or gravity to prevent any change in altitude. Similarly, thrust must equally oppose the airplane's total drag to keep the forward speed constant. Using this information, let's discuss basic flight maneuvers.

Altitude changes. To get the electric sailplane to descend, you need to change the balance between lift and weight. Since increasing the weight in flight is difficult, you'll need to decrease the lift.

As mentioned, lift varies with the speed of the air that flows over the wings. To decrease lift, you must decrease the electric sailplane's speed, accomplished by stopping or slowing down the motor. When the thrust is decreased, the electric sailplane will slow down and lift will decrease. The model will then start descending, fig 1-16.

This is what occurs in a nonpowered sailplane with no thrust. Later I'll cover methods you can be use to counteract this constant descent. Conversely, to initiate a climb, the lift needs to increase. An increase in motor speed propels the model through the air quicker, causing an increase in lift. A climb is the result.

Once the airplane is established on the climb or descent, its airspeed is the same as when the airplane was straight and level. For example, if an airplane flying straight and level at 30 mph has its motor speed increased, the immediate increase in thrust transfers to a direct increase in lift, fig. 1-17). Once the airplane is established in a steady climb, the speed will again be 30 mph. Similarly, the same airplane in a descent after a reduction in throttle will have an airspeed of 30 mph.

This occurs in all airplanes that exhibit dynamic stability. I'll cover stability later in this chapter. The important concept here is that the motor speed ultimately controls the altitude of the model rather than the airspeed.

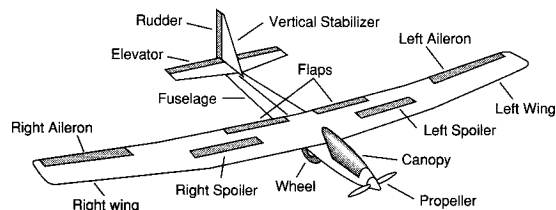


Fig. 1-6 BASIC AIRPLANE COMPONENTS

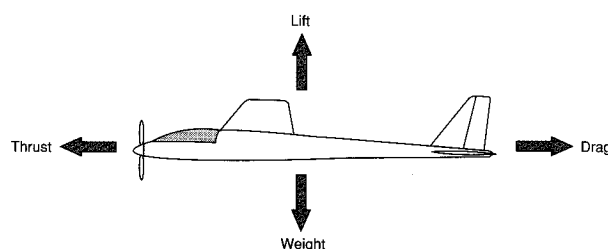


Fig. 1-7 RELATIONSHIP OF FORCES ACTING ON AN ELECTRIC GLIDER



Fig. 1-8 PARASITIC DRAG (Airguide Publications)

Can you spot the major source of parasitic drag above?

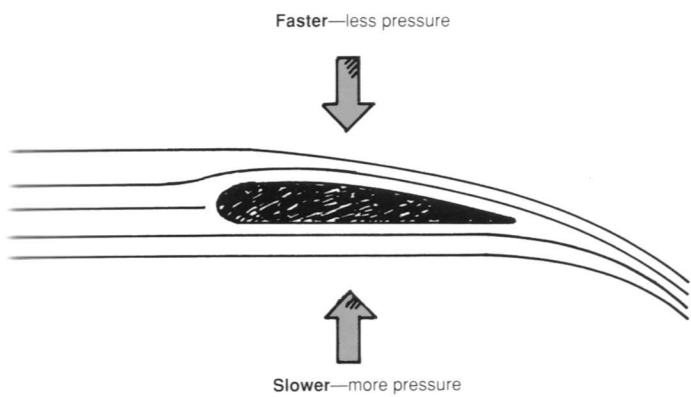


Fig. 1-9 FORCES CREATING LIFT AS AIRFOIL MOVES THROUGH THE AIR

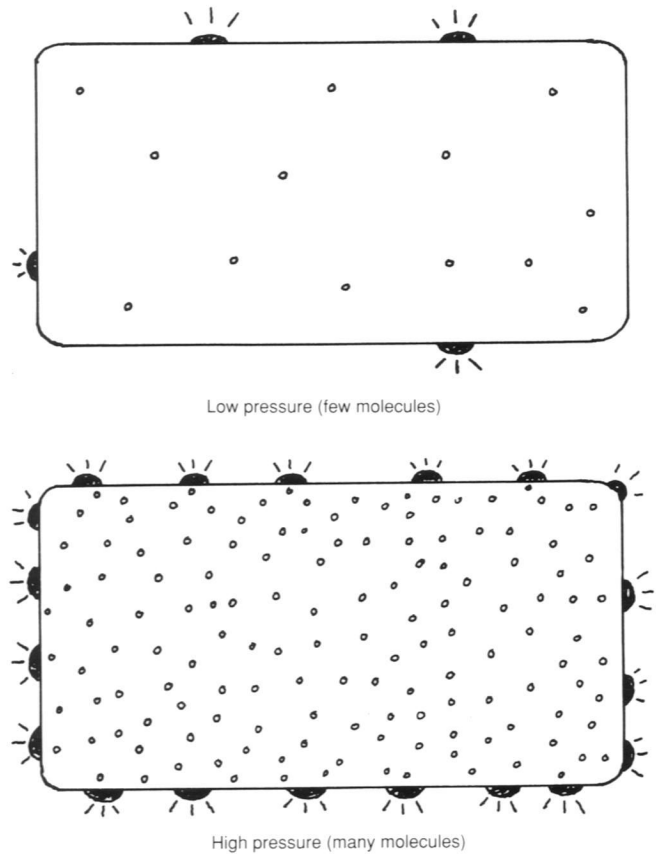


Fig. 1-10 MOLECULES AND FORCE

Each moving molecule exerts a pushing force when it contacts an object. More molecules in a given area results in more force or pressure than in an area that has less molecules.

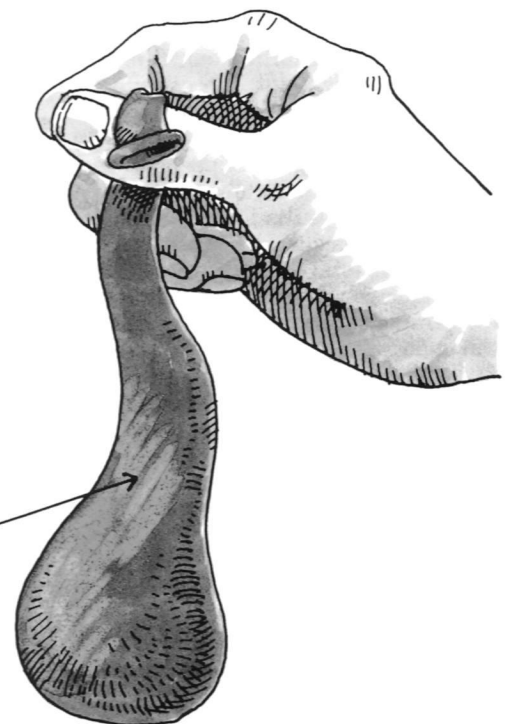
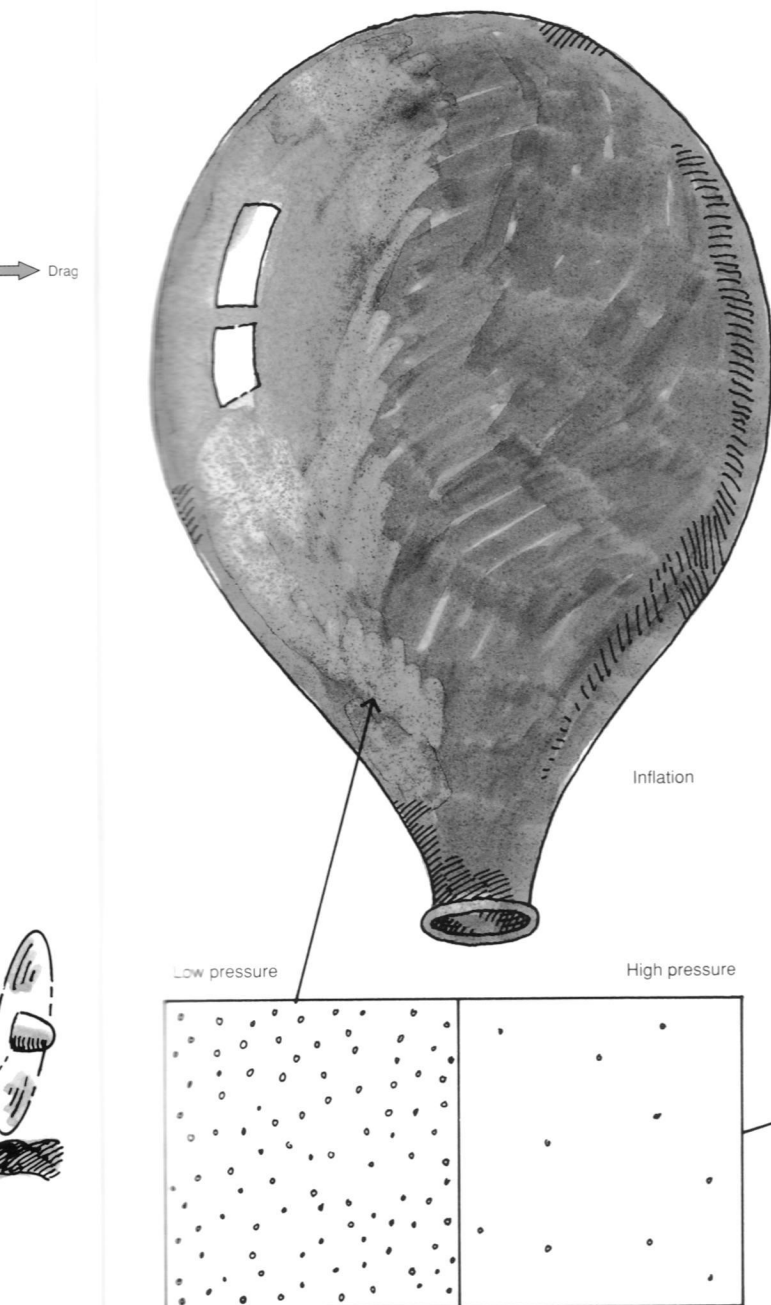


Fig. 1-11 EFFECT OF PRESSURE ON BALLOONS

Turns. Turns on a sailplane can be performed with either the rudder or ailerons. The rudder will only turn aircraft that have dihedral or a bend in the wings. Sailplanes and electric gliders typically have many dihedrals and these wings are called polyhedral, fig. 1-18A. When the rudder is directed to one side, it greatly increases the drag on that side, fig. 1-18B. Because of the drag on that side, the plane yaws or turns its nose to that side. In an airplane with dihedral, this yawing motion transfers a difference in lift to each wing and causes one wing to drop and the other to rise, resulting in a turn.

In planes equipped with ailerons, changes in the lift and drag on the wings occur simultaneously, figs. 1-19 A and B. When left aileron control is given, the left aileron deflects up and the right aileron deflects down. When the left aileron is up, it creates less lift on that wing, which causes the wing to drop.

The right aileron that is deflected down causes an increase in lift. As you can see, the airfoil on the top has been extended by the aileron. This increases lift on the right wing and causes it to rise.

These two processes work together and effectively cause the model to roll or bank to the left. Just the opposite occurs with application of right aileron. The right aileron rises, decreases lift, and causes the right wing to drop. The left aileron lowers, which increases, causing the left wing to rise. All of this results in a roll to the right.

Elevator control. The elevator is a controlling device that is attached towards the rear of the fuselage. When the elevator is deflected upward or downward, it causes an increase in drag on the side it is turned toward. As a result, the nose of the sailplane pitches up or down.

For example, if the elevator is raised, the drag on the top of the tail section will increase. This drag causes the tail to lower, resulting in a nose-up attitude, fig. 1-20. When this occurs, the angle of attack of the wing changes, fig. 1-21. The angle of attack is defined as the angle formed between the cord line of the airfoil and the relative wind that strikes the airfoil.

When up elevator causes the nose of the airplane to pitch up, the angle of attack increases. When this happens, the separation of the airflow over the wing occurs at a lower point on the leading edge. This is where the relative wind now strikes the airfoil. When the separation of airflow occurs at this new point, the distance to the trailing edge over the top is increased. As a result, the overall lift is increased.

In addition, look what happens to the induced drag. The wing is now tilted more toward the rear and is generating greater lift. This results in more induced drag. (Remember, an increase in lift causes an increase in drag.)

Because the total drag increases, the result of up elevator will be an increase in lift and a loss in speed. The opposite is true when using down elevator, fig. 1-22. Drag is increased on the underside of the tail, causing the tail to rise. The nose lowers and the angle of attack decreases. A resultant loss of lift and induced drag causes the model to speed up.

To summarize, a change in elevator deflection ultimately leads to a change in airspeed, even though a change in altitude may occur briefly. You'll use this concept later when I discuss actual flight.

Stalls. A stall is the point at which the wing stops flying. For the wing to fly, a smooth flow of air over the airfoil is needed. When this smooth flow is disrupted, lift is no longer generated and the wing stalls.

Remember that as the angle of attack increases, the resultant airflow over the wing changes, fig. 1-23. Once a large enough angle, or critical angle of attack, is reached, the air cannot flow smoothly over the top of the wing. The wing stalls, and lift is lost.

Any wing can stall at any airspeed as long as the critical angle of attack is exceeded. Stalls at higher speeds are

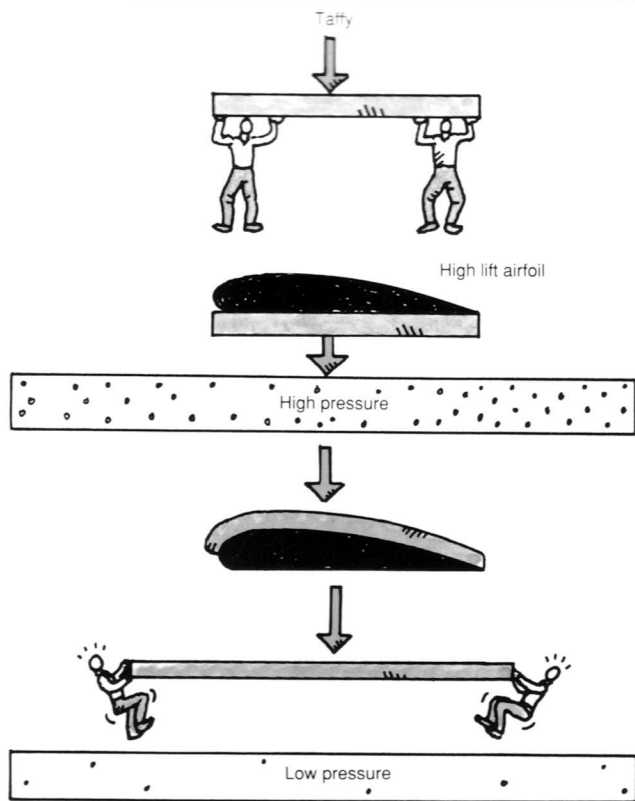


Fig. 1-12 THE TAFFY THEORY OF LIFT

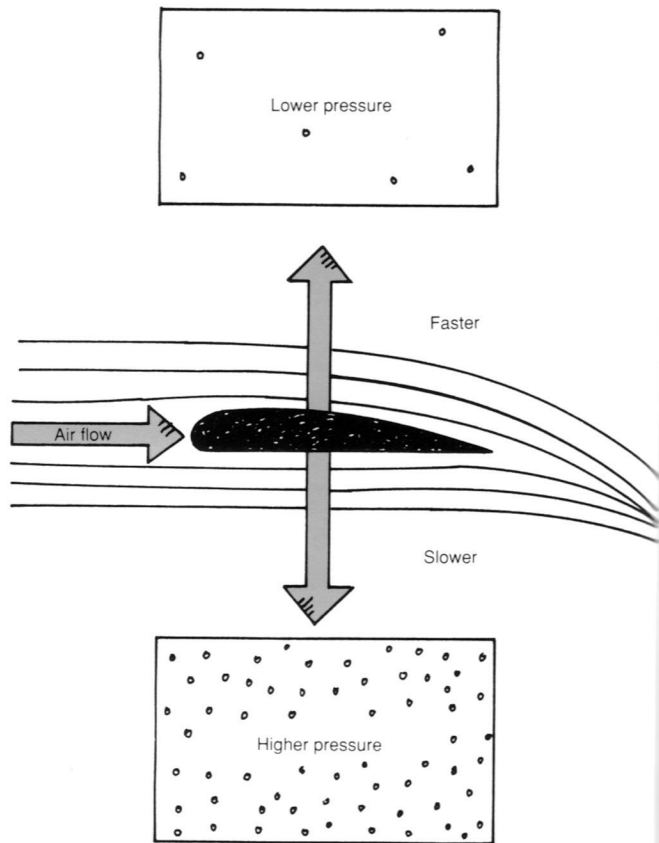


Fig. 1-13 AIRFLOW CREATING LIFT

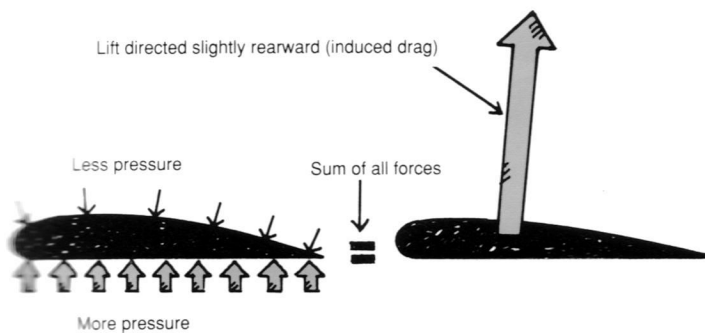


Fig. 1-14 SUMMATION OF ALL FORCES RESULTING IN LIFT AND INDUCED DRAG

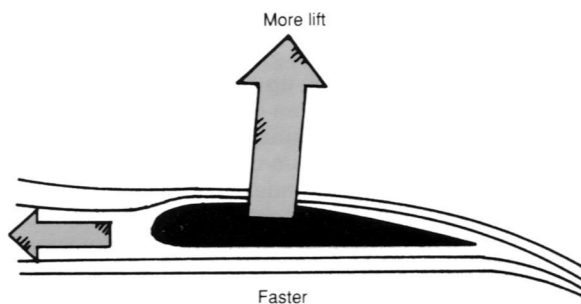
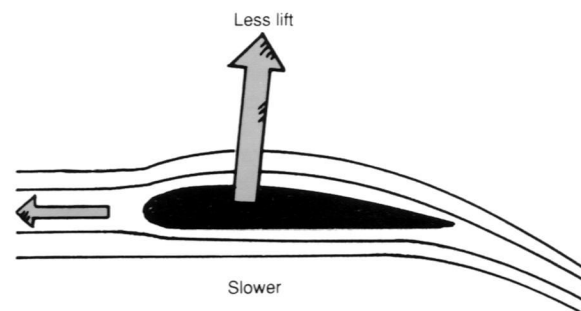


Fig. 1-15 RELATIONSHIP OF SPEED AND LIFT

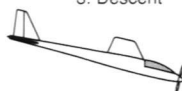
1. Straight and level flight



2. Decrease throttle



3. Descent



4. Increase throttle



5. Straight and level flight



5. Straight and level flight



4. Throttle reduction



3. Climbing



2. Increase throttle



1. Straight and level flight



Fig. 1-16 DESCENTS

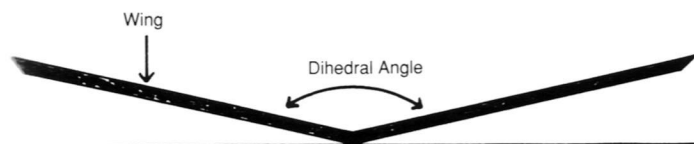


Fig. 1-18A DIHEDRAL

Action of the rudder moves plane about its vertical axis

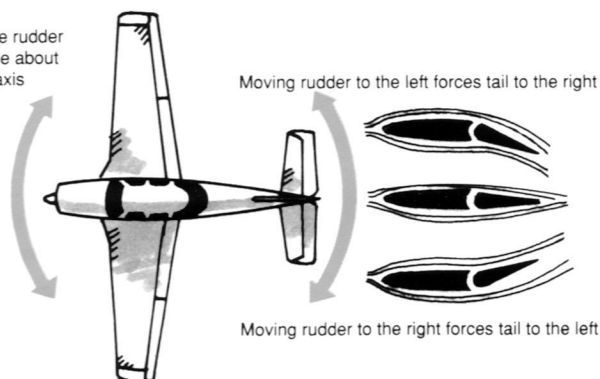


Fig. 1-18B USE AND EFFECT OF RUDDER (Airguide Publications)

unusual with beginning sailplanes because they're docile. More maneuverable airplanes, however, can stall at high speeds if there is enough elevator travel, and it is abruptly applied.

To correct a stall, quickly decrease the angle of attack and regain smooth airflow over the wing. This is easily performed by giving down-elevator control to restore a normal angle of attack. This will be important during flying practice.

Stability. All good sailplane models exhibit stability. This means that if the airplane is properly trimmed (it flies straight by itself) and is placed in an abnormal attitude, it will return to its original condition by itself. This may sound profound and even magical, but you have already learned most of the principles involved with stability.

If a sailplane flying level is given up elevator briefly and released, it will initially pitch up and lose airspeed, fig. 1-24. Gravity takes over with the loss of lift and the plane pitches downward. Speed increases and so does the lift, bringing the plane back to a slightly nose-up position. This oscillation repeats a few times and the plane is soon flying level.

Now, let's take this same trimmed model and roll it to the left, fig. 1-25. Because of the dihedral in the wing, you can see how the left or lower wing develops more lift than the right. As a result, the left wing rises until the lift becomes equal on both sides. The airplane is again level.

Any combination of pitch and roll inputs can be automatically corrected with a properly trimmed sailplane. This is one factor that makes learning to fly easier. The stability allows you more time to think while you are flying.

Spoilers. A few advanced sailplanes have spoilers for effective air braking. When the spoilers disrupt the normal smooth airflow over the top of the wings, the spoiled airflow causes a loss in effective lift similar to a stall but only involving a small part of each wing. In addition, the parasitic drag is increased when the spoilers are used.

This combination of effects, decreased lift, and increased drag results in the sailplane being able to come in on a steeper glide path, which is good when you need to lose altitude quickly. If you get caught in a strong updraft or thermal, spoilers can help you lose altitude easily without overstressing the wings. Spoilers also can be used in contests that require spot-landing precision.

I've addressed all the basic aerodynamic concepts in some detail here. When you begin flying, you'll understand why your plane responds the way it does. You also should be able to anticipate how aircraft will perform in various instances. Understanding these concepts and applying them while you fly ultimately will help you become a proficient radio control pilot.

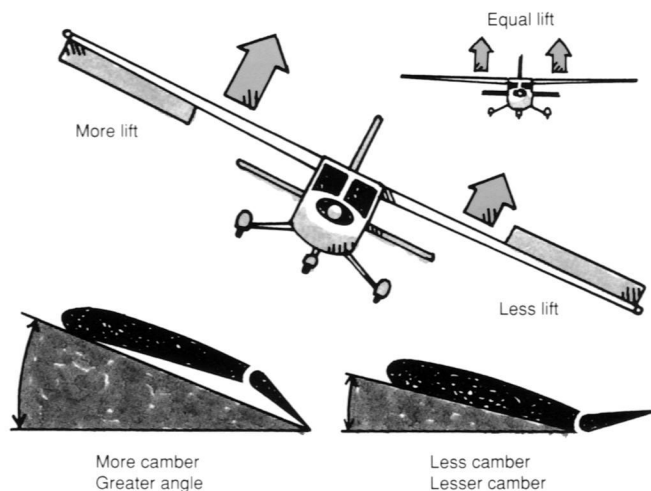


Fig. 1-19 FORCES EXERTED BY AILERONS (Airguide Publications)

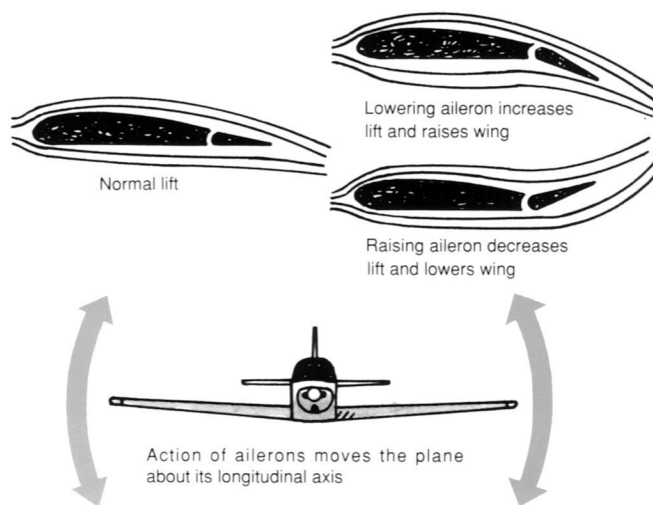


Fig. 1-20 USE AND EFFECT OF AILERONS (Airguide Publications)

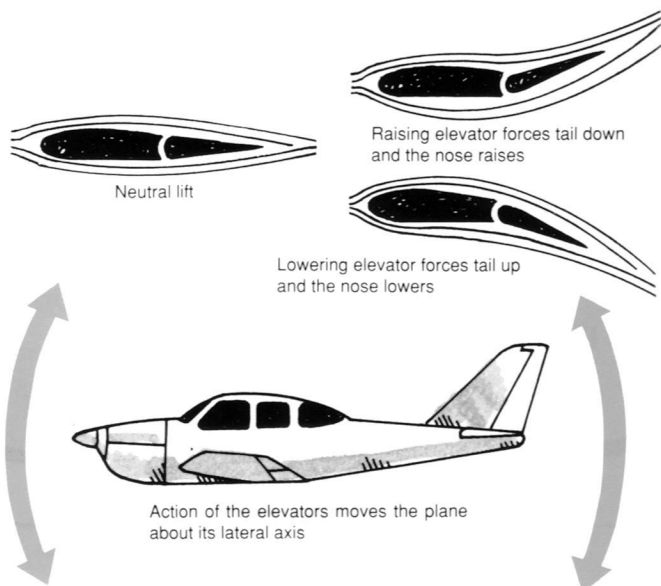


Fig. 1-21 USE AND EFFECT OF ELEVATOR (Airguide Publications)

Fig. 1-22 UP-ELEVATOR

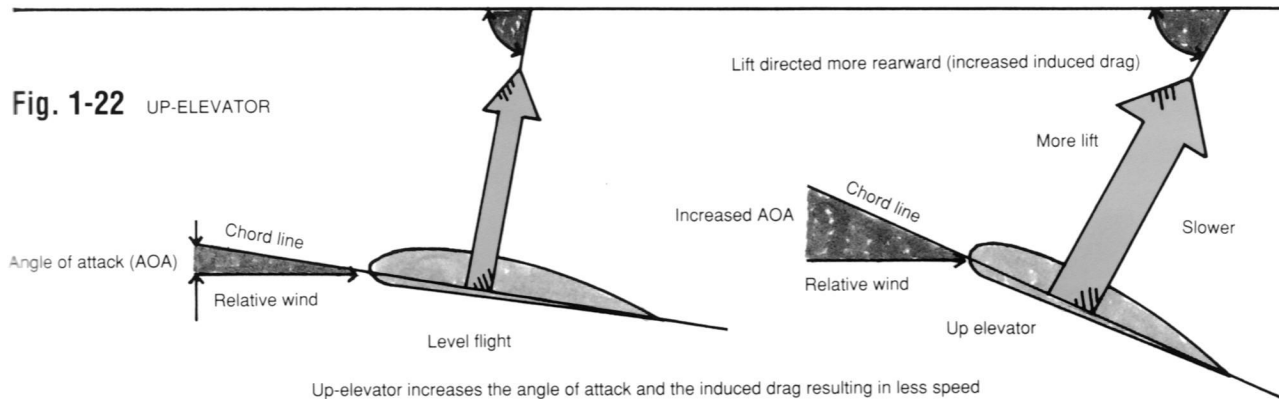


Fig. 1-23 DOWN-ELEVATOR

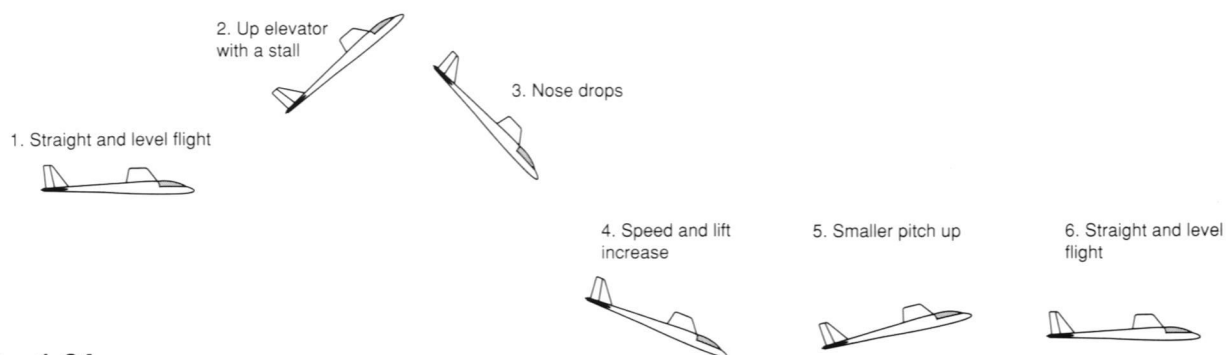
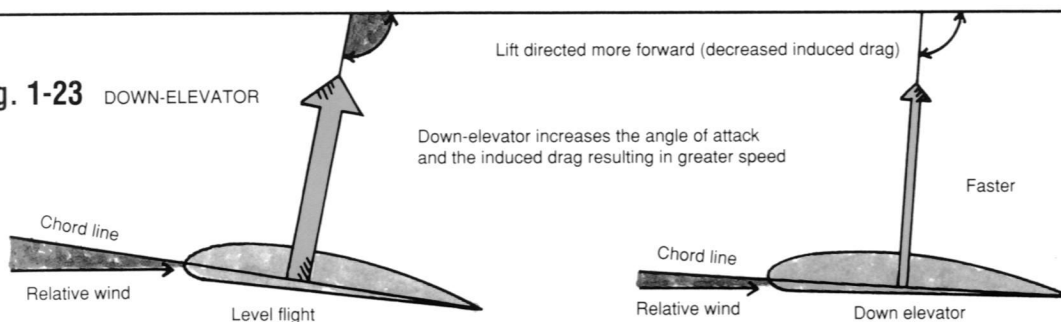


Fig. 1-24 PITCH STABILITY

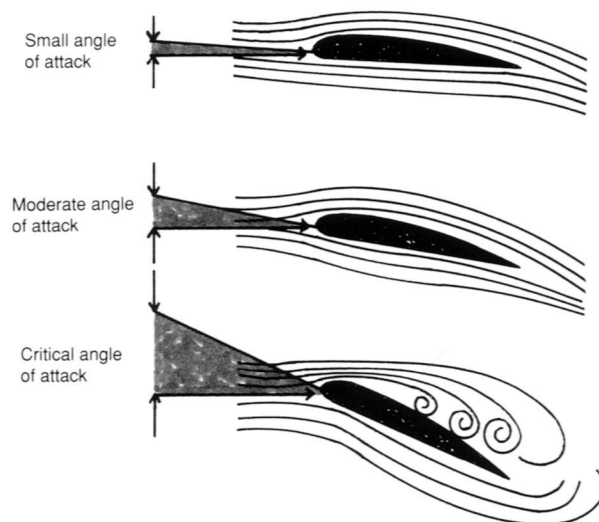


Fig. 1-25 INCREASING THE ANGLE OF ATTACK TO THE POINT OF A STALL

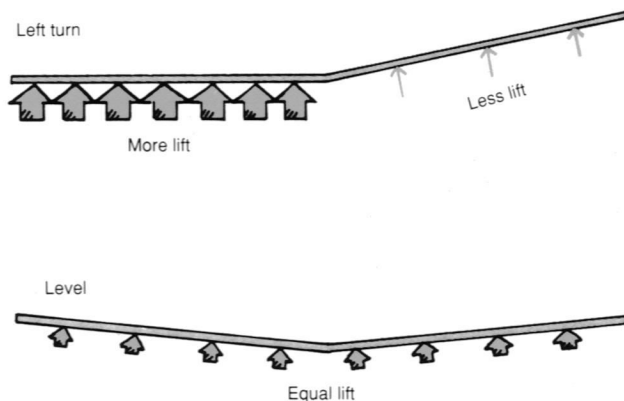


Fig. 1-26 DIHEDRAL AND STABILITY



Fig. 2-1. Hobby shop employees will always help you purchase a sailplane kit and radio that's best for you, and they'll answer any other questions you have about the hobby.

2 Choosing Your First Sailplane

Hundreds of sailplane models for all skill levels are available, making choosing one that's right for you somewhat difficult. You must take into account what your needs are now so you can purchase the sailplane that's best for you. This chapter will help make sure you do that.

What sailplanes are right for beginners? Keeping in mind some of the things we learned about aerodynamics, here's a list of characteristics all good trainer sailplanes should have:

- They should fly slowly and have good dynamic stability. These characteristics give you time to think and react when flying.
- They should have a flat bottom wing. The flat bottom wing provides for the most lift, especially at lower speeds.
- They should include wings that have two or more dihedrals built into them. This provides for good lateral stability, and it improves turning controlled by the rudder.
- They should contain at least two channels, one for the

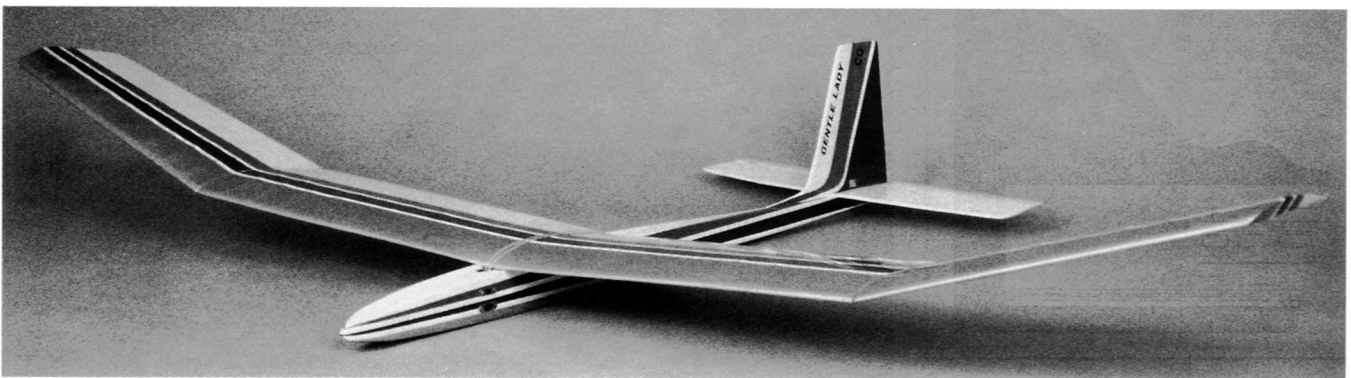


Fig. 2-2. Gentle Lady. Produced by Carl Goldberg Models, this two-meter all-wood sailplane is one of the best for beginners. It handles well, is reasonably priced, and is very easy to assemble.



Fig. 2-3. Olympic 650. This two-meter sailplane is great for slope soaring as well as thermal flying

elevator and one for the rudder.

- They should be moderate in size to ensure a lighter wing loading. This facilitates the model's ability to thermal and glide. A wingspan from two meters (78 inches) to 100 inches is a good length to start with.
- They should be available from your local hobby shop. Readily available planes are usually proven performers.
- They should be durable enough to withstand hard landings and minor accidents.
- The kit should be complete and include full-sized plans and detailed instructions.

Besides the above considerations you also must decide whether you want to purchase a kit that requires assembly or an ARF (almost ready to fly) model that requires only minimum assembly. ARFs cost a bit more than kits you have to build (consider this the price of having someone build most of the kit). Also, most ARFs come pre-covered with heat-shrink plastic, which typically has a sticky side that is used to cover the model quickly in the factory. As a result, the covering is heavier than normal and adds to the weight of the plane. So, the trade off for convenience may be shorter flights.

In the rest of the chapter I list many sailplanes I have built and flown and recommend to beginners and intermediates. This list represents a good range of choices — from two meter kits to a couple more advanced contest-type planes. All of these planes meet the requirements I set above, including those for aerodynamics and durability.

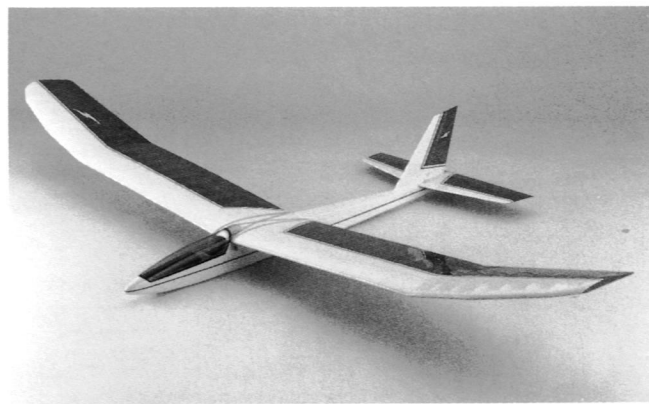


Fig. 2-4. Spirit. A two-meter sailplane by Great Planes, it was recently used to win the two-meter division at a national event.

They are all proven performers and have the highest quality built in.

When you have obtained your kit, read the chapter on special building techniques. Also, read the kit instructions thoroughly and build the plane just as the manufacturer recommends. If you need additional help, contact your local hobby shop or flying club. They can help you themselves or put you in touch with someone who can. Plenty of wonderful people are willing to provide advice and guidance to beginners.

Gentle Lady

The Gentle Lady is a two-meter all-wood glider produced by Carl Goldberg models, fig. 2-2. It has been around for many years. Because of its high quality and low cost, it has been the beginner's choice for a long time.

The kit comes with die cut parts and a hardware package. The instructions have been updated and are extremely detailed. Each step is designed to take any first time modeler by the hand using actual photographs and an informative text. There are no difficult procedures to perform in assembling this fine kit.

The instruction manual goes into great detail on covering your model. It even shows you how to make gapless hinges using the heat shrink covering material. The details of radio installation, balance, and basic flying are also covered.

Flying the Gentle Lady is a joy. The high lift polyhedral

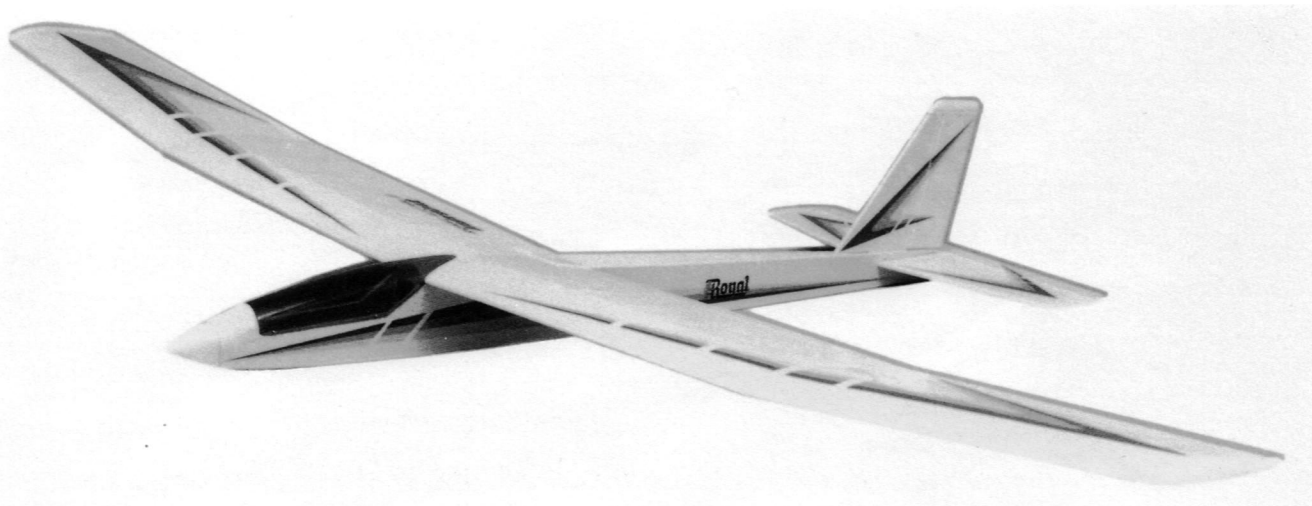


Fig. 2-5. Easysoar III. This sailplane is offered by Royal Air Products in an ARF (almost ready to fly) kit. It is beautifully covered and only takes a few evenings to complete.

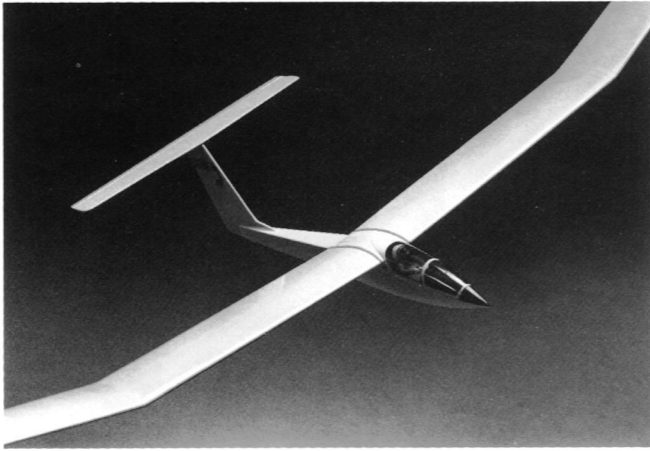


Fig. 2-6. Sophisticated Lady. This two-meter Goldberg Models sailplane features a light wing loading and a classic T-tail.

wing provides great flying stability. Because you can cover this model using lighter iron-on covering material, you will find it a lot lighter than most ARF planes. As a result, its thermalling capabilities are a notch above the ARFs.

Olympic 650

The Olympic 650 is a two meter sailplane produced by Airtronics, fig. 2-3. It requires two channels for operation and is excellent for any entry level modeler.

The kit is composed of many high quality cut, sanded and pre-shaped parts. A complete hardware package is included. The manual that accompanies the kit is detailed and any beginner can follow it and produce a good flyable sailplane.

The construction is straight forward and requires only a minimum of shaping and sanding. The structure is sturdy, and thus the plane can withstand occasionally stronger hi start and winch launchings as well as harder than normal landings.

Flying the Olympic 650 is easy and reliable. The high lift polyhedral wing provides for stable flying. Thermalling and slope soaring this sailplane is also easy, especially because of the crisp response to control inputs.

Spirit

The Spirit is produced by Great Planes Manufacturing, fig. 2-4. A wonderful two-meter sailplane that beginning pilots can build and fly, the Spirit is also suitable for competition flying; in fact it won first place in the 1990 National competitions.

The Spirit is an all wood (balsa and hardwood) model that you must build. The parts are all die cut and made of high quality wood like all Great Plane kits. The kit includes all the specific linkage hardware you'll need.

The Spirit is easy to build; every kit includes a detailed step-by-step instruction booklet. There are a few building options as well. One is to build spoilers into the wing panels to help the plane escape strong thermals. You can also use the spoilers for spot landings in competitions. For this option, you must buy spoiler line and flexible tubes separately.

Another building option involves modifying the wing for bolt-on attachment. The standard set up involves using dowels and rubber bands. The bolt-on attachment set up requires more time but is worth the effort.

Flying the Spirit is almost as easy as building it. It has great launching and flying characteristics.

Easysoar III

The Easysoar is an ARF sailplane that is produced by

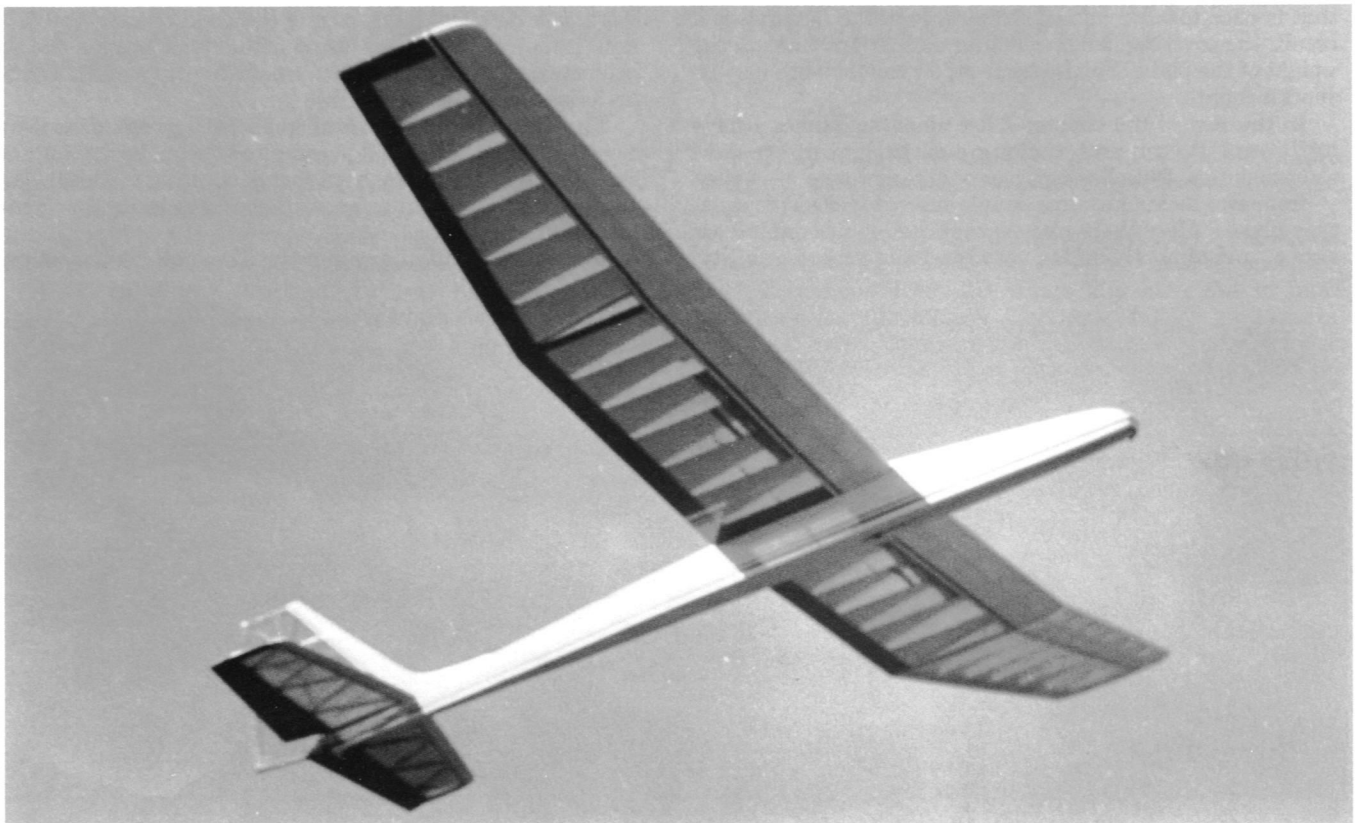


Fig. 2-7. Riser. This 100-inch wingspan sailplane is produced by Sig Manufacturing. It uses two to three channels and flies well.



Fig. 2-8. Olympic II. This great flying sailplane has a 100-inch wing and is easy to build. It is light and has a terrific glide.

Royal Air Products, fig. 2-5. This is the third version of its popular model and is certainly the best.

The Easysoar is composed of balsa and hardwood. All the structures are built and covered with a heat shrink plastic covering that is nicely decorated. A complete hardware package is included along with a towhook.

The wing is a polyhedral design and has a flat bottom airfoil. All the above makes the Easysoar a perfect sailplane for the beginner who doesn't want to spend a lot of time building. The roomy fuselage makes radio equipment installation easy too. A detailed step-by-step assembly manual is included, and it will guide any inexperienced modeler through the building process with ease. There are even sections describing basic flight maneuvers, set up, and adjustments.

Assembly requires only a few steps. Join and reinforce the wing panels. Glue the tail parts into place. Install the radio, and then attach the nose, canopy areas and other small parts and that's it.

Sophisticated Lady

This sailplane is a two-meter-wing-span aircraft by Carl Goldberg Models, fig. 2-6. It has a T-tail that gives it a distinctive look. The Sophisticated Lady's sleek design enhances its appearance—and its flying capabilities.

The economical kit comes with all the wood parts and a complete hardware package. Rolled plans and a detailed instruction book are also included. Construction of the Sophisticated Lady is very easy. Any entry level modeler could successfully complete this kit.

Flying this model is a lot of fun. It is a very light glider and can easily thermal and slope soar. The T-tail not only looks nice but is up and out of the way. Because of its location, chances are good it won't be knocked loose on

landing. Just be sure to attach the T-tail securely and use extra support where it attaches to the fuselage.

Riser

The Riser by Sig Manufacturing is a 100-inch wingspan sailplane, fig. 2-7. The model uses two channels for elevator and aileron use. You can also add spoilers or flaps easily.

The kit contains all the necessary balsa and hardwood. The wood is of high quality, typical of Sig. A hardware package is also included.

A detailed assembly manual makes construction easy, and the parts fit well. Although its heavier than some planes, the Riser is tremendously sturdy, making it especially good for beginners.

The Riser is easy to fly, too. Its long high lift wing makes thermal soaring an almost effortless joy. Hi starting it is no problem, and it has a nice flat glide. Its dynamic stability also makes it an ideal beginners' plane

Olympic II

The Olympic II is an Airtronics 100-inch wingspan sailplane that has been on the market for many years, fig. 2-8. It requires two channels, one for elevator and the other for rudder. The instructions allow for the use of optional spoilers.

The Olympic glider is ideal for beginners as well as more advanced pilots that may be interested in standard class competition. The kit contains only contest-grade wood, plus a complete hardware package.

It's easy to build, as long as you follow the instructions closely. The parts are pre-cut and many, such as the ribs, are already sanded and ready to use. Full-sized plans are also included. The large wing is made up of two pieces that you can easily join at the field using a long metal joiner.



Fig. 2-9. Spirit 100. This sailplane, by Great Planes, is a sophisticated ship that requires some experience to fly.

Some shaping is necessary on the nose and the wing tips but this requires only a little time and effort.

Flying the Olympic II is wonderful. The large wing provides for a low-wing loading. Hand launching results in an amazing flat glide that seems to last forever. Hi starts and winch launches are easy due to this model's great stability. Thermal flying is equally as good. I have had one of my longest flights ever using this model and had to land only because my batteries were getting low!

Spirit 100

The Spirit 100 is a 100-inch wingspan sailplane that is suitable for high level competitions, fig. 2-9. Manufactured by Great Planes, it is the big brother to the smaller Spirit.

You'll need to perform some sanding and shaping, and due to the more sophisticated nature of the construction and flying of this model, only pilots who have built and flown at least one sailplane should buy one. Although a detailed manual accompanies the full-sized plans (making construction easier), installing the radio into the wing is complex. The wing needs several servos because it is set up with ailerons and flaps.

Although not necessary, a computer radio will allow the Spirit 100 to achieve its full potential. Such features as differential aileron throw, crow capability, and mixed aileron/rudder control add to the plane's strengths and are easy to use.

The Spirit 100 is reasonably priced for a model of its size, quality, and abilities. In addition to its many control surfaces and the combination of their uses, the model is durable. A ballast box for adding weight is built into the fuselage over the center of gravity.

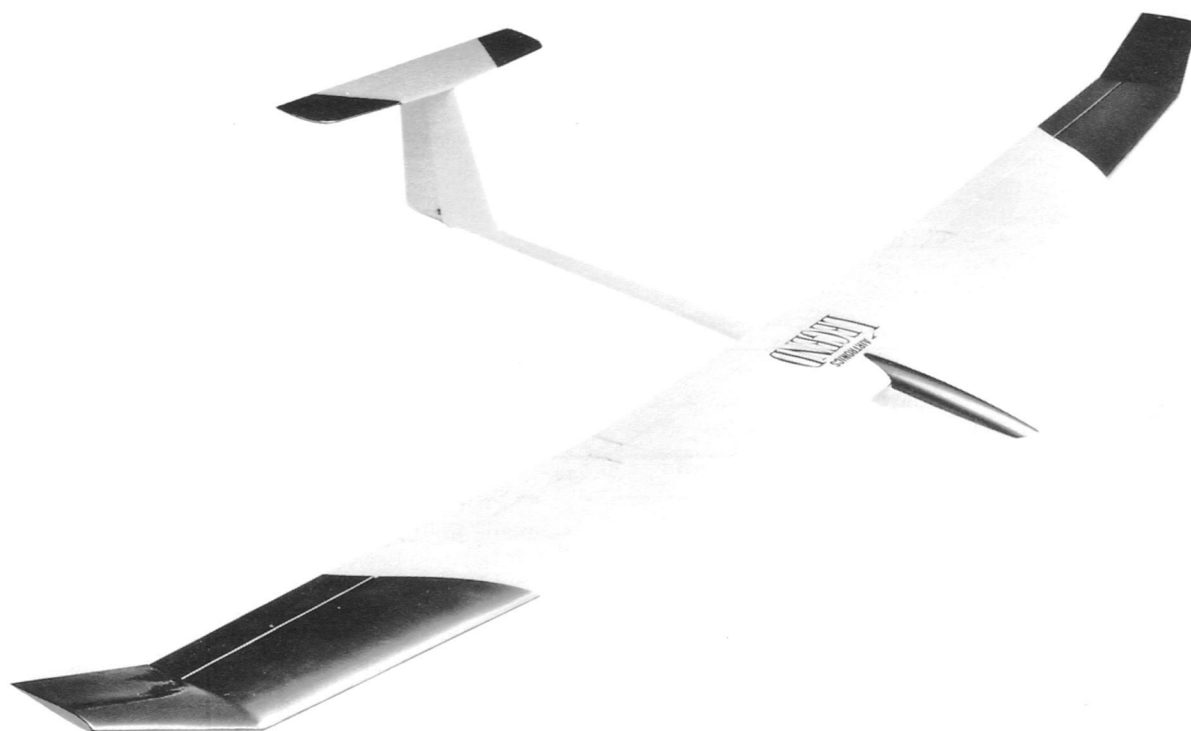


Fig 2-10. Legend. This composite-type sailplane is made by Airtronics and is a wonderful contest plane. It is great for intermediates and up.

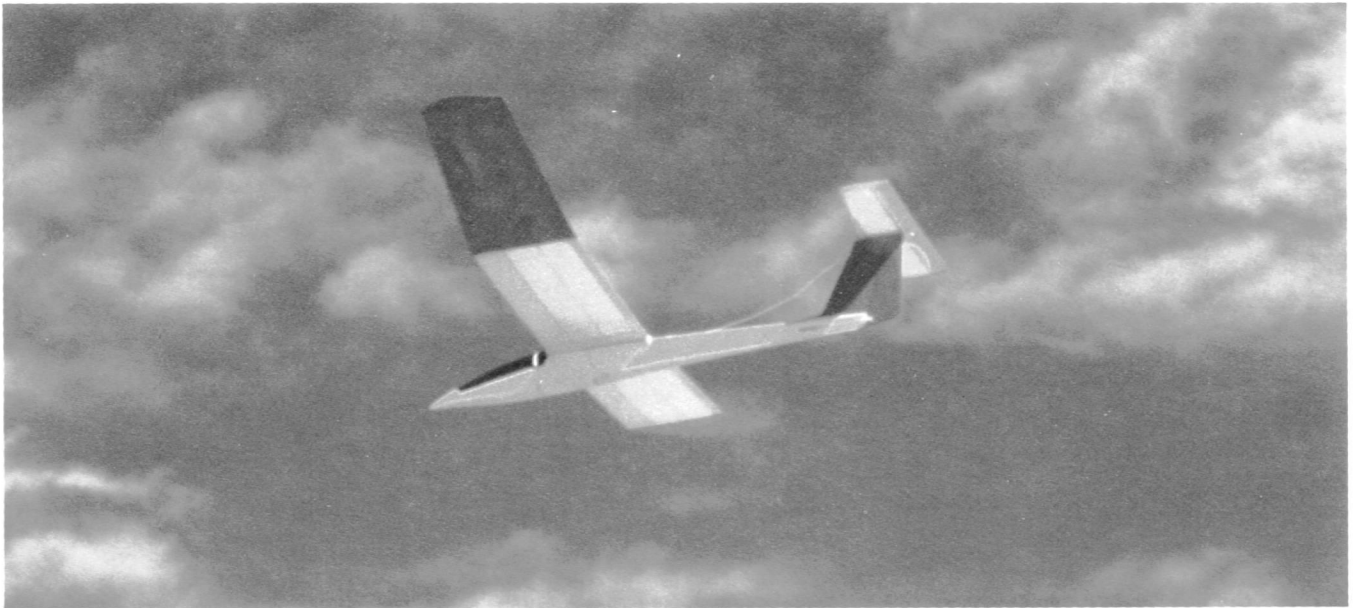


Fig. 2-11. Selecting your plane is only the first step toward actually flying. Subsequent chapters explain where to go next.

Legend

The latest in Airtronic's sailplane line up, the Legend is one of the best competition sailplanes on the market, fig. 2-10. Anyone who has built and flown an entry level sailplane can handle the Legend.

This kit cost more but is worth it. The wood parts are all band sawed and sanded and are made of the best contest woods. The fuselage and canopy are made of epoxy glass, and the rear of the narrow fuselage is reinforced with Kevlar. All the necessary hardware is included with the kit, as is hinge tape, a pull-pull rudder control system, and even carbon fiber reinforcement tape.

Building the Legend is straightforward. The manual contains step-by-step instructions with detailed photographs. The Legend has a distinctive looking T-tail

with an intricate bellcrank type control system.

The wing has a main portion and two outer winglets that plug in, giving the Legend an overall wingspan of 113 inches. Flaps and ailerons are standard on the plane's wings. Elevator and rudder control are also needed. Because of this configuration, a computer radio will help you optimally use the functions.

The Legend's flying performance is fantastic. The manual describes the recommended control throws — and how to program your radio for cross, launchings, and landings. The Legend has excellent thermalling capabilities due to its low drag and low wing loading. It is strong enough to be zoom launched even when using flaps on most winches. Its slow speed characteristics are gentle and its stability is obvious. If you have flown other sailplanes and want to get seriously into contest flying, buy the Legend.

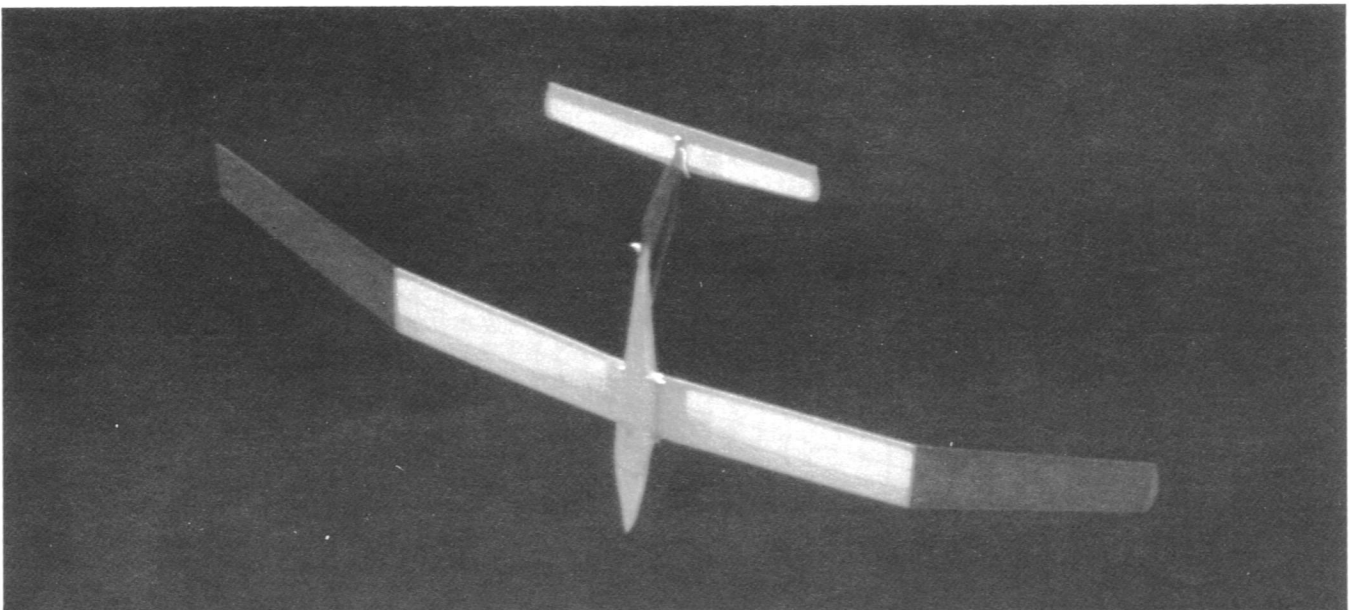


Fig. 2-12. The sight of a sailplane soaring through the air on a sun-drenched day can be exhilarating.



Fig. 3-1. The Cox Cobra Radio comes in two- and three-channel models.



Fig. 3-2. Futaba 4NBL Transmitter. This is the same transmitter used in Futaba's popular four-channel system as well as in its set for electric-powered airplanes.

3 Buying the Radio

The radio is the next most important piece of equipment you'll buy, and a wide variety is available. Figuring out which radio is right for you can be confusing, especially when the price ranges from \$80 to well over \$700! So, what are you going to do?

This chapter will help you make the right purchasing decision. I'll examine what you need in a radio (keeping in mind your skill level) and how you should prepare it for use and care for it once you've brought it home.

Frequencies

Many frequencies are available for radio control units. Those set aside for radio control flying fall within the 72MHz (Megahertz) range. Some older radios, however, may be on the old — and now illegal — frequencies of 72.08, 72.16, 72.24, 72.32, 72.40, 72.96, and 75.64. Check before purchasing a used radio.

Avoid radios without an AMA authorized gold sticker, found on the back of all approved transmitters. It demonstrates that the radio meets the stringent guidelines of frequency band width. In other words, the radio won't interfere with other radios that are on frequencies right next to yours. Also ask your hobby dealer about frequencies you should avoid in your area. In some places local transmitters and even TV stations have been known to cause interference on certain frequencies.

Radio options

A common radio option is servo reversing, which makes radio installations easier. After mounting the servos in your aircraft, the surfaces may move in the opposite direction, a common occurrence. For example, if you pull the right stick toward you, which is usually the command for up elevator, the elevator may move down instead. Without servo reversing, you'd have to change the entire linkage around. With servo reversing, a mere flip of a switch will immediately correct the problem, causing the elevator to move up as it should. If you choose this option, don't forget

to set each servo's direction correctly before flying. With more experience, you'll automatically check the travel direction of all surfaces before launching your plane.

Another radio option is dual rate switches, which can greatly reduce the amount of servo movement when activated. Useful for advanced aerobatics, these switches are not necessary for the beginning sailplane/electric glider pilot. If the radio you buy has them, set the rate control to full throw. This ensures that you will still receive full servo movement in either switch position.

Channels

Another decision is how many channels you want on your radio. One channel causes one surface to move or one servo to operate. Thus, the more channels a radio has the more functions it can perform. So, how many channels do you need? Let's examine the possibilities.

Trainer sailplanes have only two movable surfaces, an elevator and a rudder. If you are going to fly only sailplanes with these two movable surfaces, you'll only need a simple and inexpensive two-channel radio (see the Cox Cobra below).

Two-channel radios. Avoid most of these radios, however, especially any two-channel radio with two separate levers or sticks on the transmitter. One controls the elevator and the other controls the rudder.

With both functions mixed on one stick you don't have to separate your thoughts between two sticks. You'll have enough to concentrate on. You will also have a hard time finding an instructor capable of flying this type of configuration. There are many other fine models for you to consider.

Cox Cobra. If you will be flying sailplanes that only require two channels for quite a while or if you plan to buy a more complex system later and want to keep your current costs down, look at the new Cox Cobra radio, fig. 3-1. It features one single stick with a state-of-the-art ergonomic design — the transmitter has been shaped to be held more

comfortably in your left hand. The Cobra comes in two- and three- channel versions, and all feature servo-reversing switches. However it is inexpensive because it comes dry, so you'll have to supply batteries. You can easily upgrade this system to nicad operation by purchasing AA cells. The Cobra transmitter features a built-in charging jack, making recharging these batteries easier. Cox sells a separate charger for this purpose.

The cobra is AMA gold labeled and meets all the legal frequency requirements. Each unit comes with two micro servos and a lightweight two-channel receiver. I have used the Cobra in a few of my sailplanes with no problems. It is comfortable, inexpensive, compact, and easy to maintain. If you are going to fly powered gliders with a speed control or use a third servo for a power switch, spend the extra few dollars and purchase the three-channel unit. The third channel is also useful for deploying spoilers on a sailplane.

Four-channel radio. Why would a sailplane/electric pilot choose a four-channel radio? A four-channel system gives you the ability to add spoilers, motor control, flaps, or other options to your aircraft without having to buy another radio. In addition, many beginning sailplane pilots eventually wander over to the more noisy aspect of our sport, gas-engine airplanes. These planes typically require all four channels to operate. The functions include the engine, ailerons, elevator, and a coupled rudder/ground steering linkage. Finally, almost all of these systems have nicad batteries and a charger in the radio package, so an upgrade is not necessary.

Another consideration is the size of the servos. This book is about sailplanes, not the more powerful gas-engine aircraft, so let's consider the smaller micro servos. Sailplanes must be as light as possible to minimize the effects of gravity. To meet this criterion, you can take several steps. I'll discuss building techniques to help achieve this goal later. As for the radio, choose one with the smaller micro servos. They are usually not as powerful as those used in gas-engine aircraft, but these servos supply plenty of power for our needs. If you decide to buy a gas-powered plane later, you can buy the larger and more powerful servos separately.

Smaller servos are easier to install. In fact, many modern sailplane designs can only accommodate micro servos. These smaller dimensions not only mean the sailplanes are lighter, but their overall drag can be drastically reduced. If you want the larger servos check the dimensions of the radio compartment before buying a kit. If you can afford the extra dollars, buy a system that includes the micro servos.

Choosing a Four-Channel Radio System

Many good brands are available. I have been using Futaba radios for most of my flying career. Futaba has recognized the demands of the sailplane/electric glider pilot and has designed a few radio systems around these requirements. There are three in particular.

4NBL. This simple four-channel radio has been around for years, fig. 3-2. It is Futaba's lowest-priced model and comes with servo reversing and full nicad batteries and is on a simple AM frequency. The drawback for the sailplane enthusiast is that it is only available with three standard servos. If your budget is tight and you are careful about choosing an aircraft that can accommodate the larger servos and weight, consider purchasing this system.

4NBF. Newly released by Futaba, this radio is a superior, low-cost unit tailor made for the novice sailplane/electric glider pilot, fig. 3-3. On the outside, the transmitter and receiver look much like those found in the 4NBL. The 4NBL comes with FM frequency to help prevent radio interference. Vibrations from motors, gas engines, metal-to-metal linkages, and other sources of radio noise are basically ignored in FM operation.



Fig. 3-3. Futaba's 4NBF FM transmitter comes with a dual conversion receiver and two micro servos for sailplane use.

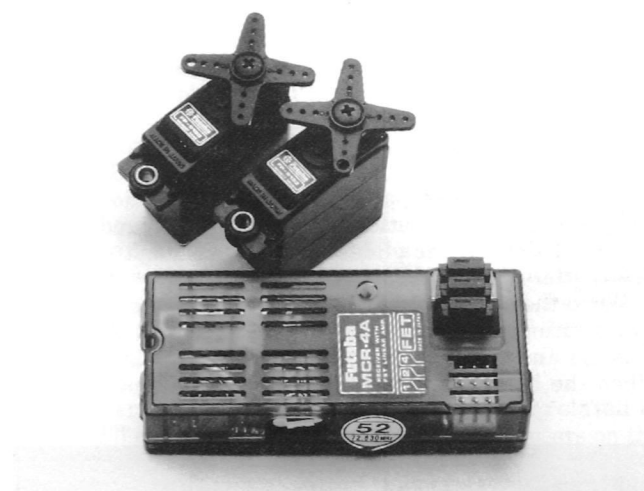


Fig. 3-4. 4NBL Attack E. This system comes with a 4NBL transmitter and features the MCR-4A combination receiver/speed control and 2 S133 servos.

If you look closely at the 4NBF receiver, you'll notice it has dual conversion. This is what makes this unit so unique. Dual conversion gives the receiver an ability to reject not only the radio noise we just discussed, but also other images or waves that other radios in the area may project. In simple terms, other radios that may not be properly tuned or may project harmful harmonic frequencies that may "bleed" onto your frequency will be rejected. This will save a lot of airplanes over time.

This system has another advantage for budding sailplane pilots: It comes with two S133 micro servos. These servos weigh a mere .67 ounces (19 grams) but are able to put out 30.6 ounces per inch (2.2 Kg/cm) in torque. This torque is about two-thirds of what the standard servos can produce.

The 4NBL system for electric-powered aircraft. This unique system features the reliable 4NBL transmitter we already talked about. Two S133 micro servos are also included, which makes it great to use in any sailplane or electric glider.

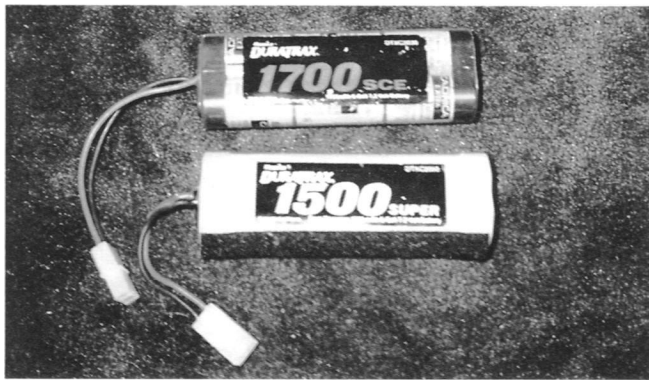


Fig. 3-5. Sold by Duratrax, the top battery pack is an SCE type that holds more charge per cell and can give your plane more endurance than the standard Duratrax pack below.

As I will discuss later, you can add motor control to an electric glider in many ways. Two of the more popular ways are to couple a switch to the elevator servo or to add a third servo and link it directly to a switch. Each will give you either full on or full off operation. For complete linear control, (from full off to full on including everything in between) you can add an electric speed controller. These last two options also add weight to the existing setup.

How do you gain the luxury of full proportional motor speed, avoid the hassle of coupled linkages, and keep the weight down? The solution is in Futaba's MCR-4A receiver that comes with a linear controller built in, fig. 3-4.

This receiver/controller weighs little more than a typical four-channel receiver. In addition, it has a BEC (battery eliminator circuitry) capability, so the whole radio unit and the motor run on one battery pack. This greatly reduces the weight of the electric glider because you don't need any radio battery; it all runs off the motor battery.

When the motor battery runs down, won't the radio shut off, resulting in a loss of radio control? Futaba thought of that too and installed an "auto-cut" feature in the unit. When the battery's voltage drops to 6 volts, power to the

motor is automatically shut off. This assures you of at least ten minutes of extra radio time so you can safely land.

(This is a good place to mention battery packs [a more detailed discussion is in chapter 10]. Some of the more popular packs are designated by SCR; they deliver the optimal voltage right up to the end then rapidly drop off. Avoid these packs for electric gliders. This type of battery may not provide your radio with enough power to land after an auto cutoff. Buy packs that are SCE rated; they slowly lose voltage over the entire run and will give you enough residual power to land after the auto-cut feature takes over, fig. 3-5. This unit is rated up to 8.4 volts so it can operate safely on seven-cell flight packs.)

The electric control unit requires good ventilation for cooling. When mounting it, don't wrap it in foam, which prevents air from getting to it. In the case of an overload or thermal stress (overheating), the unit will automatically shut down the power going to the motor, but the radio system will remain operational. After the unit cools down, it will perform as before. If this thermal protector does happen to engage, correct the cause of the problem before flying again.

This wonderful little unit has two switches connected to the receiver/controller. The first turns on the radio (assuming the motor battery is correctly connected). When this switch is activated, all channels except the speed controller will function normally. The controller function can only be activated when the second switch is pressed. To review, to activate the motor and put yourself at risk for a propeller strike, you have to plug in the battery, activate the radio switch, and then activate the controller switch. By the time you complete these steps you should be ready for the propeller to come to life.

The 4NBL Attack E cannot be used in gas-powered models where throttle control is required. The trade-off for this option is the ability to have full proportioned motor throttle at a reduced weight. No receiver battery is needed.

Installation and care are simple and straightforward. The auto-cut and thermal protector features are designed to provide your radio with enough electricity to "get home" in the case of low battery voltage or electrical overloads. Finally, the system has been designed with safety in mind.



Fig. 3-6. The X-347 by JR



Fig. 3-7. The Infinity 600A by Airtronics

If you are looking for a unique and reasonably priced radio for electric sailplane use, consider buying this system.

Computer Radios (The X-347)

The X-347 is a computer radio made by JR and is exclusively distributed by Horizon Hobbies, fig. 3-6. It's the ultimate radio for any radio control modeler.

The X-347 gets its name from the three overall features that make it different from other radios. This radio has specialized features for three types of aircraft: sailplanes, pattern (aerobatic) planes, and helicopters. It can store up to four separate aircraft programmings at one time. And it offers seven channels of operation.

The X-347 comes in three different sets, depending on the number and types of servos and battery packs offered. The first set, item No. J7XPG, was used in the glider pack I reviewed for this book. The transmitter is contained in one package.

The second set has the frequency package that contains a transmitter frequency module, a matching receiver and appropriate frequency flags. The last set contains two JR341 servos, 550-mah battery pack, a switch harness, charger, and other accessories. If you wish to fly a powered plane or helicopter with this radio, buy a flight pack for the appropriate aircraft. Because of the tremendous flexibility and capacity of this radio, you can use the same transmitter for several different aircraft. This review will first cover the general aspects of the X-347 and then more specifically how you can use it most effectively in your sailplane or electric glider.

The transmitter. When you first look at the X-347, you will notice its futuristic metal-like case. Once you pick it up, you'll be surprised at its light weight. The transmitter is ergonomically designed and fits comfortably in any one's hands.

The gimbals are adjustable in length and in spring tension. The switches are of three different types. Three of them deal with dual and exponential rates for the aileron, elevator, and rudder channels. There are also two mixing switches and a switch used for training.

There are also three knobs. For sailplanes these knobs can be set for different functions. One can operate flaps, another can cause the ailerons to droop. The final knob can be programmed to allow all of the flaps and ailerons to droop at the same time.

All of these specialty switches and knobs have different-colored dots and words next to them, because each switch and knob can have a different function in a different aircraft mode. Color coding makes understanding the proper use of each switch easy to follow: Red dots are for powered planes, dark blue dots for helicopters, and aqua for sailplanes.

Each gimbal has a corresponding set of ratcheted trim tabs. A nice feature built into these tabs is the detente you feel when the trim reaches its center position. With this you don't have to look at the transmitter while you're flying to determine if your trims are centered.

The on/off switch is in the center of the radio. Above it is a neck strap attachment. Farther up is a small speaker that provides for audible tones when you're using the timer or if the battery gets low. Six computer input keys are on the lower front portion of the transmitter.

At the top, just below the antennae receptacle, is a large LCD readout screen. When the radio is turned on, the screen gives a few bits of information. The left side indicates the model name or gives the time if the timer mode is used. In the center, the type of modulation is displayed. A C indicates PCM and an F stands for PPM (akin to FM). The right side of the screen gives the transmitter voltage. The screen also displays other words and messages when you're programming the radio.

The transmitter has a direct servo controller (DSC) port that can be used with a special cord that connects to the

receiver. With this setup, you can operate all of your servos without turning on the radio and creating radio waves that may interfere with someone flying on your frequency.

When in PCM mode, fail-safe can be used. Fail-safe is a feature that is stored and frequently updated in the receiver. If your sailplane was flying and your transmitter quit working (dropped, etc.), no more signals would be generated. After a split second of not receiving any signals your receiver would automatically go into fail-safe. You can use the default controls for fail-safe supplied by the manufacturer or change the controls to your own specifications. This is a nice feature to have when flying an aerodynamically stable aircraft like sailplanes!

Another safety feature involves the battery alarm. If your transmitter batteries voltage goes below 9 volts, the LCD indicator says BATT and a loud beep sounds seven times. Land before the fail-safe kicks in.

The power from the factory-installed lithium battery stores all of the memory in the transmitter. This battery lasts for about five years. After satisfactorily programming your radio, write the information in the menu sheets provided in the manual.

Functions. A detailed 117-page "book" is provided with the X-347. Don't let it intimidate you: It is actually three books in one. There is one section each for engine-powered aircraft, helicopters, and sailplanes.

Easy-to-follow menus are included for each type of aircraft. First, access the system-setting mode to program the model number, type, and even name of your aircraft. A reset function returns everything to the factory settings.

You can make modulation changes in this mode. Why would you want to change the modulation? When the X-347 is switched to the PPM (FM) mode, it can be used with other FM receivers that you may already have. What an inexpensive way to enjoy computer capability with an older set!

You can also copy one model's settings to another. Finally, there's a type-of-wing setting, particularly useful for sailplanes, which usually have V-tail or dual-flap mixing wings that use separate servos for each flap and aileron. By establishing the proper setting, the flaps and ailerons can be made to move together or separately.

Now let's talk about the menu functions related to gliders. I'll explain each point in the order it appears on the menu.

Dual rate. Two separate amounts of servo travel can be selected for ailerons, elevator, and rudder control, from 0 to 125 of throw.

Exponential rate. This feature also can be selected for aileron, elevator, and rudder control. This rate allows you to select only minimum throw when the gimbal is moved halfway or so and then provides more servo movement at the extremes of gimbal movement. This can decrease overcontrolling tendencies but retain full movement if it is needed.

Servo reversing is available for all seven channels and makes setting up the radio easier.

Sub trim adjustment. This setting is available for all seven channels. The adjustable range of each servo is about 30 degrees. Using this function you can center the trim tabs without adjusting your model's control linkages.

End point adjustment. The amounts of servo travel in each direction on all seven channels can be set with this feature. The range is from 0 to 150 degrees.

Elevator to flap mixing. For more precise pitch control in a sailplane, this function automatically causes the flaps to move in concert with the elevator to any degree you wish.

Flap to elevator mixing is the opposite of the above. When flaps are used, the elevator moves to a preset angle. In some models adding flaps can cause a pitch change. Flap to elevator mixing can off set this tendency.

Differential aileron mixing. Adverse yaw is a common



Fig. 3-8. When the right stick is moved forward the elevator goes down. When it is moved down the elevator goes up.

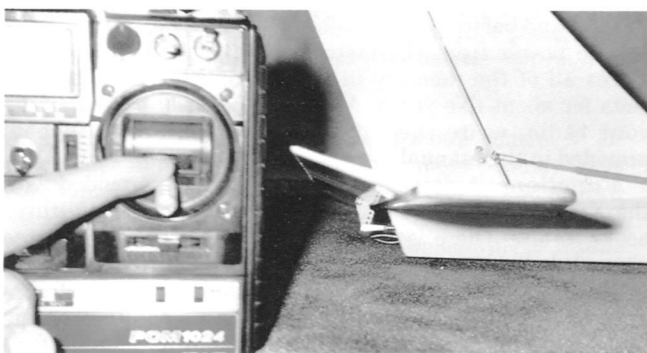


Fig. 3-9. When the right stick is moved to the right the rudder on a two-channel plane moves to the right and vice-versa.

problem on sailplanes that have ailerons. The increased drag that occurs from an aileron that travels downward causes the nose of the sailplane to yaw away from the turn. This feature allows you to program the ailerons so they have more upward than downward travel. Your sailplane must have one servo for each aileron to use this function.

Flap to aileron mixing. This function allows you to use the ailerons like flaps in addition to their ability to roll the model. With this program, the ailerons will also droop to a pre-set amount when the flaps are used.

Aileron to flap mixing allows the flaps to act as additional ailerons to increase the model's roll rate.

Butterfly mixing (crow). This program allows for an effective speed brake in sailplanes with flaps and ailerons. You can predetermine the amount of aileron-up deflection and flap-down deflection you want to effectively slow your sailplane for steep descents. This is helpful for getting out of strong thermals and for spot landings in contests.

Dualflap trim is used to trim flaps attached to separate servos.

Programmable mixing is probably the best feature. It lets you couple any function to any other function to any degree you wish. You can have it always working or couple it to a mixing switch and turn it on and off as you desire. Up to four mixes can be programmed for each model. One useful mix for sailplanes is an aileron to rudder mix, which helps make the larger gliders fly more smoothly with less drag.

Flap knob operating adjustment allows you to determine how much total throw the flaps will have.

Fail safe (in PCM mode only). This function lets you preset your servos where you want them in case the radio control is lost. This feature can easily save a sailplane or glider, so I recommend using it.

Trainer system. This innovative program allows any student to use any single or multiple functions at one time. If the instructor wants the student to use only the ailerons it can be easily programmed in. The instructor retains control of the rest of the functions. Later, anything up to and

including full control can be given to the student, letting him learn at his own pace.

Time. Two types of timers are available for each model. The stopwatch can be used to time up to 44 minutes 59 seconds. The countdown timer can be set for up to 35 minutes. The alarm beeps three times at 30 seconds, twice at 20 seconds, and once each second from 10 to 0.

The integral timer keeps track of the cumulative time that the transmitter is turned on. Resetting this timer after charging will help you keep track of your flying and battery times.

As you can see, the X-347 computer radio system has a lot to offer. It seemed intimidating to me at first (I am still computer illiterate), but with a little time and use of the detailed manual, I easily programmed my contest ship. The X-347 can exceed the needs of most glider pilots and programming any contest ship is easy. If you have some RC experience and want to fly any type of aircraft without buying a whole system for each, the X-347 is for you.

Airtronics Infinity 600 A

Airtronics recently produced its own computer radio: the Infinity 600A, fig. 3-7. This radio is great for powered airplanes and sailplanes. In fact, Airtronics has been dedicated to the sailplane modeler for years and used many sailplane ideas when it developed this radio.

Transmitter. The transmitter case is a durable black plastic that is ergonomically designed and comfortable to hold. You can gauge your battery's effectiveness with the RF meter at the top. Two adjustable gimbals and their corresponding trim tabs are easily reached. There is a neck strap hook, six switches, an auxiliary lever, and an on/off switch. The lower front portion of the transmitter has the six programming buttons and a good-sized LCD readout area.

An automatic low-voltage alarm sounds if the transmitter battery falls below 9.59 volts. The plug-in type battery is easily replaced. Finally, the transmitter uses a

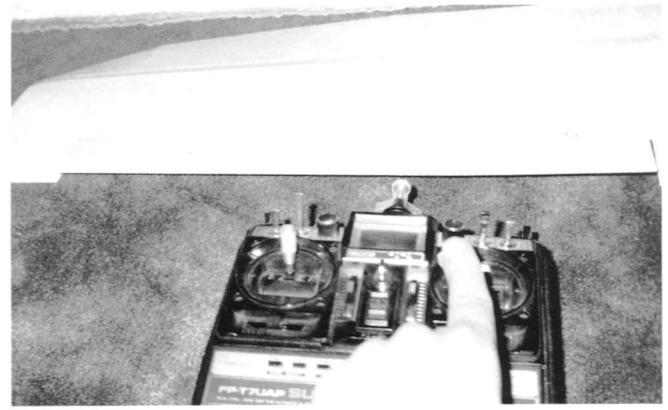
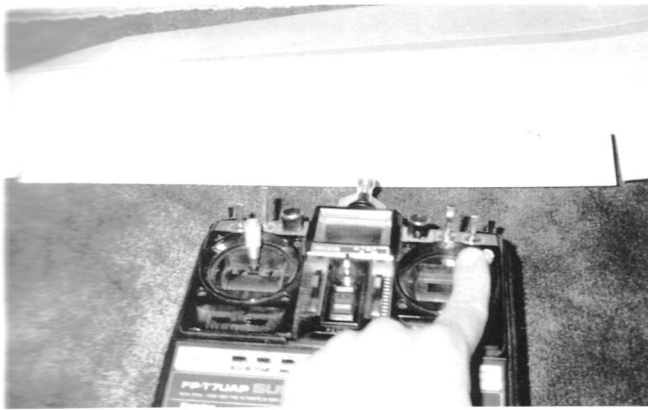


Fig. 3-10. On an aileron-equipped plane the right aileron goes up and the left aileron goes down when the right stick is moved to the right. The opposite is true when moving the stick to the left. (The left aileron is pictured)

removable frequency module that plugs into the back of the case.

Programming features. The heart of the Infinity 600 A's computer is the Advanced Technology Radio Control System. ATRCS has a menu that simply lists questions on the LCD: six push buttons are used to answer the questions and to move around in the menu.

The menu is on the back of the 38-page operation manual. After a little practice, I was easily able to find my way through the menu. Programming my Legend was easy and fun.

The system can store up to four separate aircraft at one time. The menu allows you to protect any of these setups from being erased or changed by accident. A typical trainer system is available and is compatible with any other Infinity transmitter. The mode of the transmitter can also be changed to suite any flyer. A beep sounds when you push any of the programming buttons, but it can be disabled easily.

The basic configuration group allows you to use this system in a variety of planes. Functions in this group include: the data-reset program, V-tail mixing, elevon use, and a two-aileron servo option. PCM or PPM is also selectable and servo reversing and fail-safe are included in this menu.

The switch assignment group allows you to customize which switch you want to perform a particular function. The switches are all assigned numbers, not words, a nice feature I haven't seen with any other radio system.

The next group on the menu is for surface or control adjustments, including electronic surface center (trim adjustments), travel volume adjustments, and aileron differential.

The mixer adjustment group has many nice features for a sailplane pilot. Aileron/rudder coupling for coordinated turns and elevator/flap mixing are easily programmed with this system. In addition, flap/elevator and flaperon or elevon mixing is available. Compensation mixing lets you couple any two functions as you like to compensate for any flying problems. After selecting the mixing and amounts of movement, you can assign this feature to a switch and turn it on and off during flight as needed.

Bidirectional mixing allows you to mix two channels so that operation of either channel causes the other to move in a predetermined direction and amount. This can be useful in V-tail mixing and other possible configurations.

The last group of programming is for setting dual rates and also has a roll button program. When you push a button the ailerons, elevator rudder, or all three will move to a predetermined position. After you release the button, the surface(s) will go back to neutral.

For the competition sailplane pilot, this system will allow you to elaborately set up your plane with a minimum of trouble. On pages 36 and 37 of the manual, a sailplane setup guide takes you by the hand and shows you an orderly way to program your radio. The Infinity 600 A is a great choice if you are leaning toward flying in competition with sailplanes or pattern planes.

Radio Setup

Installing your radio equipment is explained in the instruction manuals of the kits that I recommend in this book, and I'll describe modifications to these instructions in chapter 13. Now you need to become familiar with the proper directions of the controls that the radio transmits to the plane. Referring to the aerodynamics chapter will make this easy.

Here is the basic setup you should use when installing your radio. Deviating from the standard RC aircraft radio setup could spell trouble for you down the road.

- A forward motion of the stick or upward deflection (to the top of the transmitter) is the control for going down, which can confuse a novice. As the stick is moved forward, the elevator should move downward, causing a descent. Likewise, pulling back on the stick (up command) should cause the elevator to rise, causing a climb, fig. 3-8.

- The single stick on a Cobra radio is equivalent to the right stick on a Futaba radio. Moving the stick left should deflect the rudder to the left. Similarly, moving the stick right should cause the rudder to turn to the right, fig. 3-9

- In an aircraft equipped with ailerons, a left stick movement will raise the left aileron and lower the right aileron. The reverse is true for a right deflection of the stick, fig. 3-10.

- In four-channel radios where throttle or speed control is used the left stick determines the motor speed. Full back stick should be off and complete forward movement should give full throttle.

- In aileron- and rudder-equipped ships, the left stick moved left and right should cause the rudder to move left and right.

In addition to correct direction, make sure there is solid control of all surfaces. Also, they should be free and easy to move. If a servo makes a continuous chatter at any control position, it is binding and can eventually burn up and fail. It also drains your battery faster, giving you less flying time. Proper adjustment takes little time, and is well worth the effort.

Range Checks

A range check will help identify any problems in the radio system. This test can be performed when the radio is



Fig. 3-11. Here's how to check the range of your radio. (Top) Collapse the transmitter and check the controls. (Middle) Walk away from the model while checking the controls. When control is lost, note the distance. (Bottom) Finally, extend the antenna. If control is regained, the check is complete.

in its original box or in an aircraft.

Make sure the batteries are properly charged and that the receiver's antenna is fully extended and attached to the outside of the plane. Turn on the system and try your controls to ensure that all servos move freely without glitching or jumping. If the system is in an airplane make sure the travel directions are correct.

Now have a helper stand by the plane or radio components. Collapse the transmitter antenna and walk away from the receiver unit while smoothly operating one or more of the controls. Count your steps. Your helper should signal when the servos either start glitching or stop. Note this distance in steps. Pull out your antenna fully and check to see if control has been restored, fig. 3-11.

Before performing this procedure, be sure to read the manufacturer's information brochure to see if it has any specific recommendations for testing your system. Most will follow these same guidelines and almost all radios on the market today will give antenna collapsed range of at least 50 feet. If this minimum range is not attained, I suggest that you have your radio checked before you go flying. In addition, it would be a good idea to check your system as often as once each day you fly. This will help you to determine if there are any problems with your system or if there is any interference in your flying area.

Radio Etiquette

When you go to a flying field, you need to know if anyone else is on your frequency. Stay in contact with him and use any frequency board or pin setup that he may have, fig. 3-

12. This will help prevent either of you from getting "shot down." This can occur when two people try to fly at the same time while using the same frequency.

Try to agree on a time limit for each of your flying sessions. Remember, when you are flying these types of aircraft, you can easily stay in the air for hours with the right conditions. Don't let these wonderful circumstances cause you to forget about the others who are on the ground waiting to fly.

Radio Charging

Most radios come with nicad batteries and a charger. Charge your system according to the manufacturer's recommendations.

As you will learn in chapter 10, nicad batteries can be damaged easily in several ways, including using improper chargers, overcharging the cells, and even letting them discharge completely.

Batteries also can develop memory easily. Memory decreases the overall capacity or how much charge the batteries can hold. Memory occurs when a battery is fully charged, becomes discharged only to a minimal amount, and then becomes charged again. This often happens in normal RC operation when you only get one or two short flights in during a flying session. Memory also can occur when a fully charged battery sits in storage for three months. Each of these problems can cause memory and can result in a crash.

Cycling Your Batteries

If your batteries need to be cycled but you don't have a battery cycle, all you need is a simple voltmeter and a lot of time. You can buy a simple voltmeter from Radio Shack or spend the extra money and buy an expanded scale voltmeter (ESV), fig. 3-13. Next, buy plugs to match your receiver and transmitter and fit them to your ESV.

First, get a full overnight charge on your batteries. After this, check the battery voltages on the ESV. In the rare instances when they don't fall into the green area there is at least one battery cell failure. Don't try to cycle these cells because there is irreparable damage. Just buy a new pack.

Usually your packs will register in the green areas, so it's time to discharge your batteries. Turn the whole system on and record the voltage. While you're at it, put a good movie into the VCR, this may take time.

Remember, discharging the batteries all the way can cause damage. Use a minimum of 1.1 volts per cell. In a standard transmitter pack this works out to be 8.8 volts. Likewise, a standard receiver pack should not go below 4.4 volts.

While watching your movie, occasionally work the controls to move your servos and simulate flight conditions. Every 15 minutes or so check the voltages and the total times. When these minimum voltages are reached, turn off the system that is involved and record the time. Let's say the receiver pack reaches 4.4 volts and the transmitter pack reads 9 volts. Turn off the receiver pack, note the time, and continue to monitor the transmitter battery pack until it reaches 8.8 volts.

If the time to discharge is two hours or more, cycling will not be needed; just recharge your batteries and fly. If the time is less than two hours, put the batteries back on to charge and, at least 16 hours later, repeat this process. The batteries will take longer to discharge after each cycle. Once the two-hour minimum is met, your cycling and extended

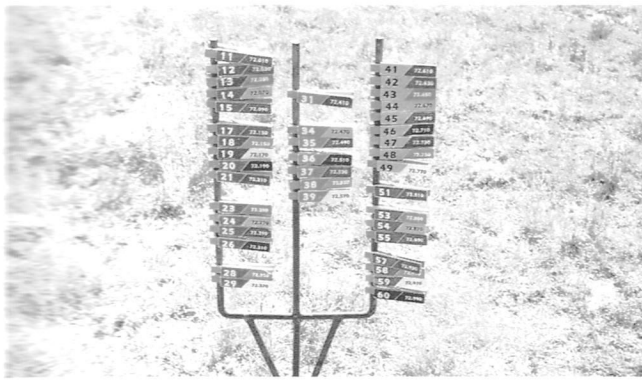


Fig. 3-12. The frequency pins are used to help share radio frequencies. Before turning on your radio, obtain the appropriate pin and place it on your transmitter.

TV watching are over. Fully charge your batteries and go flying. You should cycle your batteries an average of once every three to four months.

If you have many radios and don't have the time to cycle all of them manually, consider buying a battery cycler to discharge your cells to their normal safe limit and then charge them back up to full capacity. It also should be able to measure your batteries capacities. If memory has occurred the measured capacity will be low. By cycling the batteries and correctly charging and discharging the cells two to three times, the full capacity can be regained. These units also can detect damaged or bad cells.

I use the Digipace II by Ace R/C, fig. 3-14. The Digipace II is a good investment because it automatically cycles your batteries. With the flick of a switch, the unit will discharge your batteries to a minimum safe level, recharge them at the proper rate, and then switch to a trickle charge after that. Batteries can be safely left on trickle charge indefinitely without damaging the cells. So even if you forget to unplug the unit, your batteries will be fully charged and ready to use. Also, this unit is designed to accept many different-sized packs and can charge and discharge batteries at various rates.

You may want to check your battery levels at the flying field with an expanded-scale voltmeter (ESV). There are several available from Ace R/C and Hobbico. Simply plug your charging jack from the radio or receiver battery to the ESV and check the level. The unit automatically places a simulated load on your batteries and gives a readout in volts. To make things easy, the scale is color-coded. If the needle falls in the red area, it's time to go home. If it's in the green area, you have enough charge to fly again. If it is low green, consider a shorter flight and check again.



Fig. 3-14. The Ace Digipace II. This is the best unit to use when you need to charge or recondition your radio batteries.



Fig. 3-13. This ESV (Expanded Scale Voltmeter) is being used to check the receiver battery's voltage before another flight. This inexpensive device can save you many dollars worth of damage.

Basic Radio Care

Treat radio components gently. Damage can occur with a drop of only a foot or two. Also, a dirty radio can be difficult to use. The gimbals and trim switches can easily get gummed up. Protect the radio from the elements, namely harsh heat, dirt and water. When transporting your transmitter from home to the field and back, it can be exposed to all of these dangers.

Purchase a small to medium-sized gun case to protect your unit, fig. 3-15. Sturdy plastic cases are available at variety stores. Tougher metal cases are also available. Each case should be lined with thick shock-absorbent foam. To customize this foam to fit your transmitter, place the unit onto the foam and use a marker to draw the transmitter's outline. Remove enough foam in the area to provide a comfortable bed for your radio.

Radio Repair

After a crash or a hard landing, check your system thoroughly for cracks or blemishes. Look at all servos, servo arms, pushrods and clevises, battery pack, and receiver with its antennas. Next, check all servos for smooth and consistent movements. If it all looks okay arrange a test as described earlier. Finally, start the motor and engine if applicable and again try all of the functions.

If everything checks out, you are ready to go. If not, or if something seems to not be quite right, send your radio to the manufacturer's repair facility for a complete check. I send my radio system back after any crash whether it is working or not.

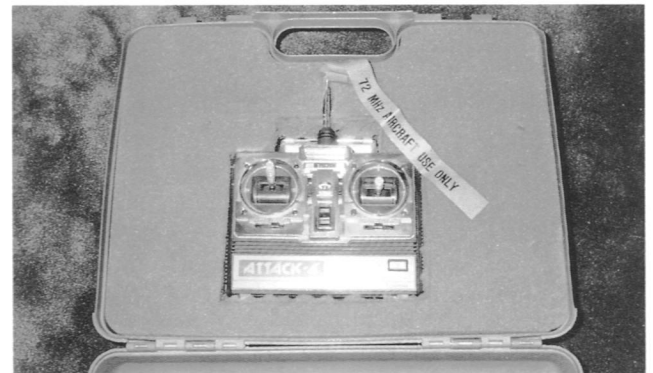


Fig. 3-15. This is a gun case that has been modified so that a radio transmitter can be safely transported.



Fig. 4-1. An instructor launches his student's sailplane on a winch. The student can now concentrate on keeping the sailplane straight during its climb.

4 Launch Methods

You'll need to trim your plane before your first launch. If you don't, chances are it'll crash. And after spending your time and money building a quality sailplane, why risk a crash on the first flight? I can't count the number of stories I've heard about a novice, in a hurry to get his sailplane in the air, who launched his aircraft only to see it come crashing down a few minutes later. Beginners should have an experienced pilot test trim their plane before they start flying.

You can find experienced pilots willing to help in many places. Ask your hobby dealer where and when the local flying club or soaring society meets. Most clubs have good instructors more than willing to help. They should check your plane and perform a test-trimming flight. Your plane should balance at the recommended center of gravity.

Trimming Techniques

Of course after a while you should be able to trim the plane yourself, fig. 4-2. On short, hand-tossed flights you can quickly check the trim or how the airplane flies with all surfaces neutralized. You'll need two people, one on the controls and one to launch the sailplane. Before doing this, make sure the surface travel is correct and that the plane is correctly balanced.

To launch the sailplane, run into the wind until it feels like the plane wants to fly out your hand. At this point gently toss it straight ahead; never throw it hard or up. It

will sharply climb, stall, and possibly crash if it is not properly launched.

After the gentle toss, you'll notice if the plane tends to turn in one direction or if it wants to climb or dive. Gently land the sailplane, and correct the plane by moving the trim tabs the appropriate directions. For example, if the plane tends to turn left and goes down quickly, move the aileron trim tab to the right and the elevator trim tab down. Test fly the plane again and adjust it if needed.

Occasionally the center of gravity (CG) of your airplane may need to be changed, fig. 4-3. The model should be balanced at the point that is recommended in the instructions. During your test flights, you may notice that the plane glides quickly and lands soon after launching. It also may need a lot of up elevator when landing. This indicates the plane is nose heavy. Rearrange the radio components or remove a little nose weight to move the CG back only about $\frac{1}{8}$ " to $\frac{1}{4}$ ". Test fly your plane again. If needed, move the CG back again no more than $\frac{1}{4}$ " at a time. Your plane is properly balanced when it glides easily with smooth control for a good distance.

If your plane is hard to control even when your surface travel is correctly adjusted, your plane's CG may be back too far. Move your radio components forward or add nose weight to move the CG toward the front about $\frac{1}{4}$ ". Repeat as needed until you get a nice flat, easy-to-control glide. Try to adjust the CG of a plane without adding weight.



Fig. 4-2. To check the model's trim gently launch the sailplane straight ahead into the wind and keep it flying on a straight line with a gradual descent. After landing, change the trim tabs and control clevises until the plane flies straight with a good glide each time.

When your plane is properly adjusted and trimmed, you are ready for longer flights at a high altitude (with your instructor's help, of course).

Launching

There are numerous easy methods to launch your sailplane, many only recently developed (remember to have an instructor perform a launch for you before going solo). Hand launching is popular in Europe. This involves using a 150-meter-long monofilament line attached to the tow hook on the sailplane with a metal ring. One person runs into the wind holding the other end of the line while the other controls the sailplane. This is rarely used in the United States.

Other methods, more popular in the United States, include hi starts and winches (which have been improved upon recently). The use of glow-engines (fuel powered) for gaining altitude with a sailplane has been used for many years.

Other exotic forms of launching are towing or piggy-backing with powered planes. You can even use rocket engines for quick high-altitude launches.

I'll describe the pros and cons and provide detailed instructions for each method.

Hi Starts

Hi starts, used for many years, are inexpensive, easy to



Fig. 4-4. Basic hi-start components include rubber tubing, nylon line, a reel, a stake, hardware, and sometimes a parachute. This hi start is made by Airtronics.

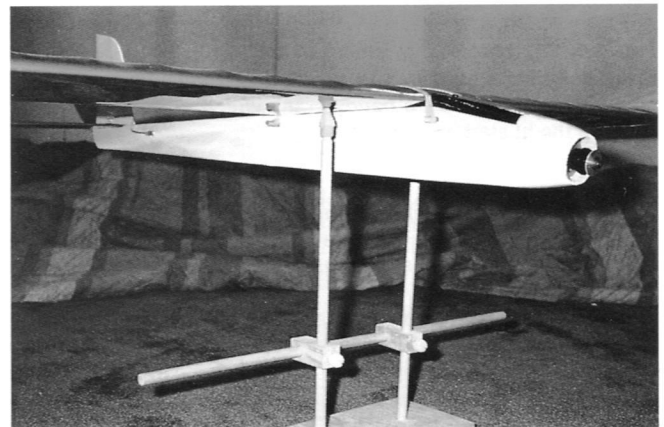


Fig. 4-3. This simple device makes it easy to check the CG (center of gravity). As you can see, this plane balances right on the appropriate CG.

transport, and can produce high launches.

A basic hi start consists of many separate parts, fig. 4-4. Most have 100 feet of surgical tubing attached to the ground with a large tent stake. Connected to the tubing is a long length (300 to 500 feet) of nylon or monofilament line. The tubing and line is attached to a parachute by a snap swivel, or equivalent, to prevent twisting. At the top of the parachute is a metal ring that attaches to the sailplane's tow hook.

Hi starts come in various sizes. Those made of light materials should only be used to launch smaller, 2-meter-type sailplanes. Large, heavy-duty units should be reserved



Fig. 4-5. This pilot has just launched his sailplane on a hi start.

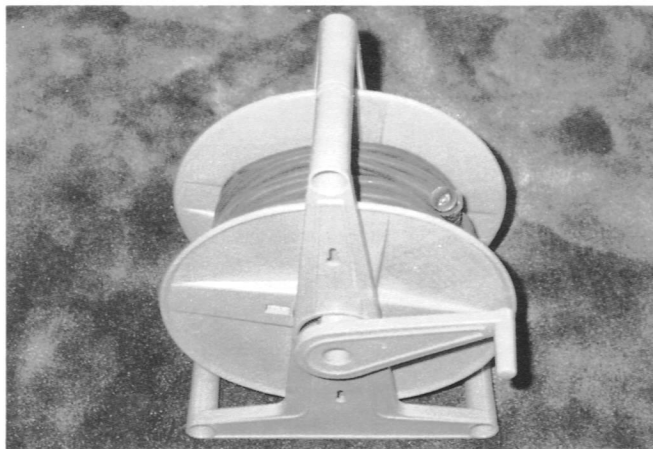


Fig. 4-6. The Minimax hi start comes with a brilliant orange nylon line that is easy to find after launches. It also has a free-standing reel that uses a handy crank which makes it easier to wind up the hi start after use.

for the larger, stronger, unlimited-type sailplanes. You can use medium or small and small hi starts for slope flying when the wind is not strong enough to keep a sailplane in the air.

Many hi start kits are available, so I suggest you buy one of these instead of making your own. Hi start parts can be expensive: the surgical rubber alone can cost more than a whole kit. Plus, building a hi start requires lots of time, and wouldn't you rather be flying?

My favorite hi start is the Minimax, fig. 4-6. It contains 100 feet of black UV safe tubing attached to 500 feet of 75-pound test nylon cord. This cord is dyed a brilliant orange, which makes it easy to find after the launching. All of this is rolled up onto a bright orange spool supported by a small base. A large hand crank for easy winding is included, as is a 9-inch stake. All of this is available for a low price. If you wish to use a parachute, buy one at a hobby shop or make it at home.

Hi-start launching steps. Select a field that is large, flat, and free of obstructions, at least 700- to 800-feet long, and aligned with the wind. Go to the upwind side where the wind first contacts the field. At this point, attach the rubber tubing to the ground with a stake. (Instead of the stake enclosed in the kit I use a spiral dog stake available for \$1 to \$2 from a pet or variety store. This stake is more secure than a regular tent stake and tremendously increases the safety of using a hi start, fig. 4-7).



Fig. 4-8. With this close up view, you can see how the parachute ring fits onto the sailplane's tow hook.



Fig. 4-7. This spiral dog stake can be bought at most pet and variety stores. I recommend that you use one with your hi start for added safety.

Next, roll out the tubing (and attached nylon or monofilament line) toward the other end of the field with the wind at your back. After everything is unrolled, continue walking in the same direction with your spool. Pace off your steps until you reach the desired length. (Your kit's manual will indicate what this length should be depending on the wingspan of your plane; if it doesn't, take one average pace for each inch of wingspan, up to a 100-inch plane.) When you reach this distance, place the spool on the ground to mark it, then bring your sailplane, radio, and parachute to this position.

Make sure the line doesn't get tangled. At this point it should be taut and springy; if it feels like it's pulling too hard, it's better to decrease the tension than to risk folding your wings during the launch. Also, if the wind is blowing fairly hard, less tension will be needed.

Turn on the radio and make sure all surfaces move correctly. For your first few launches, put in about three or four clicks of down-elevator trim to make the model easier to handle. Attach the parachute ring to the tow hook and hold the sailplane over your head and to the side, fig. 4-8. It is easier, especially for your first flights, to use an assistant to hold and launch your sailplane; however, you can do it alone after you've gained experience. Recheck the wind direction and your controls. If all is well, you are ready to launch.

Throw the sailplane forward and up at about a 30-degree angle. Throw the model firmly and straight. If it doesn't

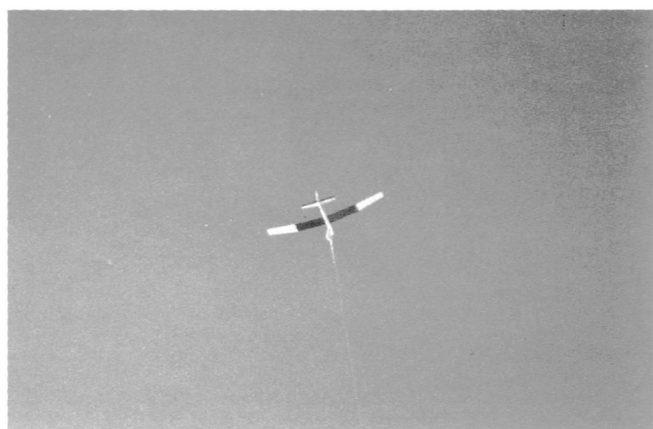


Fig. 4-9. After launch, concentrate on keeping the plane's wings level for a maximum amount of altitude.

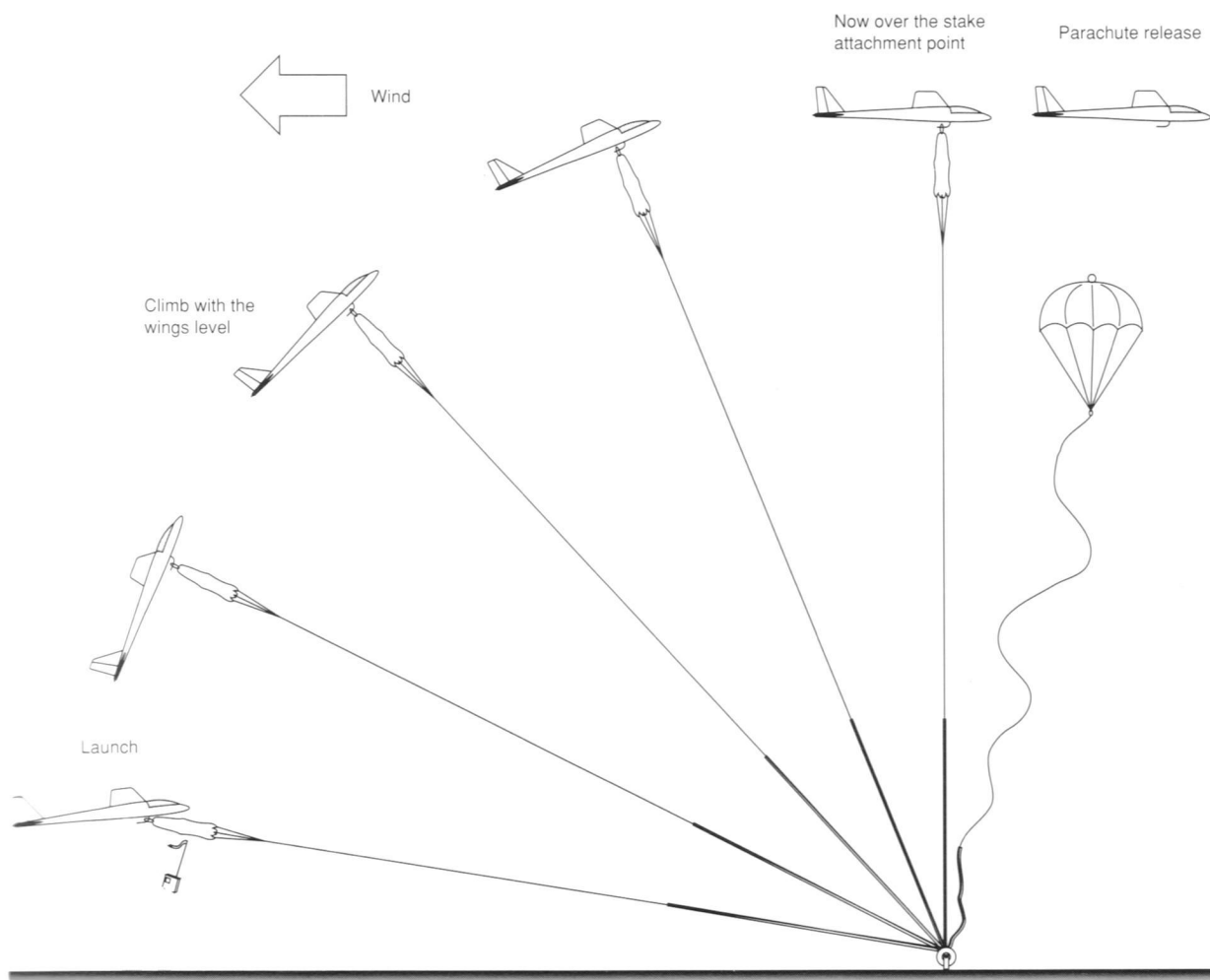


Fig. 4-10. Hi-start launching. After launching, keep the wings level until the plane reaches a point above the stake. Release the parachute by flying past this point or by pulling up abruptly after a small descent.

have enough launch speed, it may stall and fall off to one side and hit the ground. Concentrate on keeping the wings level throughout the climb, fig. 4-9. If the conditions are right, little correction will be needed for the sailplane to make a gentle arc to the top of its launch position. Once it is above the tiedown point (on the other side of the field) it's time for the release.

There are two easy ways to release the sailplane from the hi start. The easiest is to continue flying the sailplane straight ahead. The hi start ring will soon pull off the tow hook as the sailplane travels ahead of the tiedown stake. In some launches, especially with higher winds, the hi start will still be somewhat stretched out when the sailplane has made it to the apex. To retain this high altitude you'll need to release sooner.

In this situation, put the sailplane into a gentle dive, then give an abrupt up-elevator control. The nose will pitch up and the tow ring will quickly pull off. Sometimes the parachute can fall quickly for several feet until the tension has been released. After this release, the sailplane is at a nose-high attitude and will stall unless you act quickly. Give enough down-elevator control abruptly so the plane is at a level attitude. That's all there is to it, fig. 4-10.

The parachute will drift with the wind, pulling the length of hi start back to your general position. This ingenious design allows you to walk a minimum distance for your next launch.

When you're more proficient at launching your plane, you can modify your technique slightly to obtain more altitude. Shortly after throwing the plane, when it has climbed for a second or two, slowly add up-elevator control. This will cause the plane to climb and keep additional tension on the stretched rubber. If you apply too much elevator, the plane may be difficult to control and may fall off prematurely. Apply just enough to give you extra altitude without compromising the directional control. More advanced models like the Airtronic's Legend and the Great Planes Spirit 100 have flaps that can be deployed to a set amount for launch. With trial and error, a preset flap position can be used to help gain altitude during launches. Additional up elevator can be either preset or used manually as described.

Tow-hook position. Most sailplane plans show you where to attach your tow hook. If you look at the center of gravity, you will see that the tow hook is always forward of this position. Make sure your model balances correctly on

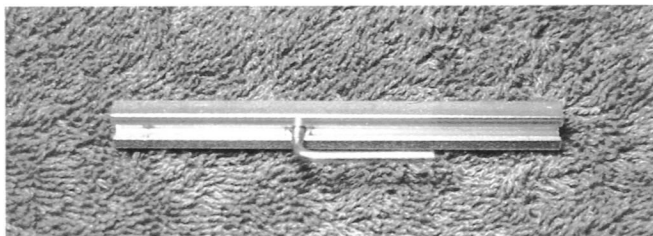
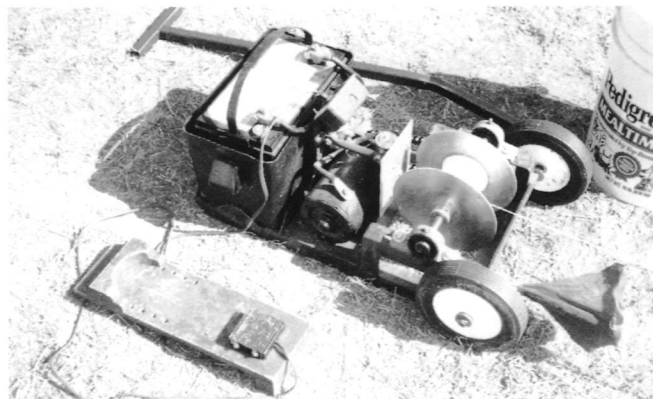


Fig. 4-11. Airtronics Adjustable Tow hook - Simply turn the hook counter clockwise and slide it to the desired position and tighten it down.



the CG. Shift your battery or add weights as needed. Next, make sure the tow hook is placed at least $\frac{1}{4}$ " forward of the CG. If it is placed too far back, the glider will immediately come off of the tow hook during a launch, resulting in a low-level loop or "figure 9" into the ground.

Use this location as a starting point. The model should be stable and should climb ahead with good control. If the tow hook is too far forward, the model will gain little altitude and will accelerate straight ahead. Move the tow hook back, about $\frac{1}{16}$ " at a time, until the model appears to be too touchy on its climb-out. Move the tow hook forward about $\frac{1}{16}$ " and it should be set for your best launches.

When the tow hook is far from its optimum setting, adjusting it can be tedious because you'll need to use lots of holes to fine-tune its position. I always use Airtronics's adjustable tow, which mounts to the sailplane with only two bolts, fig. 4-11. The hook itself is threaded into a nut that slides on the main body of the apparatus. Slide the hook to the desired position, and turn the hook clockwise until tension is met and the hook points rearward. With this setup, you can adjust the tow hook's position in any increment and in only a few seconds.

Safety considerations. Because the hi start provides a lot of power in a short time, you need to be cautious. Remember to check that your radio is on and working correctly before you attach the ring to your tow hook. I have seen people lose their grip on their sailplane during this process and if the radio isn't turned on, a lost or crashed glider can result. Check your radio one more time right before the launch. One of my flying buddies accidentally turned his receiver switch off while attaching the tow ring and his plane took a high-speed banking turn into the ground after launching. Always double-check for proper radio operation before launching.

Before using a hi start, check that the path ahead of you is clear. If others are flying, be sure there are no planes in the area that might be involved during your launch. Also be sure that the area in front of you on the ground is clear. This includes people as well as other obstacles such as another hi start that has crossed over your line. One other obstacle to avoid is your head. If you don't hold the plane high enough during a launch, the horizontal stabilizer may hit you in the head. The potential damage to your head is obvious. Also, you'll soon find that your plane doesn't fly well without its "tail-feathers" attached!

Winches

Electric winches are popular at sailplane clubs. They can provide for high launches with minimum hassle.

A typical winch is made from a few standard materials. The heart of the electric winch is a 12-volt Ford starter motor with an extra-long shaft. A drum or spool is attached to this shaft which carries up to 400 meters of high-test nylon chord. A foot-switch activator, solenoid, internal switch, and 12-volt auto battery make up the rest of the electronics, fig. 4-12.

A turnaround pulley usually is located about 200 meters from the winch downwind from the launch site. The winch



Fig. 4-12. (Second from top) This is a typical 12-volt winch that you can make easily. The car battery is connected to a starter motor that drives the large metal spool in the front. The foot activated switch is seen in the foreground. (Bottom two) Here is an actual launch using an electric winch. As soon as tension is felt in the launch line, the sailplane is firmly thrown forward and upward. Be sure to keep the wings level throughout the climb.

hook
and

Next,
of the
ately
low-

ould
f the
little
e tow
ars to
ward

ting,
ots of
onic's
y two
that
ook to
until
this
any

des a
ious.
rking
have
g this
ashed
right
ntally
y ring
o the
proper

of you
es in
also be
clear.
ch as
other
plane
may
ead is
n't fly

ey can
erials.
starter
ached
h-test
ernal
of the
meters
winch

ch that
starter
e foot
Here is
sion is
rd and
imb.

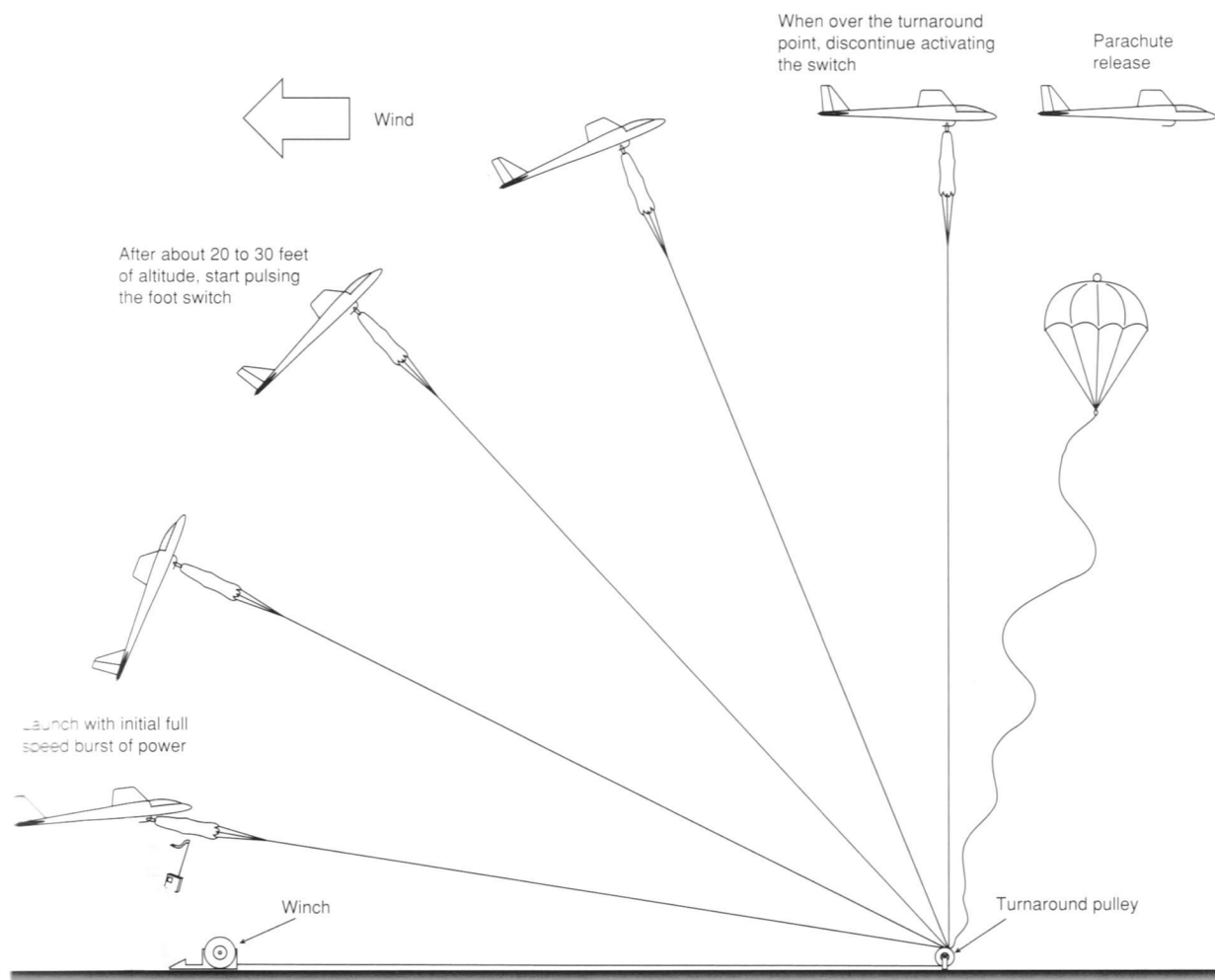


Fig. 4-13 ELECTRIC WINCH LAUNCHING

is at the launching area with the foot switch in an open, easy-to-reach area usually behind the winch. The end of the cord has a standard hi-start parachute and tow ring attached. As you can probably tell, the winch with its assorted components along with a large car battery can be cumbersome and heavy. Special trucks or carts with all-terrain wheels will make transporting it from the car to the field easier.

Most clubs make their own winches from the above-mentioned parts. Commercial winches are available at high costs.

Using a winch for launching your sailplane is similar to using a hi start, except that you can control the tension or pull of the line with the foot switch. The best advice is to have someone with experience help you launch your sailplane the first few times.

Most 12-volt winches have enough power to break sailplane wings. Thus, with foot switch pulsing, instead of holding the switch down through the entire launch, you'll tap the pedal at a rate that will give you a good launch without damaging your plane.

Winch launching. To launch your sailplane, hold the plane above your head after checking your controls and attaching the tow ring, figs. 4-12 and 4-13. Now gently pulse or tap the foot switch until you feel some tension in the line. Continue pulsing the switch and throw your plane slightly upward, 20 to 30 degrees and forward with the

wings level.

Again, throw your model with enough force to prevent a stall. Initially, hold the pedal down until the model gains 20 to 30 feet. All of this energy immediately translates into altitude and won't damage your sailplane. If you keep holding the switch down, the energy will pull the model down against the lift of its wings. If your model is not strong enough, the wings may fail, resulting in a crash. When the plane reaches an altitude of 20 to 30 feet, begin pulsing the switch intermittently to complete the launch. The entire launch profile and speed should match your hi-start launches.

At the top, stop tapping the switch and wait for the parachute to come off. If it doesn't, perform a release as before, slightly diving followed by a brisk up command. Level the wings and continue flying. When the parachute comes off, give the winch another pulse or two to take up slack in the line. After you have landed, walk back out to the field and pull the parachute and line back to the launch position.

Another device that lets you use the winch more frequently and efficiently is a winch retrieval system. The best retriever is called the EZ Winch Retriever, fig. 4-14. It has a large spool that looks like a fishing reel with a moderate test nylon cord attached. This cord goes through an islet on the end of a rod in front of the unit and then attaches to the point where the winch cord attaches to the

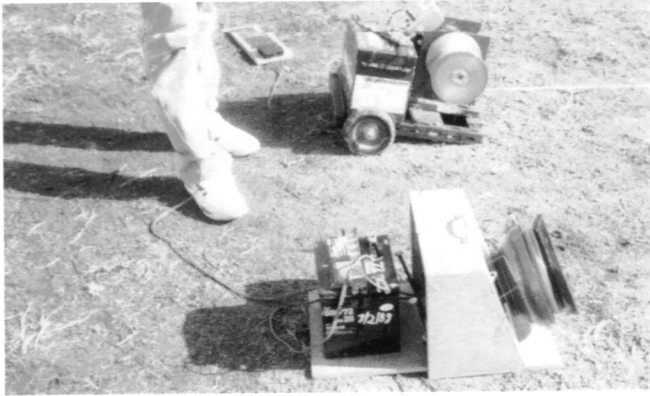


Fig. 4-14. The EZ Winch Retriever is used to bring the launch parachute back to the launch point without walking. It resembles a large fishing reel activated by an electric motor. Someone besides the pilot should be assigned to operate it after the plane is released.

parachute. Another electric motor and battery attaches to this reel. An additional foot switch is used on this unit.

You'll need a helper to activate this unit while you use the winch. Properly align the reel so it will easily pay out the line. Perform your launch as usual, and after the tow hook release, the retriever operator simply activates the switch until the line has been retrieved.

Safety. Winch launching safety concerns are similar to hi start safety concerns. Be sure your radio is turned on and working properly. Make sure the lines are not tangled or snagged and that the air and ground ahead are clear. Be sure no one is near the winch or retrieval drums before launching.

Finally, adjust your winch pulsing according to the wind. In windier conditions you'll use less frequent pulsing on the foot switch. With practice, you can learn to use a winch for some high launches with little effort.

Engine-Assisted Launches

Glow-plug engines. These engines (an engine that uses a glow plug containing a thin spiral of platinum wire that glows at red heat all the time, causing the fuel mixture to burn in the combustion chamber) can be used to take a sailplane up to where the thermals accumulate. These engines have a lot of power compared to their weight. However, they're a mess to clean up after flying, require additional flight box accessories including fuel, and are noisy (which upsets sailplane purists).

These engines can be used to power a sailplane in three basic ways. The simplest method is to use a power pod with an engine that can be mounted to your wing with rubber bands. For two-meter sailplanes, a combination of Cox's power pod and a Tee-Dee .049 engine works well. Simply attach the engine with propeller to the pod and connect the

fuel tubing to the pod's internal tank. Next attach the base of the pod to light plywood. Use a rubber band to secure the whole assembly to the top of the wing.

Fill the tank, turn on your radio and check it for correct movements, then start the engine according to the manufacturer's instructions. When the mixture is properly set, launch your sailplane straight ahead. Adjust the trims for a gradual climb with the wings level. About three or four minutes later, the engine will stop when the fuel runs out. Fly your glider as before. After landing, clean the greasy fuel off of your plane using 409 and towels. Do this before each flight; the oil can make it hard for you to get a proper grip on your glider for launching.

The next form of engine power includes a small attachment that plugs into the underside of your glider. Start the engine as before and launch, staying clear of the spinning propeller and hot engine. After the engine quits, the lack of forward tension causes the assembly and engine to drop off the sailplane. Sometimes a parachute is used.

With this system, the glider is significantly lightened when the engine departs. The bad news is that when the engine quits, it drops off at that instant. Engine/parachute assemblies have been known to float for a long distance and frequently are lost.

The last way in which a fuel-powered engine can be used to power a sailplane is permanent. The engine itself must be built into the nose of the glider. The additional building that is involved and the corresponding weight of the engine, tank, and possible extra servo to operate it are obvious disadvantages. Also the option to fly this plane as a pure glider is eliminated unless you decide to rebuild the whole front end of the glider. Royal sells a pre-built engine-powered sailplane called the Power-Soar, fig. 4-15.

There are many advantages of this type of setup. A larger tank can be incorporated behind the fire wall or first bulkhead. Using smaller engines, fuel for a total run of more than a half hour is easily feasible. As you fly and use up the fuel, the glider gets lighter. Next, adding a servo for throttle control gives you great flexibility. Imagine climbing to 700 feet and then throttling back to idle to ride thermals. When the plane eventually comes down, simply advance the throttle and climb again.

Special equipment and safety. You'll need extra equipment to fly your glider with a fuel-powered engine. This includes extra glow plugs, propellers, wrenches, pliers, and screwdrivers. Also, you will need the proper grade of fuel with a pump and a starter battery. Don't forget the 409 and towels to clean up the mess afterwards. I would suggest buying my other book, *Beginner's Guide to Safe and Easy RC Flying*, to read more about flying powered models.

Read the instructions that come with the engine and any pod or assembly you buy. When starting the engine, have someone hold your plane securely and make sure the propeller area is clear of any objects, including your fingers, fig. 4-16. Buy and use an electric starter. It is powered by a small 12-volt battery and can save your fingers from serious cuts.

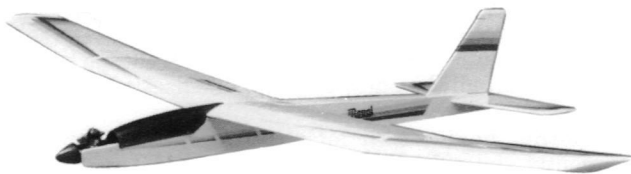


Fig. 4-15. This is Royal's power soar which features a motor built into the nose of the sailplane.

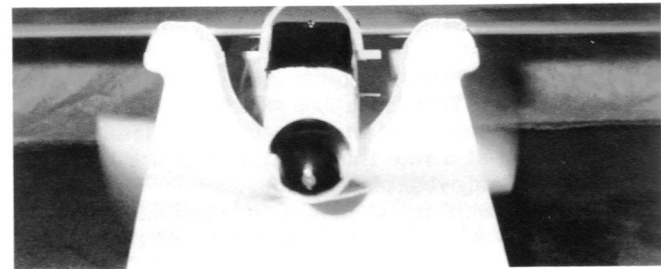


Fig. 4-16. When the engine is running, the propeller can quickly become invisible. Keep your hands and clothing clear!

base
the

correct
to the
properly
trims
four
out.
reasy
before
proper

small
lider.
of the
quits,
engine
d.
tended
en the
chute
ce and

used
must be
g that
engine,
vious
a pure
whole
engine-

up. A
or first
run of
and use
ervo for
mbing
rmals.
nce the

extra
engine.
pliers,
ade of
the 409
uggest
d Easy

and any
e, have
re the
ingers,
ed by a
serious

quickly

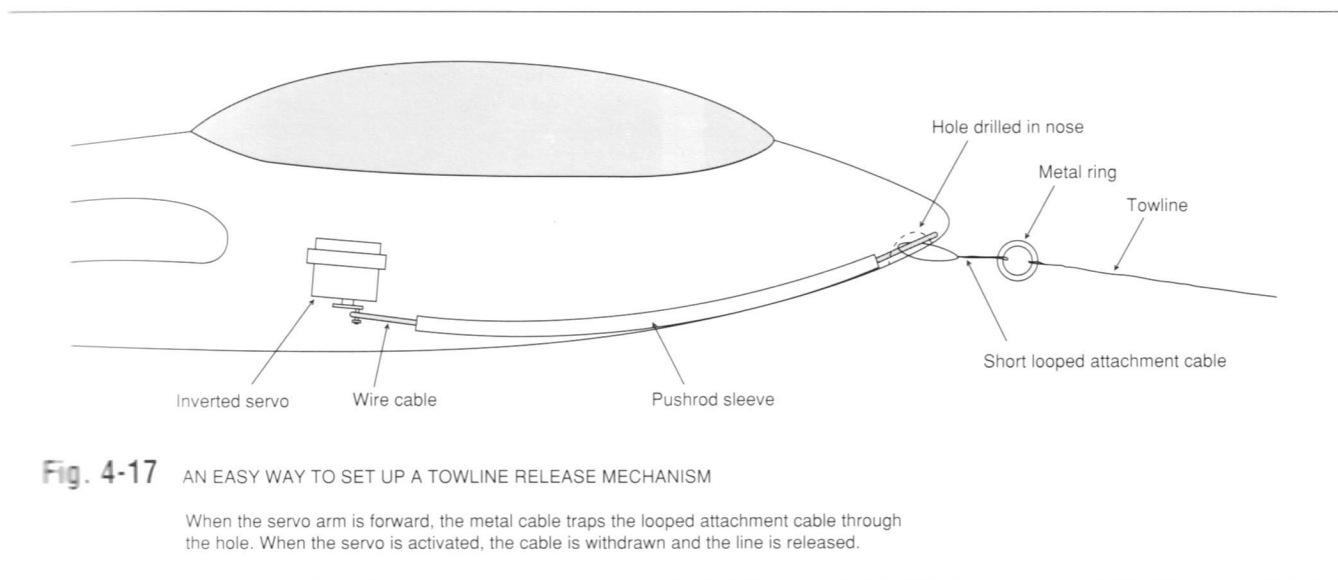


Fig. 4-17 AN EASY WAY TO SET UP A TOWLINE RELEASE MECHANISM

When the servo arm is forward, the metal cable traps the looped attachment cable through the hole. When the servo is activated, the cable is withdrawn and the line is released.

When the engine is started, get behind the engine when removing the starter clip from the glow plug. Finally, be aware that the engine is hot not only while running but also after flying. Be careful and don't get burned.

Towing

Towing sailplanes to altitude with powered airplanes is the most common way to launch full-size sailplanes. This same method can be applied to model sailplanes.

First, find a proper tug or powered plane and an accomplished flyer to guide it. Since most sailplanes fly slower than the typical gas plane, use an airplane that flies slowly but also provides a lot of power so that both the tug and the attached sailplane can reach a good launching altitude. The two tugs I recommend are the Sig Senior and the Hobbister 60 by Hobbico. When powered by a strong engine, each will easily meet these requirements.

Most sailplanes can be launched using a tug. Almost all of the thermal sailplanes can be used. Due to the higher flying and stalling speeds of some of the higher-performance sailplanes, I wouldn't recommend them for this type of launching; it's too difficult to get the sailplane airborne behind the tug because of the great speed that is needed. Generally speaking, if you can easily hand launch a sailplane and get a good glide out of it over level ground, it's a good candidate for towing.

Now you need to set up a release mechanism in the sailplane. Do not use the usual tow hook located on the

fuselage for hi starts to connect to the tug. Disaster will result. You can fashion a release mechanism into the nose of the glider in a couple of ways.

The first is made by using a cable that slides through an external plastic housing. Drill a hole through the nose of the sailplane, fig. 4-17. Then place a wire cable across this hole from the inside. Secure the external sleeve that the cable goes through inside the fuselage and attach the other end of the wire cable to a separate servo.

To use this setup, insert a towline loop in the hole in the nose of the sailplane. The cable must be in the retracted position. Next activate the servo so the loop is threaded onto the wire cable. Adjust the servo travel so the cable retracts far enough to release the tow loop easily. Hook this release servo to either the throttle or retract switch on the radio if they are not already being used.

The second method of release involves a new product imported by Hobby Lobby. This unit includes a sturdy metal cylinder that mounts to the nose of a sailplane. A spring-loaded piece has a ball on the end of it and this piece mounts to the towline. The third piece is beveled metal that attaches to a servo by wire.

Simply push the ball end of the towline mechanism into the exposed cylinder that is attached to the nose. Now activate the servo so the beveled piece slides down the cylinder and traps the ball into a locked position. To release, activate the servo to pull the beveled piece away from the ball and the towline mechanism literally springs



Fig. 4-18. Glider towing. The towline can be connected to the center of the tug's wing or to its tail. Due to its lighter wing loading the glider typically flies above and behind the tug.

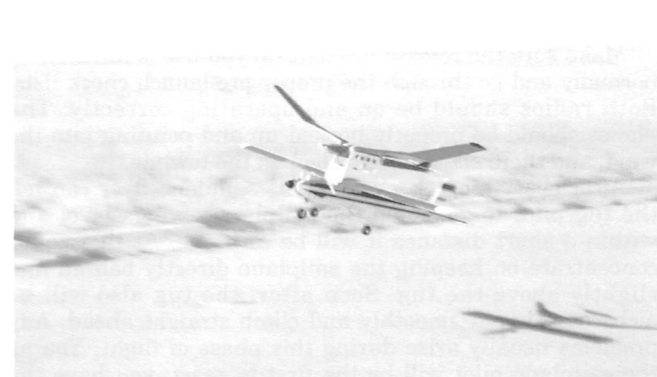


Fig. 4-19. The tug and sailplane combo gracefully taking off for a high altitude launch.

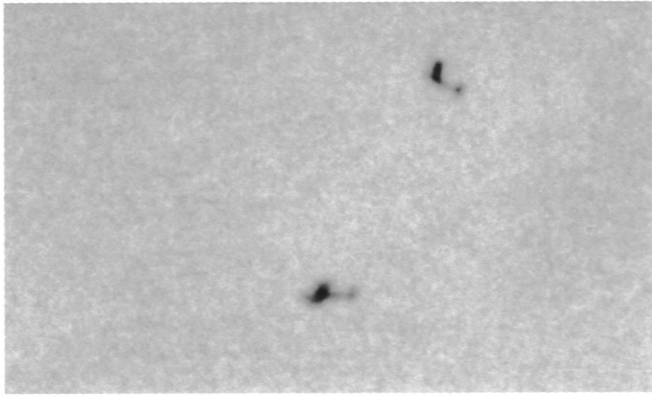


Fig. 4-20. Now that the two are at a good altitude the tug is slowed down and the mechanism is activated. The sailplane is immediately released and the two planes can separately descend and later repeat the process.

loose.

Now that you've chosen an appropriate tug, sailplane, and release mechanism, we have only a few more things to do before our first tow. A bright red and orange towline that is about 100 pounds test and 100 feet long test is good to use. You may need to attach a piece of wire on the ends of the line, especially if you are using a wire cable-release mechanism. To attach this, use a metal ring or key chain to link the two so the wire doesn't fray or cut the towline.

The last step in preparation is to attach the towline to the tug. This can be performed in one of two ways. The first is to attach the line to the tail of the tug, as in full-size applications. A ring could also be easily mounted to the underside of the rear fuselage. The problem with this point of attachment becomes apparent during the towing. You will find that the greater speed supplied by the tug to the sailplane will cause greater lift on the sailplane's wings. As a result, the sailplane will fly above as well as behind the tug. The sailplane literally will pull the tug's tail up, making it difficult to control the tug.

I recommend that you attach the towline to the tug's wing, fig. 4-18. It is closer to the tug's center of gravity so its stability will only be minimally affected. A special ring could be attached to the wing to hold the towline. The line can be attached easily by using the wing hold-down rubber bands or a wing hold-down bolt and washer if you prefer. A release mechanism also can be used on the tug, but it's not necessary.

Flying Techniques

Both the tug and sailplane should be proven performers and be properly trimmed. Use a large, flat, grassy area for launching if the sailplane doesn't have a wheel.

Make sure the release mechanism you use is functioning normally and go through the proper pre-launch check lists. Both radios should be on and operating correctly. The planes should be properly hooked up and pointing into the wind, and there should be no slack in the towline.

After everything checks out, the sailplane flyer can tell the tug pilot to go. Keep the sailplane's wings level and within a short distance it will be airborne. At this point, concentrate on keeping the sailplane directly behind and slightly above the tug. Soon after, the tug also will be airborne. Fly out smoothly and climb straight ahead. Any problems usually arise during this phase of flight. You as the sailplane pilot will be the first to react; you have the release mechanism. Be keenly aware of your position to the tug. If you lose control and your model veers sharply away from the tug's path, release, land, and try it again. Remain in close contact with the tug's pilot; if he has any problems,



Fig. 4-21. This is a close up of the piggyback mechanism sold by Hobby Lobby with a sailplane mounted and ready for flight.

be ready to quickly release if he needs you to (if his engine quits, for example).

Barring any problems you should now be in the air right behind the tug and climbing to altitude. Coordinate your turns. All turns should be no more than 10 to 20 degrees of bank. Smoothness and stability are the names of this precise game.

When you have reached a good thermalling altitude, call out your release. Activate your release mechanism as usual and have a nice ride down. After you gain more experience, you may find this type of launching to be the most challenging and fun, figs. 4-19 and 4-20.

Piggybacking. As you can tell from the name, a sailplane literally sits on top of a powered plane, is carried to altitude, and is then released, fig. 4-21.

Hobby Lobby sells a launcher that is built up out of hardwood, balsa, and foam. Its release mechanism is activated by an extra servo that is mounted to the unit.

The system sits on top of a powered plane that conforms to a typical tug type and is attached with rubber bands. Put the sailplane on the top of the cradle and attach it with rubber bands. Slip the free end of the bands onto a well-lubricated piece of piano wire that is hooked to a servo. To release, activate the servo; the rubber bands will slip off and the sailplane will fly free.

For this system, again use a previously flown and properly trimmed tug and sailplane. Attach them to each other as stated and be sure that both radios are turned on and properly working!

After everything checks out well, the powered model should be taken off as usual. Only minimal bank angles should be used while climbing. Be prepared to release the sailplane if there are any problems.

Once at altitude, carefully slow the plane down as much as possible. When the pilot is ready, the model should be released and flown as usual. The tug can be immediately landed and another sailplane can be taken up right after.

Rocket assist. Launching gliders with rockets has been around now for quite a few years, mainly on a full-size level. It took me a little while to figure it out too, but it's called the space shuttle! The orbiter is nothing more than an expensive glider that is launched using rocket power.

Two new model-rocket-powered gliders are the Astro-Blaster by Estes Industries, fig. 4-22, and the Phoenix by Aerotech, fig. 4-23. These models are intended for use by late beginners to intermediate fliers because of the high speeds attained during launching. If your model is not properly trimmed before launching, any small control inputs will be greatly exaggerated by the model's speed. This could make for an exciting and possibly dangerous situation for a rank beginner. After launching, you also will find that the glider's speeds are faster than a typical slope

ism sold
flight.

engine

air right
ce your
rees of
of this

de, call
s usual
erience,
e most

ame, a
carried

out of
ism is
it.
nforms
ds. Put
it with
a well-
ervo. To
slip off

wn and
to each
rned on

model
angles
ase the

s much
ould be
ediately
after.

as been
ze level.
lled the
han an

Astro-
enix by
use by
he high
l is not
control
s speed.
ngerous
also will
al slope

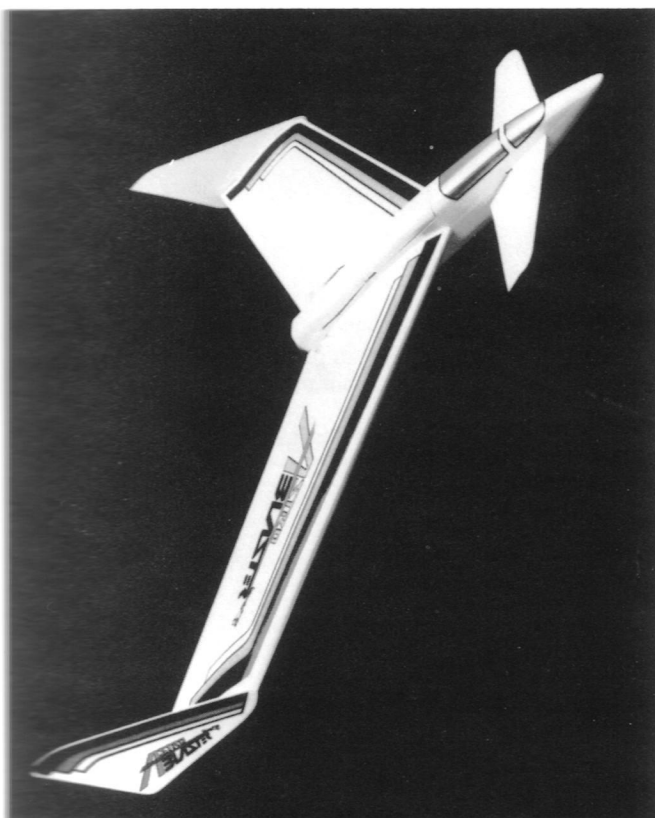


Fig. 4-22. The Astro Blaster by Estes

swarer.

Each kit requires a radio, adhesives, covering materials and rocket motors. If you have built one or two models, you're more than prepared to assemble these kits. Each come with detailed instructions that describe building and

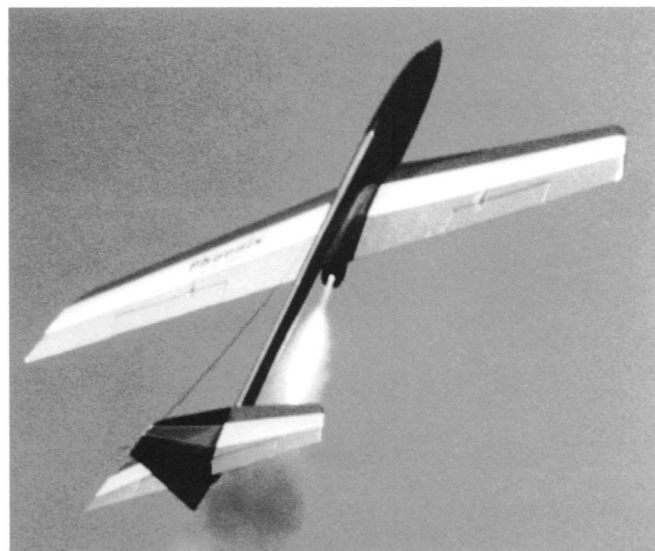


Fig. 4-23. The Phoenix by AeroTech launching for a high altitude flight.

flying techniques.

These models are exciting not only in their spectacular sounds and launching speeds, but also in their flights on the way down. Both are aerobatic and maneuverable. Be sure to obey all of the standard AMA as well as the special rocket glider safety codes when using these planes. After you gain experience with faster sailplanes, give this a try, you may love it.

Electric power. This is the last form of launching that I will cover in this book. Electric power has been around for many years but recently has become popular for launching gliders and powering other models. The second part of this book is devoted to the wonderful intricacies of electric-powered flight.



Fig. 5-1. Two gliders sharing a thermal on a perfect day.

5 Thermal Flying

Now that you know how to launch your sailplane, how do you keep it in the air? There are several types of lift. You've already learned about aerodynamic lift, generated by a wing; there is also environmental lift. The types that concern us as sailplane pilots are thermal lift and ridge lift. Ridge lift will be introduced in the slope soaring section (Chapter 6).

Once your sailplane is launched to an altitude, it is destined to return to the ground because there is nothing to oppose gravity. Fortunately for us, the differential heating of the earth's surface can produce columns of rising warm air called thermals. A strong thermal can carry a sailplane to tremendous heights.

Differential heating means that one portion of the flying area becomes warmer than the surrounding area. This warmth is produced by the sun's rays contacting the land or an object — as a result its temperature rises.

The darker the contact point is, the hotter it gets. Remember getting into a car on a summer day and burning yourself on objects within the car? The glass in the windshield is barely warm, but the darker-colored seat belt, steering wheel, or seat can be burning hot. This principle applies directly to thermal formation.

Darker environmental surfaces get hotter than surrounding lighter areas. For instance, a paved parking lot, freshly plowed dark soil, or an area of houses that are upwind from an open field are all good thermal-generating sources. Poor lift can be expected over open bodies of water, light-colored ground, and heavy areas of vegetation.

As one of these dark-colored areas heats up, the air that comes into contact with it also heats up. As the air warms, it becomes less dense and begins to rise. Cooler air from the surrounding area rushes in from all sides to replace the rising air. This air also warms up and rises to join the

growing thermal.

As the thermal builds, a strong column of rising air forms. The air rises until it cools at a high altitude. The now-cooler air falls outside of the thermal column until it reaches the ground. Then it flows back into the base of the thermal for reheating, which completes the circuit.

If the air is moist, as it rises and cools it will condense and form clouds. These clouds grow to high vertical altitudes and are appropriately called cumulus clouds, fig. 5-2. These clouds can reach heights of more than 60,000 feet. Although these clouds signal great conditions for thermal soaring, don't let your model get too high. Many have lost their sailplanes to strong thermals.

As a precaution, place your name, address, and phone number in all of your aircraft. Several friends have lost airplanes that eventually were returned to them. Cheap insurance!

Another great way to identify a thermal is by watching the birds. Hawks and eagles love to soar and ride thermals too. I have shared thermals with these majestic birds many times. It gives you a feeling of how pure this sport really is. So if you're out flying and spot a soaring bird, see if you can join him for some wonderful flying.

Finding and Intercepting Thermals

Several thermal identifiers have been given to you already. Although clouds and soaring birds usually aren't around when you need them, there are other ways to find thermals.

Let's go back to thermal formation. As you now know, certain areas can generate more heat than others. If you have one of these heat generators at your flying site, fly toward it after your launch.

As you fly toward this area, be aware of the prevailing

wind. Thermals rise with the wind and tend to slope away from the surface that generates them. Fly toward a point that is downwind from the area and watch your wings.

As you begin to enter the edge of the thermal, the wing that enters it first will be lifted up. It will look like the plane is turning by itself. You have found the thermal, and you need to enter it.

There are a couple of ways to enter a thermal after you see this wing lifting "sign." Let's say, for example, that your right wing went up, causing your plane to turn sharply to the left. The thermal is to the plane's right.

Complete the turn to the left until the plane is flying directly toward the thermal (a 270-degree turn will be about right). As you continue flying in this direction the plane will begin to rise, and you will immediately know that you are in the thermal column, fig. 5-3.

Another way to enter this same thermal is to immediately make a 90-degree turn to the right after the right wing rises. I choose my entry by the degree of bank that the lifted wing takes. If the wing rises sharply, I'll continue the turn to 270 degrees. If it is a mild deflection, I'll turn directly toward the thermal.

Now that you're in the thermal, how do you stay in it? First, you need to slow the plane's forward speed by slowly increasing the elevator trim until the plane is close to stalling. Next, make shallow banking turns in both directions and watch your rate of ascent. When you find the area of the highest lift or the thermal core fly into it and begin turning a bit steeper. This will cause the sailplane to circle within the thermal core and a rapid climb can result. If your altitude is less than 400 feet circle tightly to stay in the small thermal core. At higher altitudes less banking is needed because the thermal column increases to a greater diameter, figs. 5-4 and 5-5.

What if you get caught in a strong thermal? You have

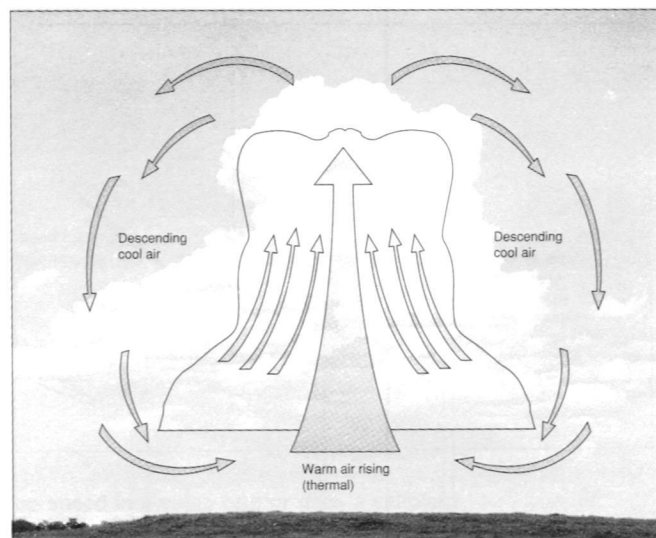


Fig. 5-2. This building cumulus cloud is a result of central rising warm air. Notice how the rising air cools then drops around the outside creating a lower velocity downdraft in this area.

several options. First, try to fly out of the thermal. At the thermal top, the column of rising air may be wide so your model might not be able to escape the thermal before it goes out of sight. Use spoilers if your sailplane is equipped with them. They can effectively decrease the lift on your wings and let you descend safely.

Never try to dive out of a thermal unless you have an unusually strong wing. I've seen many sailplane wings fold up even after a mild to moderate dive. Your last option is to

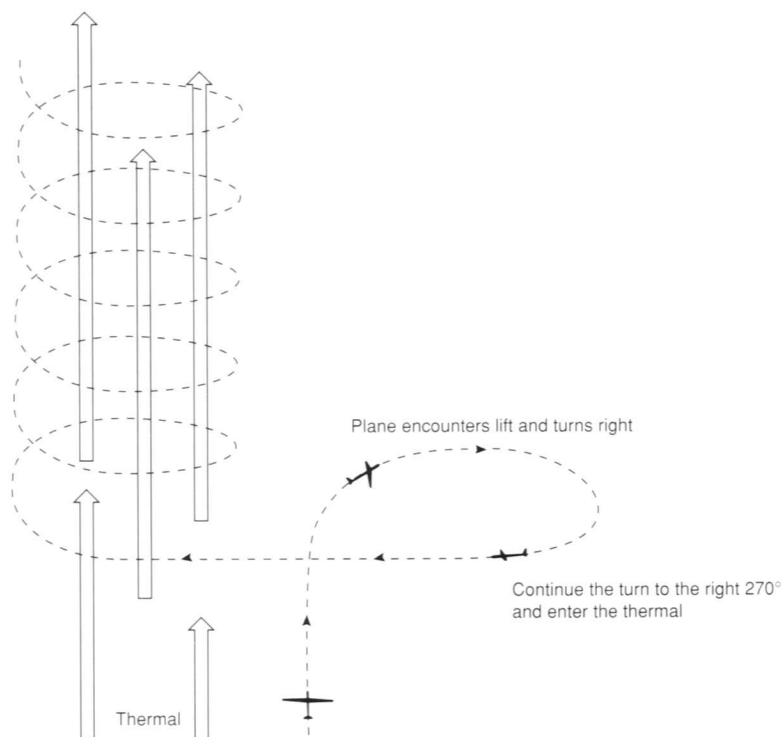


Fig. 5-3. When you are searching for a thermal, one wing may rise when hitting the edge of lift. A turn the opposite direction can be used to enter the thermal. In this example a very sharp bank in the wings occurred. Simply complete the turn 270 degrees and fly into the thermal and begin spiraling upward.

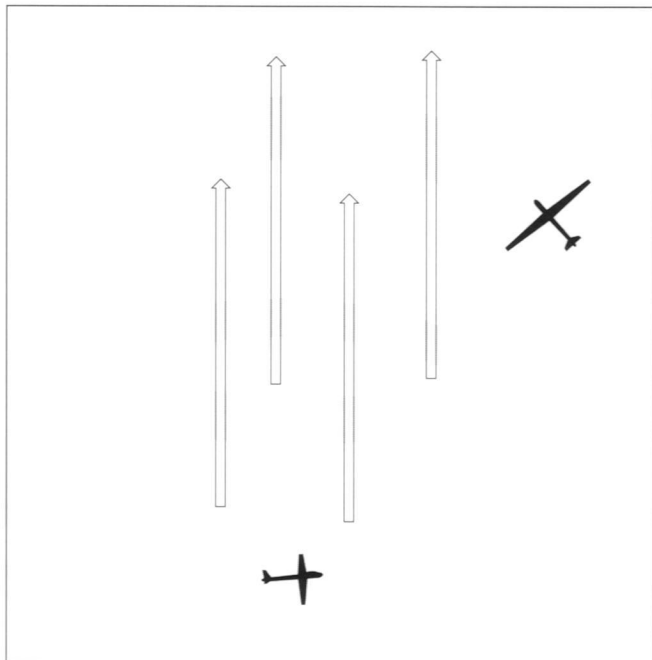


Fig. 5-4. When you find a thermal, slow the plane down by adding up elevator trim and try to circle within the thermal's core or center. This can result in a rapid climb to tremendous heights and long flights.

spin the sailplane. When an aircraft spins, one wing actually flies around the other wing which is stalled. The overall speed of the model is low. This prevents the wings from becoming overloaded and breaking as in a dive.

To get into a spin, gradually pull back on the elevator to slow down the plane. Just before the plane stalls (or right at the stall), give full rudder control and hold it. Either direction is fine. Also hold full up elevator with it. The control stick should be held in one of the bottom corners of the transmitter. When the sailplane has reached a more comfortable altitude, release the controls and return to normal flying.

Some of these "elevator" rides can be thrilling. Again, be careful of the possibility of losing your sailplane in a strong thermal. When you have reached a high but safe altitude leave the thermal and enjoy a long and peaceful flight.

If you're interested in competition flying, the Thermic Sniffer from Ace R/C has a transmitter that mounts into the sailplane and detects changes in altitude. The receiver fits into your shirt pocket and has a piece that fits into your ear. The Sniffer emits pulses which are translated into sounds. As your sailplane begins to climb in a thermal, the pitch of the sound increases, tipping you off about the conditions.

More Flying Tips

Because sailplanes do not normally have an engine or motor, a stall series can easily occur, fig. 5-6. As you remember from aerodynamics and pitch stability, a stall series usually occurs after a sailplane's airspeed is slightly

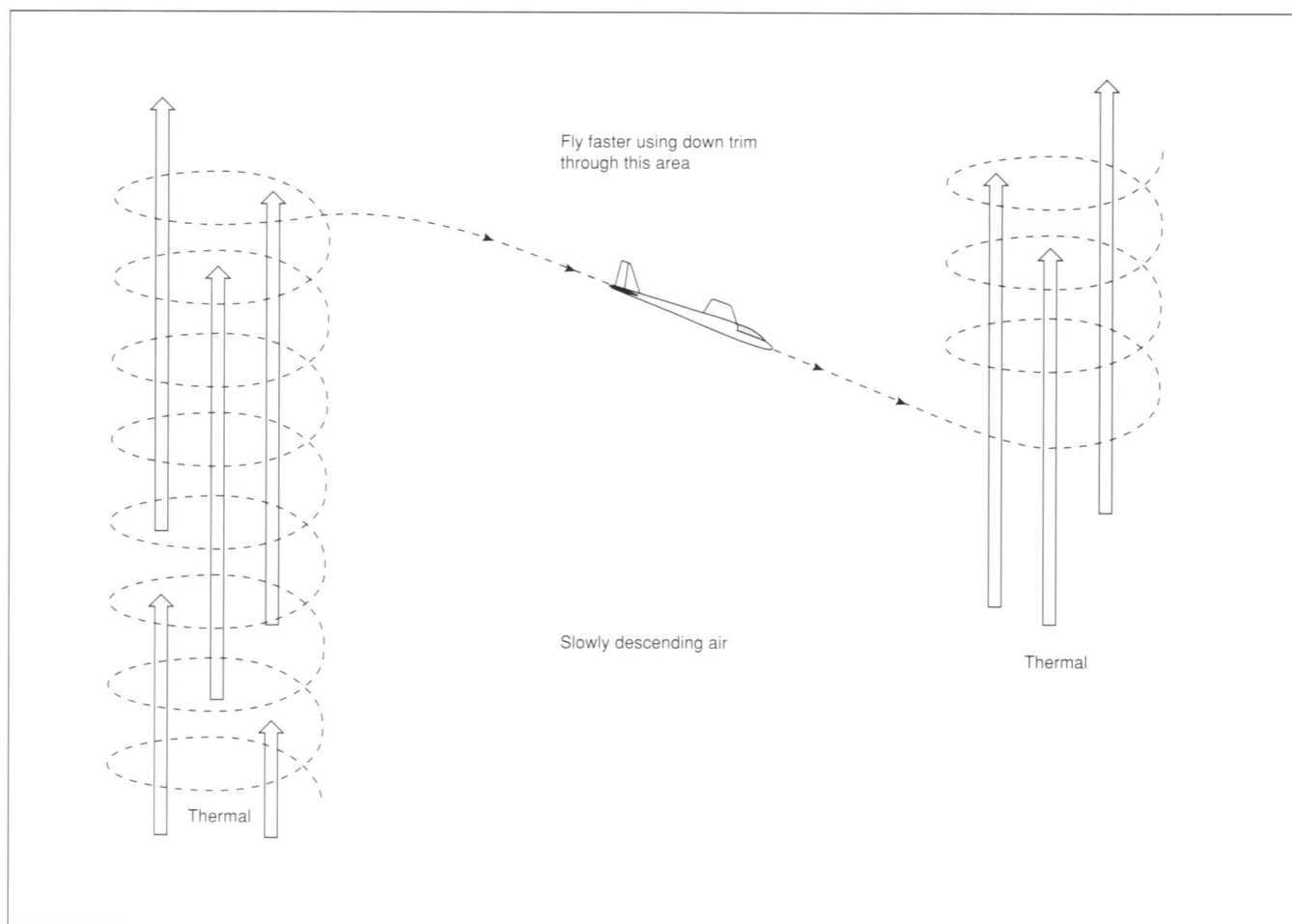


Fig. 5-5. After climbing in a thermal, adjust the elevator trim for faster flight through the area of descending air until you enter the next thermal. This technique will prevent you from losing too much altitude between areas of lift.

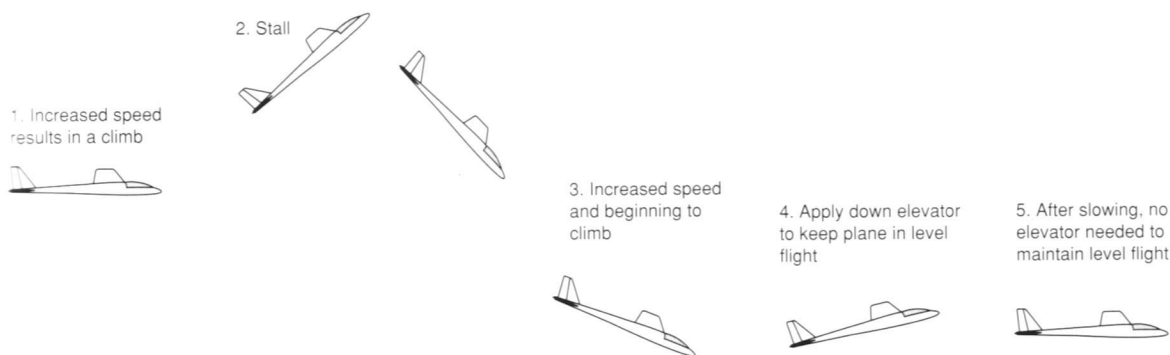


Fig. 5-6. Porpoising or stall series. After building up speed in a steep turn or dive, a sailplane will translate the speed into lift and climb until it slows, stalls, and drops. To prevent this from continuing and from losing too much altitude, apply enough down elevator to keep the plane flying level when it looks as if it is starting to climb. While holding down elevator, the plane will slow down, and you will gradually need less and finally no down elevator to maintain level flight.

increased. This can occur after banking too sharply during a turn or after flying out of a downdraft.

With this increased airspeed the speed transforms into lift because of the faster air that flows over the wing. The sailplane will immediately climb, slow down, stall, and then drop. With this drop, the plane again speeds up, climbs, and stalls. Most sailplanes will recover from this series given enough time.

Unfortunately, precious altitude is lost with each cycle. Our goal is to stop this oscillation as soon as possible and get back to thermal hunting. The cure for this problem is simple. After the sailplane stalls and drops, it quickly builds up airspeed; when the plane starts to climb again, gently push the stick forward, giving down-elevator control.

Give just enough control to keep the plane flying at a level altitude. You may have to hold quite a bit of down elevator to keep it level. Soon the plane will slow down and less correction will be needed to hold the model level. Gradually you won't need any elevator compensation and the plane will be gently flying again.

Trim Changes

Another tip is to try to stay out of still or descending air and maximize your time in rising air. Although this sounds simple, in reality, it's difficult to do. As you'll remember from the discussion about thermal formation, the core of the thermal with rising air can be small. However, the entire area surrounding the thermal has a very large area of descending air. Sailplanes already descend on their own thanks to gravity. This additional effect of the descending air around thermals compounds the problem of shortened flight times. The descending air fortunately has less velocity than the concentrated thermal core's center, but it does play a factor in flying endurance.

To minimize your time in these altitude-eating areas, fly through them quickly. You'll need to trim the plane for faster flight. Earlier, you learned that the elevator controls the model's actual airspeed. To use it for this purpose follow these simple steps. When you recognize that your sailplane is quickly losing altitude, slowly push the elevator trim tab forward. You will notice an immediate loss of altitude followed by a significant increase in speed. You'll need little stick movement to control the plane. Be careful not to turn too sharply; in fact, the best way to fly this setup is straight and level while you hunt for a thermal sign. Once you've found one, enter it as before and retrim the plane for slow

flight. Return the trim tab to its original position or even with slight up trim to slow the plane to a speed just above stalling. This will maximize your time while in the thermal and will help prevent you from flying through it so quickly. Once established in the thermal at your new airspeed, bank the plane and spiral up.

With practice you'll find these trimming tips easy to use. These simple skills coupled with your knowledge of thermals will give you many hours of flying enjoyment.

Flying in Strong Winds

You can lose your sailplane by flying too far downwind. In strong winds, many sailplanes cannot generate forward ground speed and may actually fly backward! If the wind is strong enough and you are far enough downwind, it may be impossible for you to get the sailplane back to your flying site. This may result in substantial damage or even the loss of your precious bird.

When flying in stronger winds, if you keep your sailplane upwind you'll be able to land within the confines of your landing area.

If the wind is so strong that you have a hard time keeping the plane upwind and down-elevator control is the only way to get any forward movement, you have two options: Call it a day and wait for better weather or add ballast to improve your plane's penetration into the wind. Ballast basically is added weight; it will increase the plane's overall weight and the wing loading so it will be able to fly forward against the wind without having to dive.

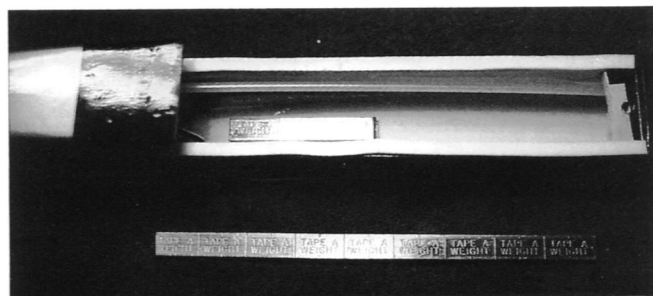


Fig. 5-7. Stick-on tire weights can be easily used to add ballast to any plane. Simply cut out what you need, remove the peel-off backing, and press it in place over the center of gravity.

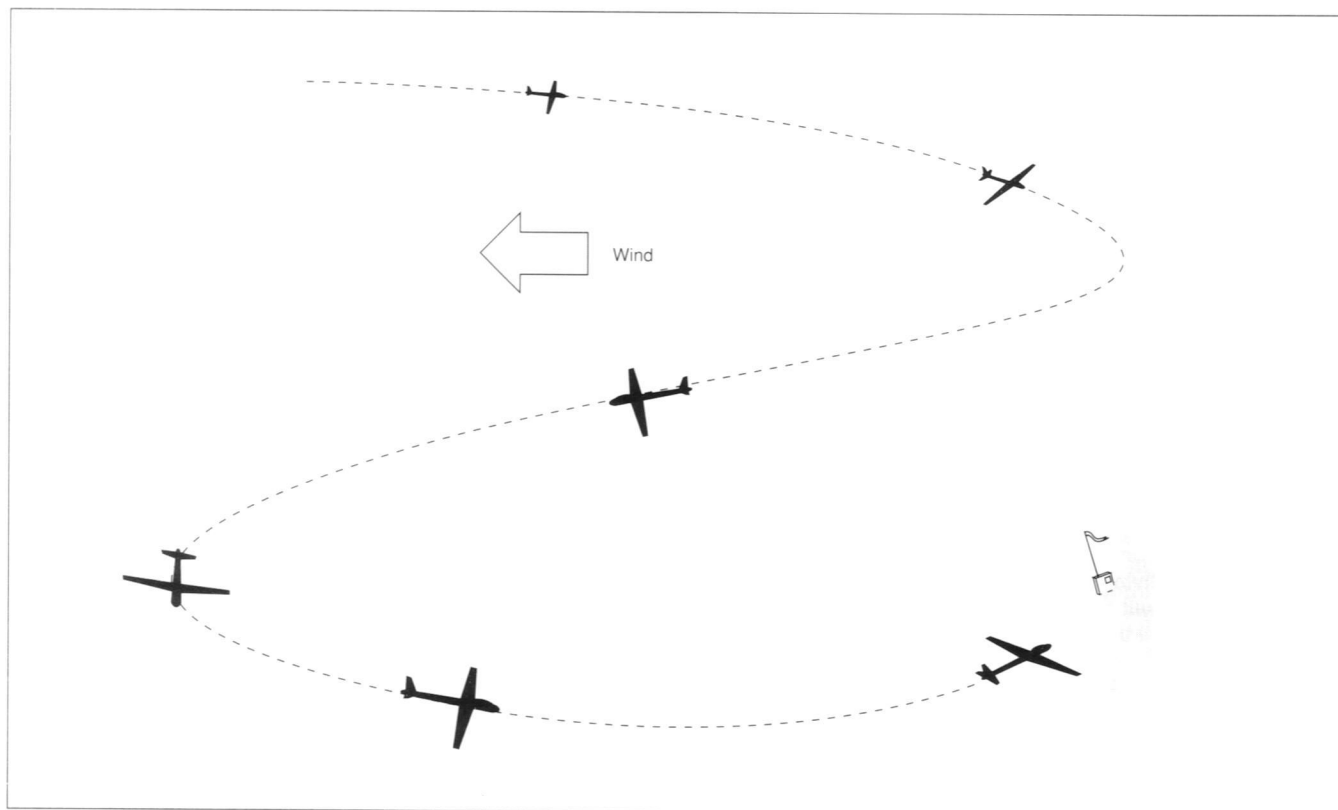


Fig. 5-8. Landing pattern. Try to cross over your landing point at about 50 feet flying into the wind. Now turn 180 degrees flying with the wind. Soon after passing the landing point turn another 180 degrees and proceed to the landing area. With practice, you will be able to land your plane within a very close distance of your intended landing point.

In addition to better penetration, the sailplane's stall speed will also increase. This is usually not a problem, though, because when landing into brisker wind, the sailplane's ground speed will be about the same as usual.

If you add too much ballast at once you may break the wings. Start with a quarter of the sailplane's overall weight and slowly increase it as needed. When flying with ballast, avoid dives and sudden control changes because of the added stress on the airframe.

Add ballast in the fuselage right over the center of gravity. Stick-on metal weights can be used, fig. 5-7. Many pilots fashion lead weight into certain shapes and sizes and make compartments in the fuselage to hold them. Some even make compartments in their wings to hold extra weight. Just be sure not to overdo it and risk damaging your sailplane.

Landings

Most onlookers rate RC pilots on their ability to land their aircraft. Sailplane pilots pride themselves on being able to land their planes in a small designated area. As with launching, make all landings directly into the wind.

Ask for help with all aspects of flying before attempting this on your own. All sailplanes need to follow a prescribed pattern before they begin their landing. You should use a short pattern, fig. 5-8. As the sailplane descends, fly into the wind and cross over your landing point at approximately 50 feet. After passing this point, slowly turn the sailplane 180 degrees; make sure it's flying with the wind. In time you will be able to better judge just how far downwind you need to fly. This distance decreases as the strength of the wind increases.

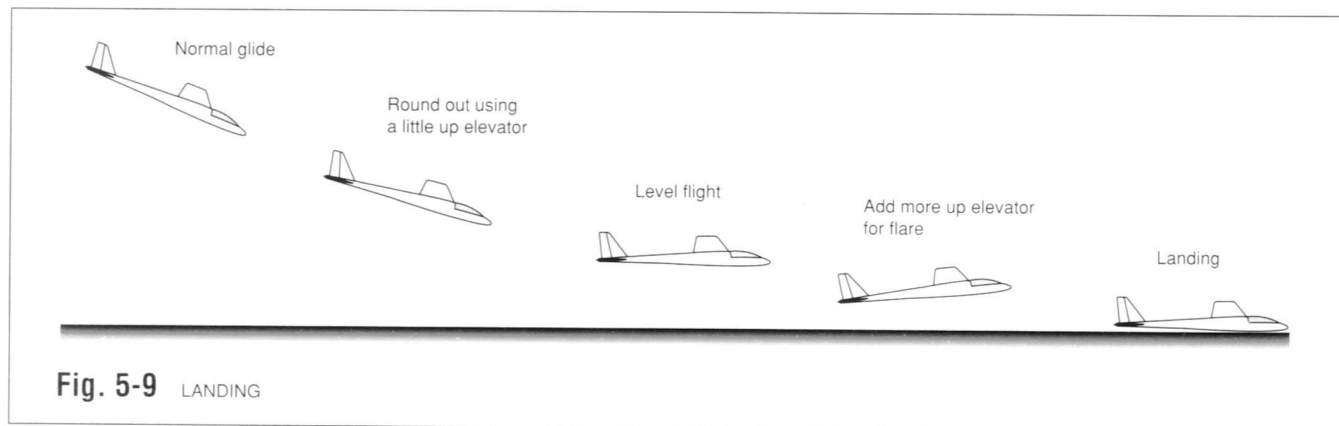


Fig. 5-9 LANDING

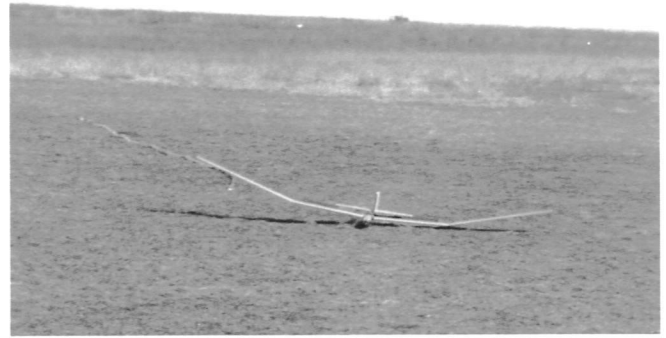
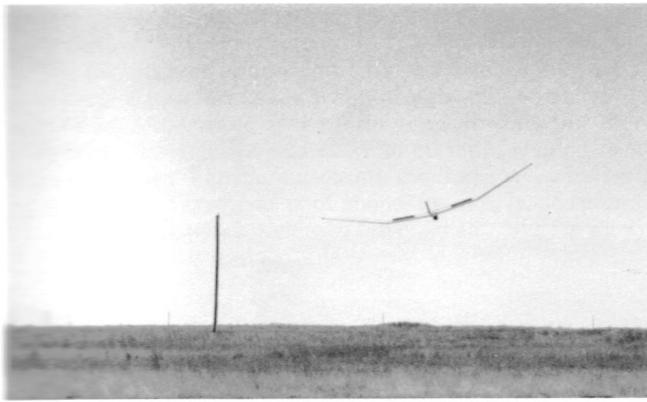


Fig. 5-10. In these pictures, you can see a sailplane deploying its spoilers in an attempt to land as close to the nearest point on the tape on the ground. The closer you land to this point, the higher the score.

Now turn the plane again 180 degrees into the wind and with the landing point directly between you and the glider. Keep the wings level and allow the sailplane to descend at its normal rate. As it nears the ground, gently apply enough up-elevator control to allow the sailplane to fly parallel to the ground at only a foot or so. When it slows down and begins to drop apply the flare or final amount of up elevator while keeping the wings level. The plane will gently meet the ground and slide to a stop, fig. 5-9. Again, practice makes perfect. If you have flaps or spoilers, you can use them to help with precision landings. With a lot of experience you may be able to gently land your sailplane in your own hand!

Safety

People don't realize that these planes are not simple toys and can be dangerous. When flying at a club site, familiarize yourself with the club's rules. Usually you're not allowed to fly over places such as the parking lot and spectator areas. This is just common sense: If a wing fails or you lose control over these areas, damage to something or someone may result.

Also avoid houses and industrial areas. If a thermal is generated by a housing tract and you are on the downwind side of that lift all is well because the lift will accumulate over the field. No matter how tempting it is, never fly over the houses themselves. Stay over the field, and as you get more altitude you should find the core of lift to be even farther from the houses.

Also be aware of ground turbulence, which occurs when wind blows over a large object such as trees or buildings. After the wind goes over these objects it tends to curl under itself and continues rolling for a long distance.

The higher the wind, the farther downwind the turbulence can be felt. A good estimate for determining the extent of this turbulence is seven times the height of the obstruction. Take this into account before you launch and land your sailplane because ground turbulence can easily flip your sailplane upside down and into the ground.

The last safety point to note with thermal flying is to avoid other sailplanes. Try to stay out of the launching paths at lower altitudes and make sure the path is clear before you launch.

Often you'll be riding a thermal with other sailplanes, so keep in constant communication with the other pilots. A collision is possible if a sailplane is overtaking yours on the climb. Communicate your intentions to the other pilot and make way for him either by extending your circle or briefly

leaving the thermal allowing him to climb past.

This also can occur on landing. If two sailplanes are low enough to land, the lower sailplane has the right of way. The following pilot should position himself to land safely away from the first plane.

Club Contests

As you become more accomplished, you may want to join in club contests and events. Don't worry about having to fly against the club pro, or at least not yet! Most contests are divided into novice, sportsman, and open divisions. A further division for the type of glider you're flying can be made, including:

- Class A — Sailplanes with wingspans of 1.5 meters or less.
- Two Meter — Sailplanes with wingspans of 2 meters or less with unlimited controls (i.e. spoilers).
- Standard class — Sailplanes with wingspans of 100 inches or less with only rudder and elevator controls.
- Modified Standard Class — Sailplanes like Standard Class with unlimited controls.
- Open Class — Sailplanes with greater than 100-inch wingspans and unlimited controls.

Thermal contests generally test the pilot's skill in finding thermals and staying aloft for a certain time frame. After the soaring portion, a spot landing is usually the next requirement. A long tape with measurements is affixed to the ground and you try to land as close to the attached portion of the tape as possible. The distance between this end of the tape and the nose of the sailplane is measured. Points are acquired by accomplishing each task based on time and landing distances. After several rounds, the winners are chosen, fig. 5-10.

Another popular contest is cross-country flying. A route is chosen and several contestants launch their sailplanes and ride a local thermal to altitude. Next, they briskly fly to the next thermal that is in line with their route while riding in a convertible or the bed of a truck. The first one to the finish line wins.

The League of Silent Flight is a large organization of sailplane enthusiasts who have developed serial task levels of achievement. There are five levels and each one is described in detail. Because each level becomes progressively more difficult to achieve, few pilots have made it through the fifth and final level. For information send \$1 to the League of Silent Flight, P.O. Box 39068, Chicago, IL 60639.