Radio Controlled Soaring Digest

July 2007 Vol. 24, No. 7

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Photo by Bill Kuhlman.
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R/C Soaring Digest

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R/C Soaring Digest (*RCSD*) is a reader-written monthly publication for the R/C sailplane enthusiast and has been published since January 1984. It is dedicated to sharing technical and educational information. All material contributed must be exclusive and original and not infringe upon the copyrights of others. It is the policy of *RCSD* to provide accurate information. Please let us know of any error that significantly affects the meaning of a story. Because we encourage new ideas, the content of each article is the opinion of the author and may not necessarily reflect those of *RCSD*. We encourage anyone who wishes to obtain additional information to contact the author.

In the Air

Simon Nelson described his unique retriever system in the May issue, and it seems to have generated quite a bit of interest. While Simon was able to find a reversible motor in the form of a winch for off-road vehicle use, this may not be an option for some who wish to tackle this project. With this in mind, we decided to follow up on Simon's suggestion and publish Paul Hills' web-based instructions for modifying a standard starter motor for reversible operation. We've included Paul's description of a basic speed control for the modified motor in the hopes that some enterprising person will be able to utilize the information within some other concept. We do not have an electrical diagram for Simon's set-up, but it is essentially two separate circuits which are similar to that used on our winch systems. We would be grateful if someone could draw up an applicable circuit diagram.

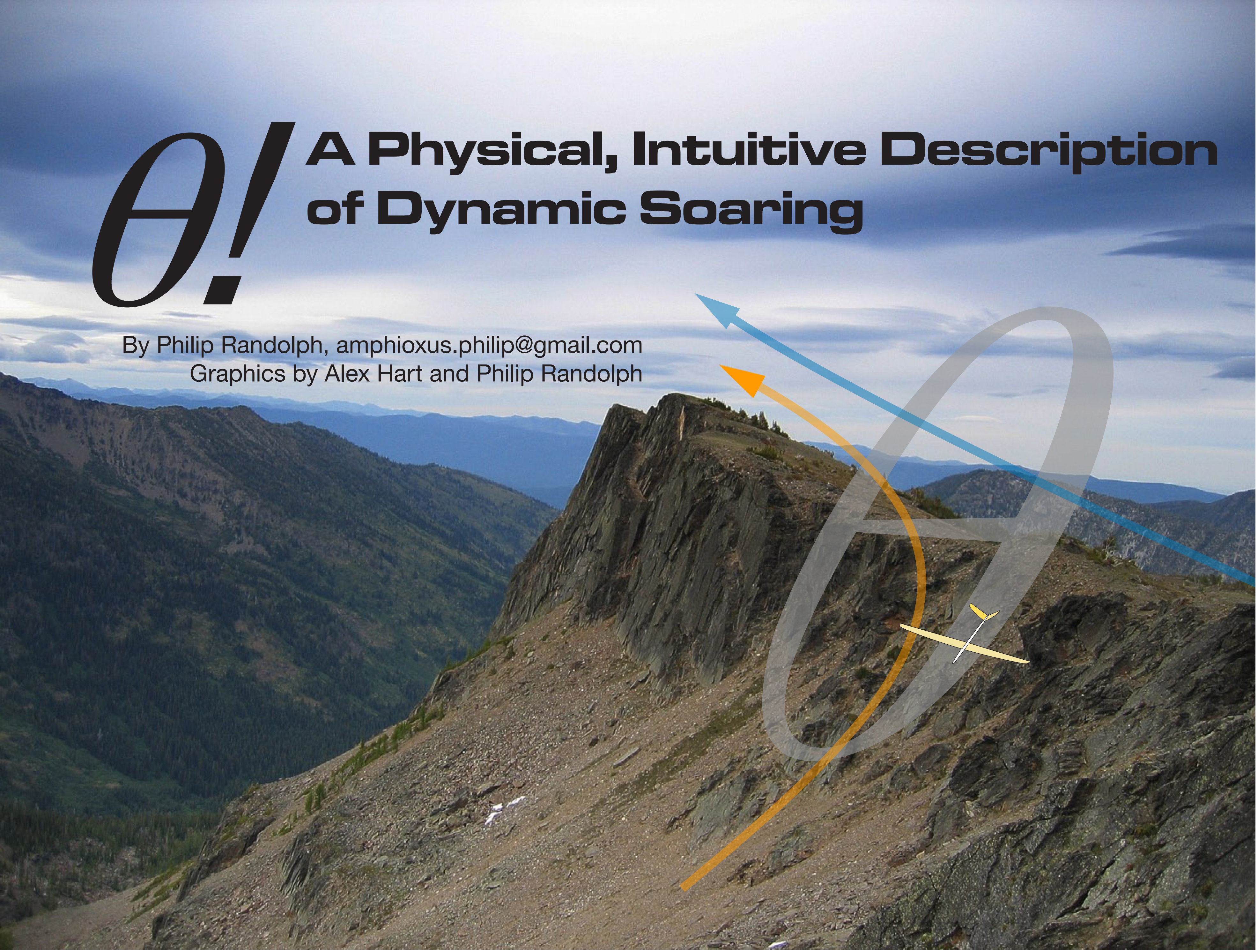
Daryl Perkins, several time F3B World Champion, has been building his own web site, http://www.darylperkins.com, as well as a new sailplane, Psycho. The web site is still under construction and currently consists of the home page only. We're not sure of the current state of the development of the Psycho, but we did find some digital renditions on Sergi Valls' web site. See page 43 of this issue.

Yes, we're still working on our Redwing XC! The forward fuselage is finished, and we're now working on the vertical fin and rudder. Hopefully we'll have it flying by the August issue deadline.

Time to build another sailplane!

θ! A Physical, Intuitive Description of Dynamic Soaring

By Philip Randolph, amphioxus.philip@gmail.com
Graphics by Alex Hart and Philip Randolph



How the opposing velocities of a couple of air currents can add so much velocity to a model or full-scale glider or bird.

A physical understanding of dynamic soaring will allow model and full-scale glider pilots to better take advantage of a greater variety of DSable airscapes, and should help observers of bird flight to know what to look for.

Where to

A "Not-very-many-grownups-left-behind" article in eight parts, three installments.

Installment 1

Part One, "Introductory basics," includes web links to great videos of DS; history of DS theory (starting with Lord Rayleigh in 1883!); how birds and fish do it; and the airflows in which DS works. A fundamental is "rotors" in "shear driven cavities."

Part Two is "DS History, from pteranodon to Lord Rayleigh, 1883, current theorists, models, full-scale gliders, and flying fish."

Installment 2

Part Three, "Wild speed gains, DS Arithmetic," reviews in more detail how a model glider gains *double* the speed of the oncoming wind in each half-orbit! less velocity losses to drag and trig effects.

Part Four is "DS forces!"

Part Five, "Trig effects," is a wheelbarrow of extras, including effects of the angle of entry to the oncoming wind, θ, the italicized, lower case Greek letter theta.

I picked θ because it looks like a DS cycle. The Ancient Greeks put in a horizontal bar so I could use it to represent the shear layer between airflows.[1] However, with severe lack of foresight, they did tip θ as if the wind were coming from the right, contrary to aerodynamic diagramming convention.[2]

Part Six, "DS and ping-pong elastic collisions," is a simple physics comparison of DS with ping-pong. It's partly to give aerodynamic neophytes one more way to "get it." But it also illustrates some basic physics. A glider's turning-rebound from oncoming air is a highly elastic collision, similar to the elastic collision of a ball with a paddle. A model glider gets batted back and forth, faster and faster, between opposing airflows exactly! like a ping-pong ball gets batted faster and faster between opponents' paddles.

Installment 3

Part Seven, "More ways to DS more airscapes," shows a few more ways to DS different terrains and wind patterns, including dust devils and shears around vertical formations. The most easily flown, even by less-than-expert model flyers (such as your author) and by full-scale gliders, is a horizontal pattern in the mini "convergence zone" where warm air flows up both sides of a ridge to collide and turn upwards.

Part Eight, "Dynamic soaring dynamic seascapes," raises the question of petrels and northern fulmars DSing waves, rather than just the horizontal, shear-layer velocity gradient of wind above water. It's partly from a model glider competitor's observations, and partly conjecture.

1 From the Non-Organization for Adoption of the Italicized Lower-Case Greek Letter Theta as the International Interspecies Symbol for Dynamic Soaring, better known by its acronym, NOAILCGLTIISDS.

2 Republicans also claim wind comes from the left. Therefore the Ancient Greeks were Democrats.

Nobody but intrepid slope explorer Chris Erikson would try to DS this rock pile.
The bar in the theta represents the shear layer between opposing airflows. Photo by Allisson Woods. Graphics by Alex Hart.

A lack of physical understandings

Too often, aerodynamic concepts aren't also stated in readily understandable, physical terms. Even when the target audience is laypersons, where one would expect a good, physical explanation, one often gets mysteries.

For example, in an otherwise excellent presentation, recently aired on PBS, of raptors and model gliders dynamic soaring, the explanations were obscure. Maybe it's because concepts a director doesn't understand end up on the cutting room floor, or because aerodynamic thinking is predominantly in the language of mathematics, from which translation can be difficult.

I have the retrograde hobby of attempting to state such things in simple, physical, (rather than complex mathematical) terms, and perhaps drawing conclusions that more sophisticated approaches don't always make evident.

My object is not to instruct how to fly DS. Your author isn't an expert there. And to a great extent, the slopes are the real teacher.

The object is to give some analytical understanding at a physical level. The physical approach should be especially helpful to those for whom higher math isn't a playground. Partly this is feeding "how it works" to hopefully "most 'satiable curiosities."[3] Physical understandings should also help readers find, and more effectively use, a widened variety of DS conditions on actual slopes.

θ! Part 1 Introductory basics

For jacklegs, abecedarians, and the newly bitten on the nose by the crocodile of slope addiction.

We'll start with some links, so readers unfamiliar with DS can observe videos. We'll follow that with a bit of history, and a note on where DS works. Then we'll get to how DS adds so much velocity to a model plane.

Try a few web links to amazing DS videos

Initiates, the best way to get the idea of Dynamic Soaring is to watch a few videos.

If you want a couple hours of truly amazing DS flying, try the DVD, "Lift Ticket, Director's Cut," from reeseproductions.com. It ends with Kyle Paulson DSing a 100" Extreme (model glider, no motor) at 301 mph.

3 Reference number one, to "How the Elephant Got It's Nose," Rudyard Kipling

Several DS videos, including a clip of the above record, are downloadable at slopeaddiction.com

A clip from the PBS "Nature" show 'Raptor Force' is at http://homepage.mac.com/pnaton/iMovieTheater28.html It shows Paulson DSing at 229 mph. The record is now 302 mph. However, don't be intimidated. These are just speed records by experts. DS isn't the same as speed.

Basics

Dynamic soaring is a means of getting velocity or altitude energy from shearing airflows. Intermediate pilots can find DS conditions at lower speeds. Your author has DS'd at the phenomenal speeds of ten or fifteen miles per hour, and up, on sharp little ridges in the Cascades.

Speed increases in dynamic soaring are very different from how gliders usually trade sink for speed. So DS speed increases aren't from speed/sink, lift/drag curves.

High lift/drag ratios are important to DS gliders, not for gaining speed, but for maintaining speed—for not losing too much to drag in the DS circles. Ballast is important for the same reason.

Dynamic soaring takes advantage of either gusts, the difference in velocities within a shear layer, or the difference in velocities between two airstreams (separated by a shear layer) to increase

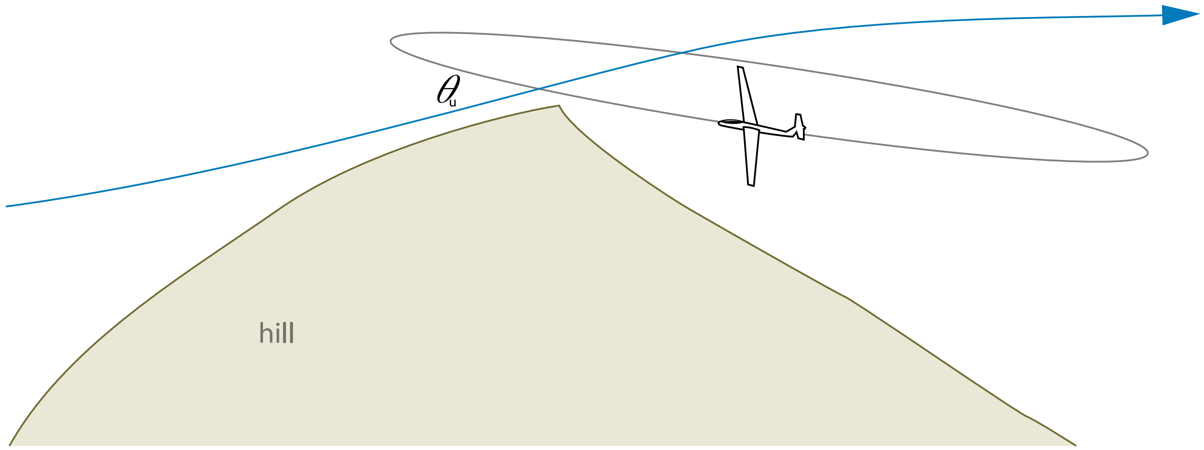


Figure 1-1a: DSing a thin shear over dead air, the largest velocity difference is from a small angle to the shear. This changes as a rotor develops. Graphics by Alex Hart.

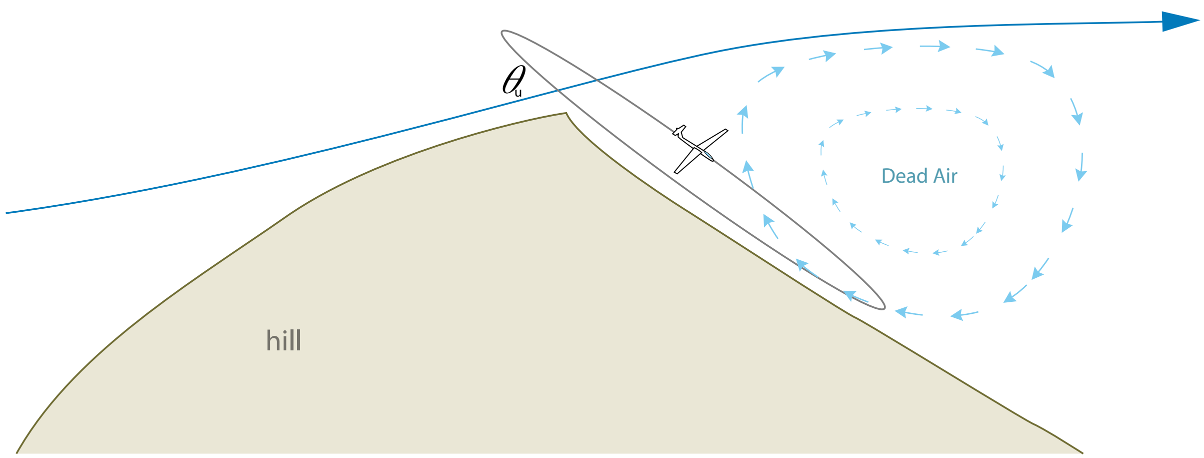


Figure 1-1b: Shear forces develop a rotor. Note that near the shear, a strong rotor lessens the velocity difference between the upper and lower flows. So when DSing a shear over a rotor, dive deep. Graphics by Alex Hart.

airspeed. By "ballooning" upwards, or by a turn, that airspeed is then converted into either altitude or ground velocity.

Later we'll look briefly at how birds use gusts and shear gradients.

Settings

The most common setting: Dynamic soaring a shear over the backside of a hill, and the uphill rotor beneath

Here we'll imagine the most familiar DS settings for model glider pilots.

- First, when there is a thin shear over dead air, as when air flows over the top of a sharp ridge: Here a small angle to the shear will maximize the glider's jump in airspeed as it penetrates up into oncoming wind, or down into dead air. See Figure 1-1a.
- Second, once the shear powers up a rotor: Here punching down close to the slope, into the teeth of the upslope flow, may maximize the glider's jump in airspeed. Since the upper flows of the rotor parallel the shear, penetrating the shear at a small angle may not make a big jump in airspeed. See Figure 1-1b.

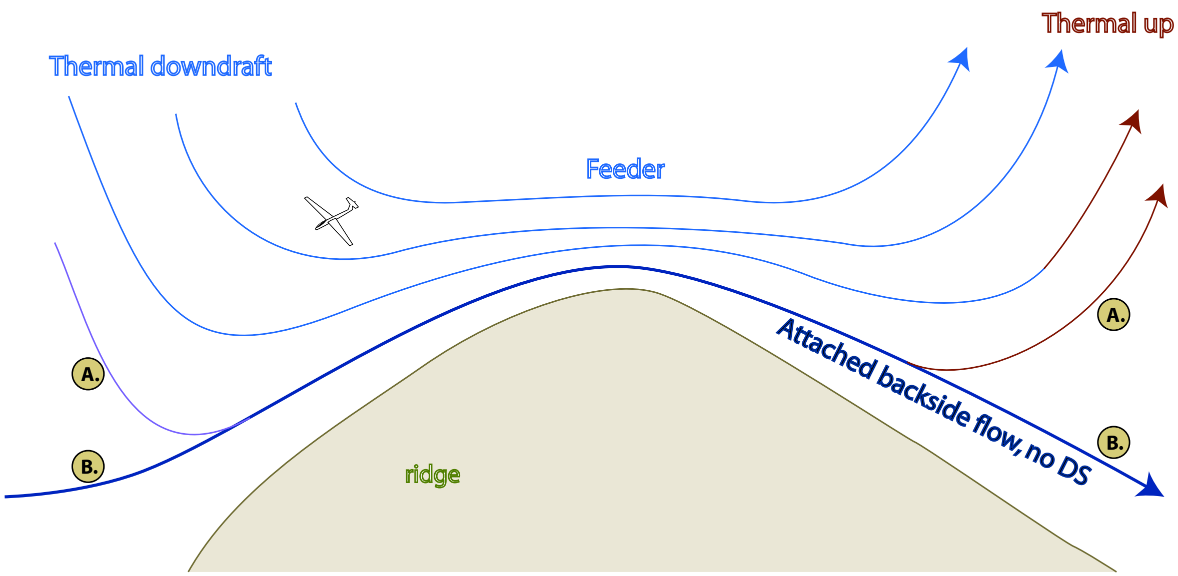


Figure 1-1c: If the wind sticks to the hill, no DS.

Path A - A cold, down-thermal can destroy rotors and shears, and attach the flow to the ridge. It may even kill frontside lift, except very close to the hill. A thermal feeder can remain attached to the ridge, flowing down the backside, and not turning up till some thermal behind the ridge.

Path B - Sometimes wind stays attached to a ridge, even without a down-thermal. This is just like how air usually stays attached to a wing.

Graphics by the author.

If the wind sticks to the hill, no DS.

Air is fickle in how it breaks free from some ridges. If the ridge is softly rounded, if it gets hit by a down-thermal, or if the wind isn't fairly square to the ridge, airflow may remain attached. See Figure 1-1c.

A rotor is more likely when a sun-warmed flow up the backside of a ridge meets wind over the ridge. That also makes the rotor stronger, adding thermal energy. Instable air conditions, where air is warmer and less dense near the ground, help create these uphill flows. In turn, uphill flows help ambient winds break free of the crest of a ridge, rather than following its curve down. See Figure 1-1d.

In temperature inversions, where warmer, lighter air sits on colder, heavier air, flows over hills are less likely to detach and shear. Flows up the backsides of ridges are notoriously fickle.

The shear between airflows can be broad and gradual, narrow and abrupt, smooth or turbulent.

Air flows... Over ridges, through saddles, around hills See Figure 1-1e.

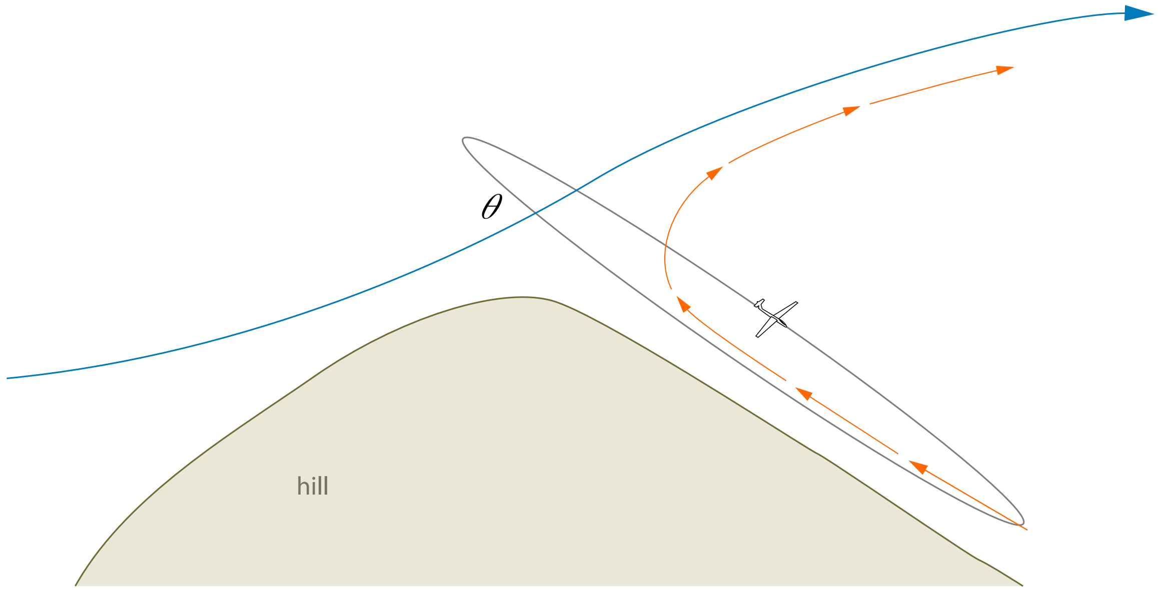


Figure 1-1d: On the same hill, backside upslope thermal flow may break the prevailing wind free. This is a lot like a stall or flow separation over a wing. Graphics by Alex Hart.

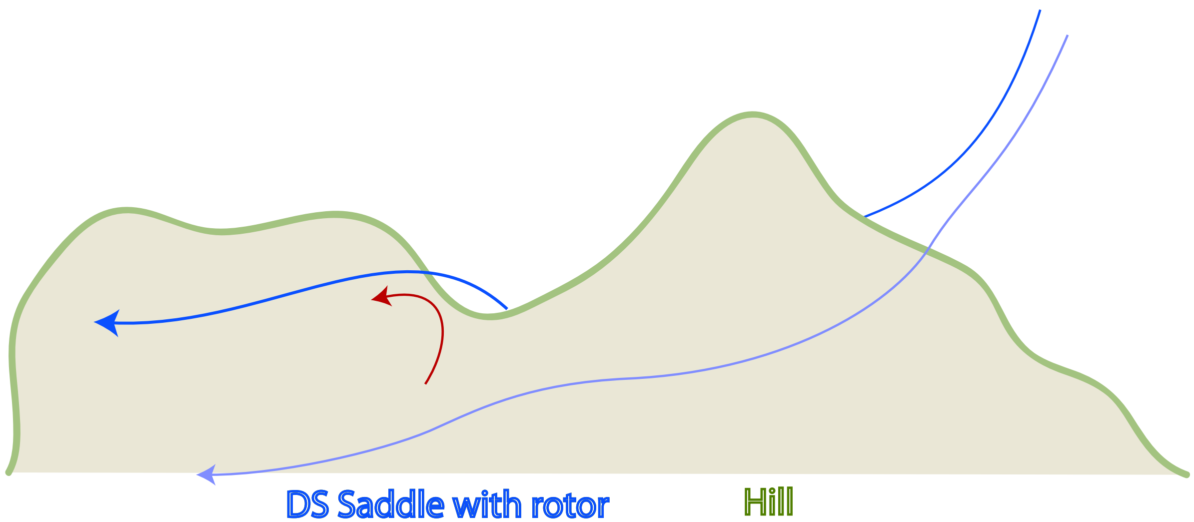


Figure 1-1e: Air tends to flow over ridges, through saddles, and around hills. Graphics by the author.

Nineteenth century glider pioneer Otto Lilienthal had a two hundred foot conical hill built so he could always launch square into the wind.

This didn't help him - air mostly flows around hills, rather than turning up, to make lift.

Saddles intensify ridge lift and make DSable wind shears more likely.

Rotors! Shear-driven cavity flows! *Rotors have dead centers, unlike wingtip vortices.*

Steven Allmaras, Ph.D., Aerodynamics, explains that rotors are examples of shear-driven cavity flows, a classic fluid dynamic problem, where a wind blows across a pit. Unlike wingtip vortices, where velocities are higher near the vortex core, a shear-driven cavity has its highest velocities near the edges of the cavity, here the hill. (I assume it's a matter of whether energy is added near the perimeter or near the core.) See Figures 1-2a and 1-2b.

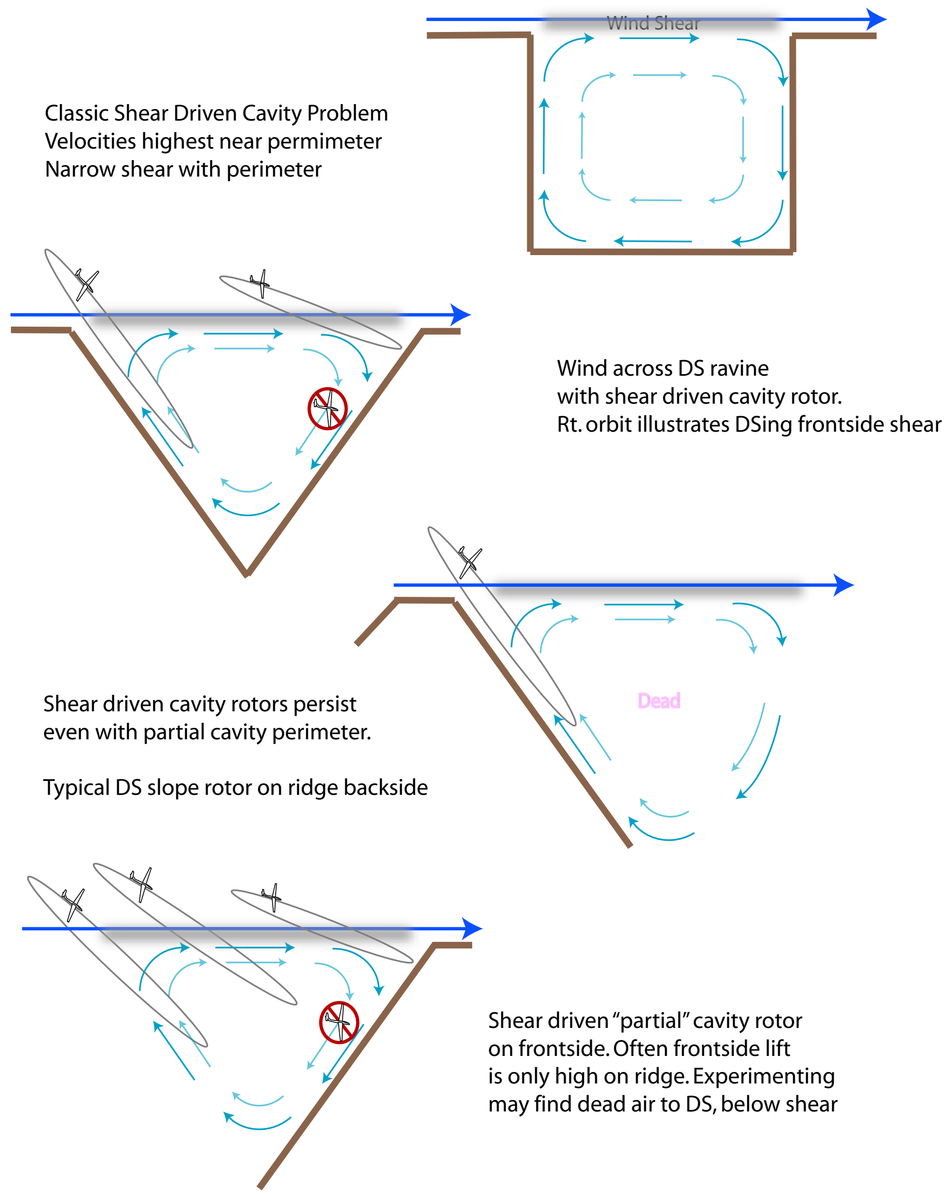


Figure 1-2a: Shear driven cavity flows.

Actual flows vary wildly with terrain. Since energy is added at the perimeter of the rotor, that's where its velocity is highest. The moral: DSing a rotor, dive deep!

Note: If you are trying to get ridge lift on the side of a ravine or valley that faces the wind, you may find rotor sink. But if the rotor hasn't developed, there will be lift, and perhaps a rotor behind the lip. Graphics by the author and Alex Hart.

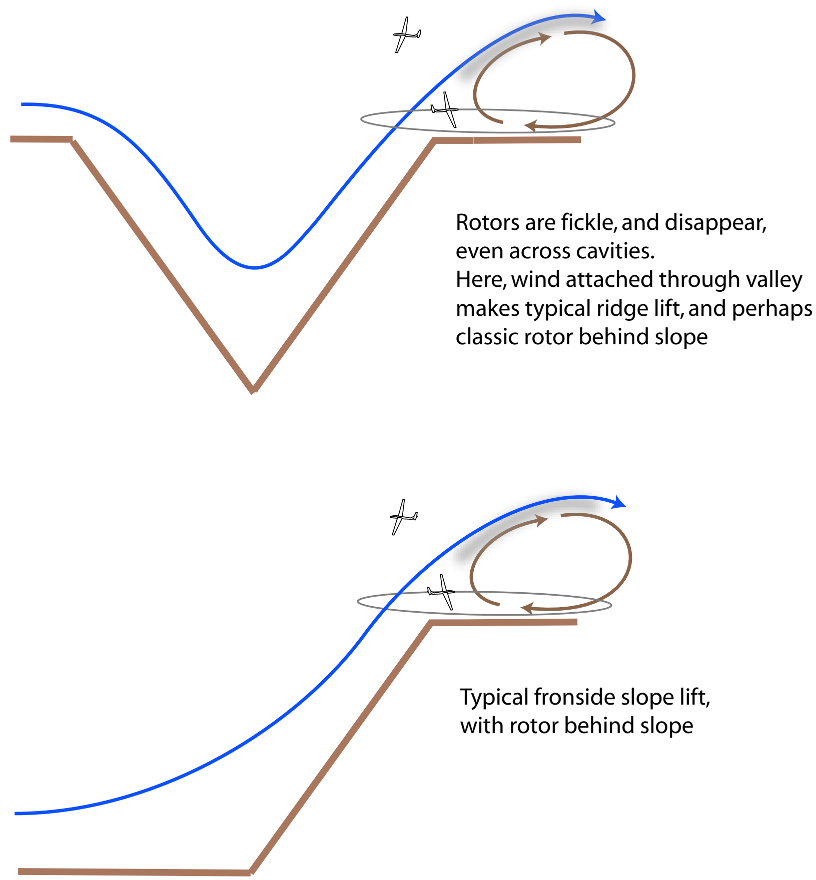


Figure 1-2b: Shear driven cavity flows.

The same terrain doesn't always make the same rotor. Graphics by the author and Alex Hart.

Our usual DS setting is also illustrated by the simulation, "Flow over a step," at http://web.gyte.edu.tr/enerji/ercanerturk/drivencavity/cavityflow.htm

The slow-center velocity gradient of a driven cavity flow is modelled at http://www.cfd-online.com/Wiki/Lid-driven_cavity_problem

The moral — Try hugging the hill, but see what works.

Rotor web-links:

Julien Giraud has some great simulations of rotors at http://jugiraud1.free.fr/

Jo Grini[1] has a video of rotors at http://193.215.54.10/jogrini/video/ds_vortex.wmv

Here's how airspeed gets added:

Groundspeed versus airspeed

You are about to launch your glider from a ridge. But you are behind the "lip" of the ridge a few rods, where it is fairly calm. You might even feel a bit of wind at your back, from a rotor. You run forward, and wind hits your face, but your legs are in relative calm. Your body is in the shear layer, and your head is in the wind. Your head only has a little groundspeed, (your running speed) but it has great airspeed (your running speed plus the speed of the oncoming wind). If your head is no better at aerodynamics than mine, it can't take advantage of this airspeed. A glider can. So you launch it.

Note that if the glider just had your running speed as airspeed, like on a calm day on a flat field, it would stall and fall. With the added speed of the headwind, it's flying! Airspeed!

Gliders turn only in relation to the air in which they ride.

Newbicile model pilots standing on the ground (yes, that's good) are often tempted to think like they are the center of the universe, because they hold the transmitter. They may think their glider turns in relation to them, or that groundspeed somehow affects turns.

Intelligent neophytes, ditch that idea.

Gliders turn only in relation to the air in which they ride. At an airspeed of 80 mph, a turn in dead air, from the glider's perspective, is exactly the same as a turn within an 40 mph wind. The center of the turn moves with the airmass.

In a 180° turn, from upwind to downwind, your glider retains most of its airspeed, *i.e., relative to the air in which it travels, which also has velocity. So a turn from heading upwind to heading downwind adds twice the velocity of the wind to groundspeed.* During the turn, there is a lot of lift (pressure) force on the glider, and a lot of equal and opposite pressure force on comparatively huge mass of air through which it turns. *Like in any highly elastic collision (more on this later), the smaller mass (the glider) keeps most of its speed energy.*

From the ground perspective, your glider turns till it is "belly-to-the-wind." It gets blown sideways to its airspeed across the wind. Then it has two velocities, airspeed across the wind, *and*, at 90° to its airspeed, its sideways, downwind drift. It keeps its airspeed throughout its turn, till those two velocities align, and add.

> zonking through the shear layer, straight into the teeth of the oncoming airflow, is what gives DS its power

The punch up (or down) through the shear layer that adds airspeed to groundspeed

See Figure 1-3.

When a glider slices up through a shear layer into oncoming air, it gains the velocity of the oncoming air as airspeed. If it kept going straight on into the wind, it would lose this new airspeed to drag. But it has a few seconds to convert (by turning) this airspeed to a new, higher groundspeed. That's enough.

Today's faster model gliders have tremendous velocity retention. That's partly airfoils and planforms, and partly ballasting (discussed later).

It wasn't always so. Dave Hughes' excellent, 1974, *Radio Control Soaring*, has a heading, "Never do it into wind."[2] Older models tended toward higher camber, higher coefficient of lift, higher drag, more lightly loaded wings. In many DS situations they would have just blown back, or wouldn't have had the momentum to get back up a hill.

But zonking up (or down) through the shear layer, straight into the teeth of the oncoming airflow, is what gives DS its power.

The dive into the lower DS half-orbit, and the punch up through the shear layer

Let's say you've gained altitude in frontside lift. You bring your model back over the ridge, diving down the backside to start your DS.

As you dive through the shear layer, from a tailwind into a slight-uphill flow, your model's airspeed is bumped up by the difference in their velocities.

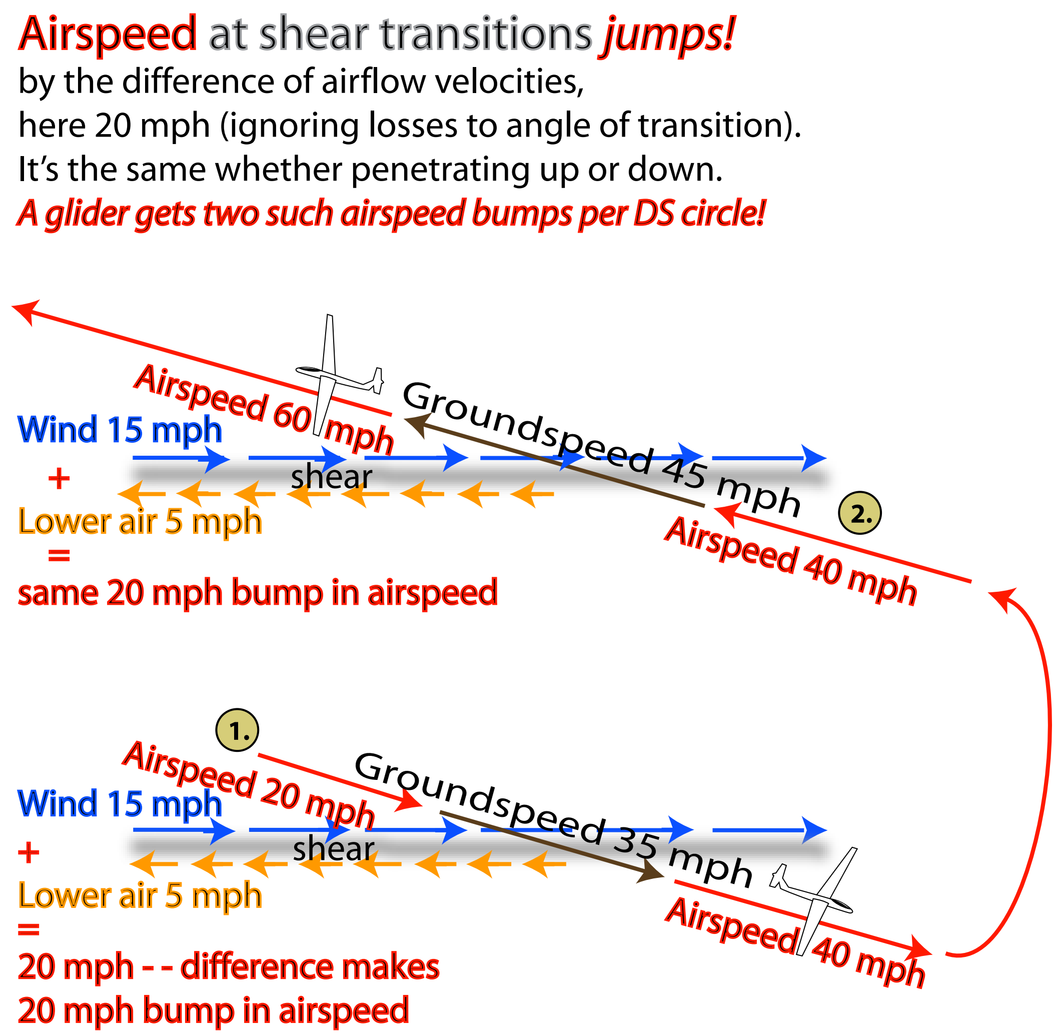


Figure 1-3: On penetrating through a shear layer into oncoming wind, groundspeed doesn't change much, so kinetic energy in relation to the ground doesn't change much. But airspeed jumps. New airspeed equals (1) groundspeed plus the velocity of the oncoming wind, or equivalently: (2) New airspeed equals old airspeed plus the difference in velocities of the opposing airflows. (We're assuming the shear layer is thin and angles of entry are small). Result: Kinetic energy in relation to the surrounding air increases. Graphics by the author.

You turn across the hill, which converts that new airspeed to groundspeed.

You pull out of the dive with plenty of uphill *groundspeed*, near the ground, in the uphill flow. It would seem that since it's flowing uphill, it doesn't slow your model much. But actually, since your glider's airspeed is fairly constant within each half circle, drag is also fairly constant.

As you near the top of the ridge, your glider slices through the shear layer into oncoming air. Your glider keeps most of its groundspeed. But punching into oncoming wind means its airspeed is increased radically. This airspeed increase is another opportunity to extract energy from that oncoming wind.

What happens: Kinetic energy (speed energy) increases in relation to the air and ground. (How it happens, via forces, is in a later section.) See Figure 1-4.

Gliders are great devices for maintaining kinetic energy in relation to their surrounding air, even when they turn. In the turn from upwind to downwind, the kinetic energy (speed energy) in relation to the air may only drop a little, meaning that the glider, after its turn downwind, is going downwind at least enough faster than the wind to still fly.

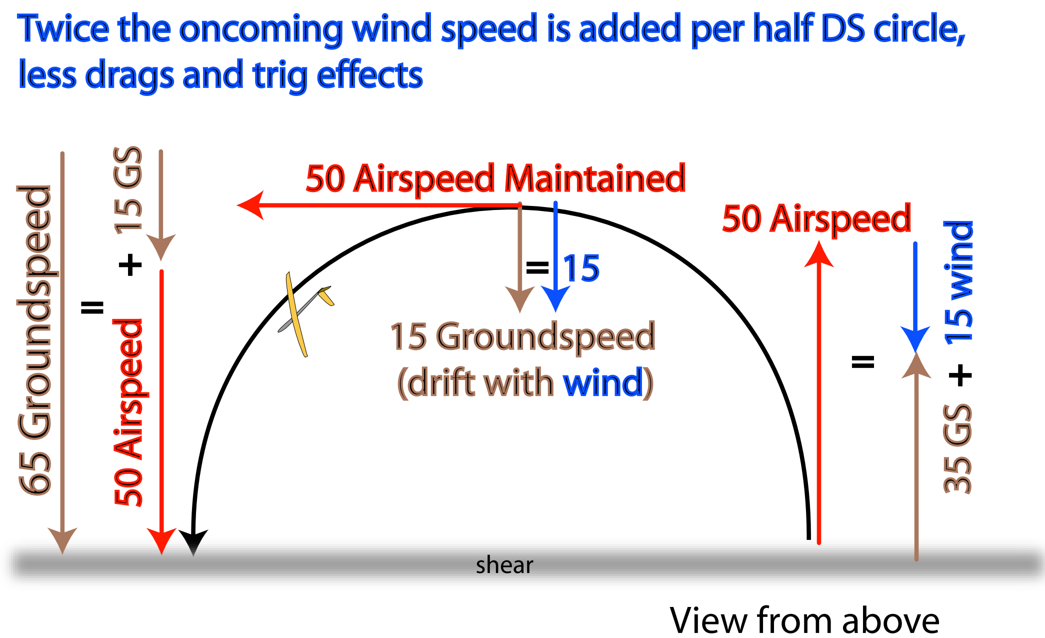


Figure 1-4: DS model gliders are very good at maintaining their speed (kinetic energy) in relation to the air in which they turn. So if the plane has 50 mph airspeed into the upper wind, after a half circle it will be going downwind 50 mph faster than the wind.

Across the wind, the glider maintains its circular path airspeed in relation to the wind. It also gains a groundspeed component equal to the windspeed. At the end of half-circle, the plane's groundspeed is its original groundspeed plus twice the windspeed, less drag. Graphics by the author.

And that means it has gained downwind groundspeed—it has gained tremendous kinetic energy in relation to the ground.

You can test that by trying a downwind landing. Splinters.

Or better yet, you can penetrate down through a shear layer, into air that is still, or coming uphill, getting another bump in airspeed—even more kinetic energy to convert from airspeed to groundspeed in the turn back uphill!

Two perspectives:

1. Straight airspeed! and

2. When we have to think about relations to that pesky ground stuff that sometimes gets in the way.

The simple way to look at DS is to forget about groundspeed, and realize that airspeed bumps up at each shear transition, from a tailwind to an oncoming flow. Groundspeed doesn't change much penetrating the shear, but airspeed jumps by the difference in the two airflow velocities! And that happens twice per DS circle! After a few transitions, the glider is zipping.

It's more complex to think about groundspeed as well as airspeed, but adds to our understanding:

The four elements of dynamic soaring airspeed and groundspeed increases

Bump in airspeed on penetrating a shear, bump in groundspeed with a turn across oncoming wind, "belly-to-the wind" acquisition of downwind drift, and turn to align airspeed with downwind drift — for whopping groundspeed increase!

Dynamic soaring speed increases happen in four ways.

- **1: Penetration into opposing airflow bumps airspeed**

The first airspeed increase is when a bird or glider penetrates through a shear layer between airflows with opposing velocities (relative to each other), or gets hit by a headwind gust.

1a: Airspeed bump relative to groundspeed at shear penetration (a bit deceptive)

One way to describe the glider's airspeed just after shear penetration is to compare it to groundspeed. This is useful because when we're standing on the ground, we have a good idea of the model's groundspeed, and just add the velocity of the oncoming wind to it. So we get a quick idea of our "airspeed capitol," that we're about to convert to groundspeed.

If the glider is slippery and of moderately high mass (inertia), groundspeed doesn't drop much, as it penetrates a shear into oncoming air. So kinetic energy in relation to the ground stays about the same, but kinetic energy in relation to the air in which the model flies increases.

So airspeed relative to groundspeed doesn't bump up when a glider penetrates down into dead air. That can make the downward penetration seem unimportant, which is false. A better way to look at airspeed bumps is:

1b: Airspeed bump at penetration of shear (better)

As a glider penetrates the shear, the groundspeed stays about the same. But, the difference in the opposing airflow velocities is added to the glider's airspeed (assuming that the shear is thin and the angle of penetration into oncoming wind is small). So the bump up in airspeed is the same whether penetrating up or down through the shear!

That bump in airspeed can be taken advantage of:

- **2: The turn across airflow maintains airspeed and converts it to groundspeed**

The second element of DS speed increases is the turn across the wind, while maintaining airspeed: Airspeed was greater than (upwind) groundspeed, but across the wind they are about equal.

So kinetic energy in relation to the air has been maintained, but kinetic energy in relation to the ground is increased.

• 3: The turn across airflow adds a downwind component to the model's velocity, in relation to the ground

Third, "belly to the wind" adds a downwind component to the model's velocity, in relation to the ground. In relation to the air, the plane only has a velocity across the wind.

downwind. When newly increased speed through air becomes aligned with the speed of the air, the two speed increases add to a whopping groundspeed increase, twice the velocity of the wind (upper or lower) in which the glider turns each half orbit! less drag and trig effects.

While kinetic energy (speed energy) in relation to the air has been almost maintained, kinetic energy in relation to the ground has been greatly increased!

And then the shear layer is again penetrated, for a new bump in airspeed.

neice and was shaking it around in a pot, my sister-in-law thought I'd lost it.)

Move the pot back and forth. (Ignore the stares of other adults, or explain to them what you are doing.) *In relation to the pot's velocity (that's like wind speed), at each reversal the marble gains twice the velocity change of the pot, less drag.* Try it, with shorter and shorter "shakes."

The marble gets zipping. See Figure 1-5.

In Part Six we'll use our pot to simulate what isn't DS, just slope lift: a circle around a hilltop in convergent thermal lift.

There are always numerous ways to look at aerodynamic events

In relation to the air, the DS glider flies a circle, in which the only significant forces are roughly constant centripetal lift. (Well, there are drag and gravity, but they are small potatoes.) (Wow! What about wind? *Wind is in relation to the ground, not the glider!*) We'll see in Part Four how simple centripetal forces add downwind groundspeed.

• 4: The turn downwind adds airspeed to windspeed

Fourth, completing the turn downwind aligns bumped-up airspeed with the drift

Corollary: DS requires turns in relation to the wind!
— After penetrating a shear into a relatively oncoming flow, or getting hit by a gust, DS always requires some turning (sideways, ballooning up, etc.) in relation to the wind. *No turn, it isn't DS.*

DS in a saucepan (What?)

You can get a quick idea of the power of dynamic soaring with a marble and a deep pot with vertical sides. (When I borrowed a marble from my four year old

That's tricky, though, because a pot can shake like a hill usually can't.

Two frames of reference: Forces and velocities on a glider or marble relative to the air (or saucepan), and relative to the ground (the kitchen floor).

There are always numerous ways to look at aerodynamic events—depending on frame of reference. Think of the reversing velocities of the pot a physical analogy for penetrating through the shear layer, into opposing wind velocities.

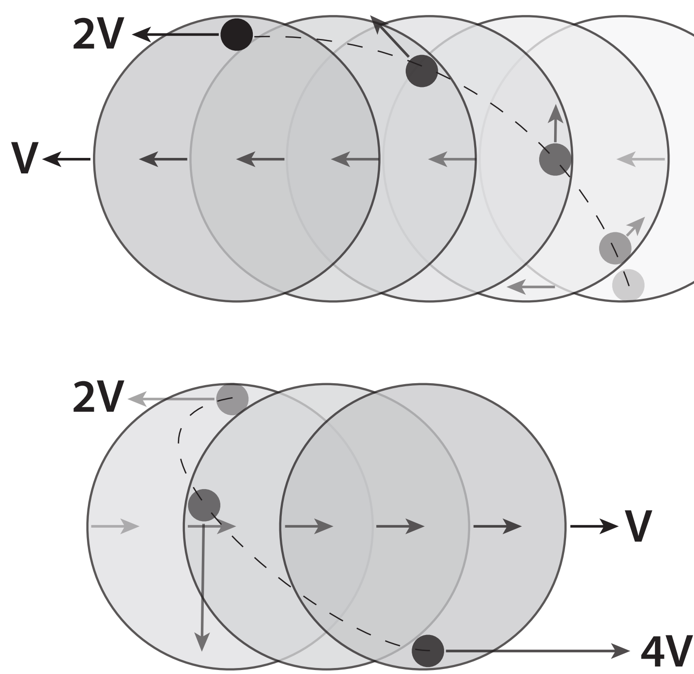


Figure 1-5: To understand DS speed increases, try DSing a marble in a deep pot.

Move the pot back and forth, in increasing frequency. Reverse the pot's velocity each time marble and pot velocities align, at points "2V," "4V," etc., analogous to shear transitions into opposing wind. The marble gets zipping.

Note that the marble's path is circular in relation to the pot. And in relation to the pot it is of constant velocity between each reversal of the pot's velocity. However, note that in relation to the ground (the dotted path), the marble accelerates continuously. See text, and Part 2, for explanation.

Graphics by Alex Hart.

Airspeed perspective: First, the reversal of the pot's velocity is like when a glider penetrates a shear layer. The marble has increased speed in relation to the pot, just as the model has increased airspeed as it enters oncoming air. This "airspeed" in relation to the pot is maintained through the curve, till it is going the opposite direction faster than the pot. Then the pot's velocity is reversed for the next "airspeed" increase.

In relation to the pot, the marble's speed is constant (less drag) in each half circle between "shear transitions." That makes sense—between each velocity change, the pot is inertial—no new energy is added. The only forces are the centripetal forces imposed by the curve of the pot, and a bit of drag. These centripetal forces, in relation to the pot, are constant, which is the formula for forces making something go in a circle (here, a circle relative to the pot, enforced by its circularity).

Groundspeed perspective: After each reversal of the pot's velocity, the force the oncoming pot puts on the oncoming marble increases its groundspeed (relative to the kitchen floor) in about the same way a collision with a ping-pong paddle adds double its velocity to an oncoming ball. Ping-pong is considered in Part Six, "Elastic Collisions."

The marble's groundspeed doesn't change as you reverse the pot at the position marked "2V." But by position "4V," twice the new velocity of the pot has been added to the marble's groundspeed. So there are forces along the marble's path in relation to the ground, within each half orbit. *The same centripetal forces discussed in the airspeed perspective, that didn't add to the marble's "airspeed," do partially align with the marble's ground path, increasing its groundspeed!*

More on that in Part Four.

θ! Part 2

DS history, from pteranodon to Lord Rayleigh, 1883, current theorists, models, full-scale gliders, and flying fish

Erroneous notions

Ideas about how DS works abound. They range from the accurate to the delightfully creative. How does one know what's right? For authority, the next section will trace the mainstream. Here are a few false notions.

A common idea is that the uphill wind acts like a tailwind, that pushes, or somehow lowers drag. Forget that.

Another idea is that it is the "belly-to-the-wind" that increases airspeed. That's false. During each half-orbit, airspeed is either maintained or somewhat sapped by drag. However, "belly-to-the wind" is the source of changes in direction and groundspeed. It's an intuitive term, but we'll see that "belly-to-the-wind" is actually just fairly constant centripetal lift flown in half-circle within moving air.

One usually excellent author asserted that the ideal DS conditions would be constant "belly-to-the-wind," in a circular pattern through centripetally converging flows. I have actually flown a model in such radially converging thermal flows above a conical point at the end of a ridge. But circling through them is just ridge lift. A glider circling such a hill gets no bump in airspeed from penetrating into opposing air. (Light DS conditions did work away from the end of the ridge. See Part Seven.)

History of an idea

Authority in the "great, green, greasy, Limpopo River" of notions, "all strewn about with fever trees."[4] *Four trustable sources. Validation!*

J. Philip Barnes' "How Flies the Albatross, The Mechanics of Dynamic Soaring"

Recently J. Philip Barnes released an excellent PowerPoint presentation of how albatross accomplish dynamic soaring. Barnes explained well how albatross extract energy from the velocity gradient in wind above water. The wind is faster fifty feet or so up.

An albatross rises from slower oncoming wind near water into faster oncoming wind above, and thus gains airspeed, that it uses to go where it wants. The article then gets fairly math intensive, but for those of you who aren't, stick with it through his verbal descriptions of DS patterns. They show an albatross can make progress upwind, across the wind, and 40% faster than the wind downwind! All without flapping! Great pictures, also. (See the link at esoaring.com.)[3]

Paraphrased, Barnes' rule for birds DSing, starting with high velocity downwind at low altitude, is: Gain airspeed by turning upwind and climbing up through the shear layer into the higher wind velocities further above water. Spend most of that airspeed for altitude. Turn downwind to gain groundspeed. To travel downwind, use a best glide. To work across or upwind, steepen the downwind leg, and use the resulting groundspeed to turn and penetrate upwind, while rising to again gain airspeed from the velocity gradient.

"How flies the Albatross" was the first cogent explanation of dynamic soaring I actually read. But the first accurate understanding of dynamic soaring is at least a century-and-a-quarter old:

Lord Rayleigh, 1883 to J. Philip Barnes, 2005

Dynamic soaring was first explained in 1883 by the physicist Lord Rayleigh, says Al Bowers, Deputy Director for Research at NASA's Dryden Flight Research Center, in an excellent web article

4 Elephant Child reference number two ("said the bi-coloured python rock snake").

accompanying PBS's somewhat obscure 'Raptor Force.'

Rayleigh noted how birds would take advantage of gusts of wind to gain altitude, which they'd then spend gaining ground distance upwind—flying upwind without flapping.[4]

Mark Drela and Joe Wurts. More authority!

And here I have to admit to going at this article backwards. Why didn't I do my web searches first? I showed an early draft to *RCSD*'s Bill Kuhlman. He referred me to an article I mostly disagreed with, but which started me through a chain of web links.

So after two weeks of writing, I found I had just been recreating the explanations of two greats, MIT Prof. Mark Drela, and model glider competitor and designer Joe Wurts.[5] (That was six months ago. This was just going to be a little note!) I wasn't surprised. Joe Wurts even did very similar arithmetic. Repeating someone else's wheel is a sort of validation!

Mark Drela's one page article on DS is concise, elegant, uses one simple equation, and has a great diagram, that I emulated.[6] http://www.charlesriverrc.org/articles/flying/markdrela_ds.htm

Joe Wurts emails on DS: http://www.charlesriverrc.org/articles/flying/dynamicsoaring.htm

Read each.

A minor difference? It's a little unclear, compared to their decade old notes, if it's only (or still) just me who says groundspeed is increased by double the velocity of the oncoming wind, after each DS half-orbit. Probably not.

the first accurate understanding of dynamic soaring is at least a century-and-a-quarter old

Little DS flying things everywhere. History, from critters to model and full-scale gliders. Fish flight, as an example of the elements of dynamic soaring.

J. Philip Barnes writes, "Pteranodon perhaps originated the technique of dynamic soaring." That would be well over a hundred million years ago.[7]

Air current energy is like food—or at least it's a food substitute. When flügel critters can get transportation energy from air, they don't have to eat as much. (Flügel, in German, is "wing," but in English it means "harpsichord." Go figger.) When there is energy to be had from air currents, flying things have learned how to take advantage of it, in all sorts of patterns. For example, DLG (discus launch glider) manufacturer Phil Pearson once observed migrating monarch butterflies waiting for thermals on the upwind side of a country club building. One came. They rode it!

How could energy hungry flying critters not extract energy from air via the elements of DS—via the conversions back and forth between groundspeed and airspeed, by penetrating shears and then turning?

I'd be surprised if swallows don't gain DS energy from the air currents around barns, as well as from flapping. Even flying fish use at least some of the elements of dynamic soaring:

Flying fish

Who knows when flying fish first spread their fin-wings barely above water while using their tails like little outboard motors, accomplishing "Wing in Ground-Effect" (WIG), and then rising into oncoming wind. But they're too smart to launch downwind. Launching upwind, they add wind speed to their tail-in-water velocity, for airspeed at which they can fly. That's the first step in DS—they exploit the difference in flow velocities, albeit of dissimilar fluids. And they reportedly ride the updraft in front of waves.

Waves form at right angles to wind, so the fish must turn, maintaining airspeed, less drag. That makes a second element of DS—the turn that converts airspeed to groundspeed. That's smarter than just pointing upwind till they get blown back into the maw of a swordfish.

To gain even more distance from predators, do they ever add wind speed to airspeed by completing the turn downwind? Perhaps. If so, they complete the half-circle of dynamic soaring.

Whether across the wind or downwind, when they splash down, they again penetrate the ultimate shear layer, the "indicated airspeed," density-velocity gradient between wind and water. At splashdown, they're going faster than they can swim underwater. If confronted with a school of tuna, they must immediately turn, retaining some of that speed to help in their next launch upwind. That completes the DS cycle!

Mostly flying fish glide low, using ground effect, rather than further exploiting the velocity gradients of the shear layer above water, as does another of their predators, the dynamic soaring albatross.

However, some flying fish do indeed briefly experience more elevated dynamic soaring, when swallowed live, by a frigate bird (man o' war bird) or the aforementioned albatross.

Full-scale gliders and model gliders

Starting in 1974, Australian Ingo Renner DS'd two full-scale sailplanes, working high-speed airflows above the dead air beneath temperature inversions. (Story credited to Helmut Reichmann, Streckensegelflug, 1978. See "Dynamic Soaring," Wikipedia.)

Till the 1990s, model glider slopers flew where wind and thermal updrafts angled up the front sides of hills.

In "Lift Ticket," model glider competitor and designer Joe Wurts talks about how in 1995 he discovered that dynamic soaring worked for models. During a slope combat at Parker Mountain, his model glider got knocked into the rotor downwind of the ridge. He said, "It came back up with more energy than it went down." He set about repeating that. And being an engineer, he scratched his head, and figured out what had happened.

This kicked off model glider dynamic soaring.

References:

1 Jo Grini, DS theory, http://www.workflow.as/jogrini/ds/index.htm.

2 Dave Hughes, Radio Control Soaring, Radio Control Publishing Co. Ltd., Suningdale, GB, 1977, p.209.

3 J. Philip Barnes, "How Flies the Albatross -the Flight Mechanics of Dynamic Soaring" SAE 2004-01-3088 http://www.sae.org.

4 PBS, "Nature," 'Raptor Force,' http://www.pbs.org/wnet/nature/raptorforce/soaring.html, 2007.

5 Joe Wurts, http://www.charlesriverrc.org/articles/flying/dynamicsoaring.htm, 1996.

6 Prof. Mark Drela, "How and Why Does Dynamic Soaring (DS) Work?" http://www.charlesriverrc.org/articles/flying/markdrela_ds.htm.

7 J. Philip Barnes, "How Flies the Albatross -the Flight Mechanics of Dynamic Soaring" SAE 2004-01-3088 (sae.org).

E-flite Ascent

by Jerry Slates, oldjer1@att.net

Well it's that time of the year again. The snow is starting to melt, the trees are starting to bloom and the thermals are starting to form. And what are you doing? You're here in the company lunch room eating an old dry sandwich, when you could be out in the parking lot or down the street in the city park getting in a bit of flying.

Parking lot, city park, flying, it beats sitting here in your work place for an hour doing nothing. All you need is a hand launch glider or a small, docile, electric motor glider. I'm going in favor of the electric motor glider, like the Ascent by E-Flite. It's small, with its 54 inch wing span, and will fit behind the seat of my pickup truck. Charge your batteries the night before and if the weather is good you're set to fly on your lunch hour.

The Ascent, an ARF, comes to you with 90% of the building already done for you. There are only a few items in the box. The fiberglass fuselage comes painted, with the motor (a speed 400 with folding propeller and spinner), servo tray and push-rods all factory installed. Plus the canopy is trimmed and installed at the factory, too. There is a set of wings, hinged stabilizer and hinged rudder and one small bag of miscellaneous bits and hardware items.

Construction

In building the Ascent, you will need only a few items - a hobby knife, Phillips screwdriver, Allen wrench, 4-40 tap, some drill bits, pencil, a ruler and some slow cure epoxy.

Not included, but manufacturer suggested, will be a 3-channel radio of some sort, 2 sub-micro servos, 20 amp ESC (Electronic Speed Control) with brake, and an airborne 7-8 cell Ni-Cd, 500-800 mAh battery pack.

I'm using a JR FM 4-channel transmitter and a Shadow 3 crystal-less RC receiver, two Hitec HS55 servos, E-Flite 30 Amp ESC with brake, and a Thunder Power 3-cell, 2100 mAh./11.5 volt Li-Pro battery pack.

Charge your batteries the night before and if the weather is good you're set to fly on your lunch hour.

Assembly of the Ascent is very easy and very quick. If you are an experienced builder you will probably take a quick look at the Instruction Manual, set it aside, and build the model. But if you are new to the hobby or a first time builder, read the Instruction Manual and follow the step by step instructions.

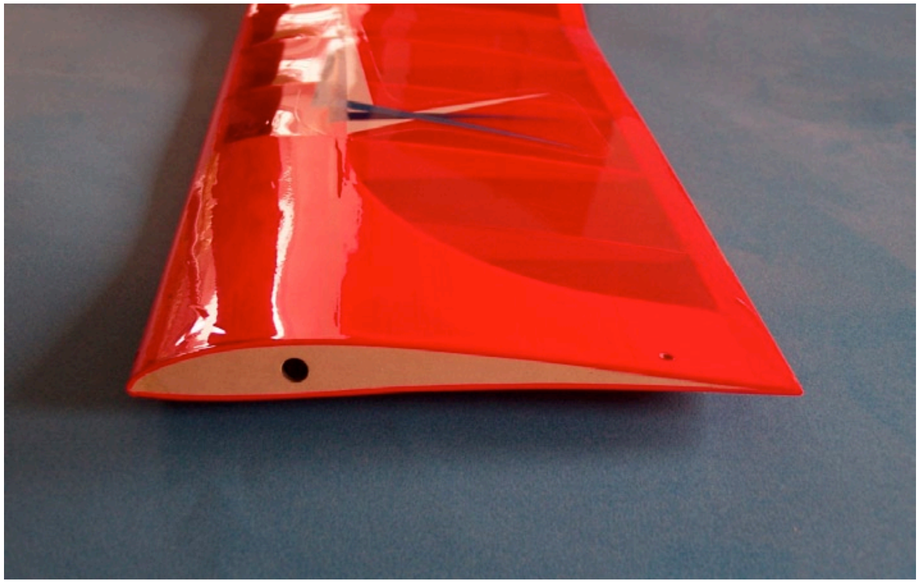
Again, the Ascent will go together very easy and very fast. There are no hidden surprises in the Instruction Manual. It's done very well,. Thank you, E-Flite! Basically there are only seven glue joints to do - the two wing rods, stabilizer to the fuselage, a sub-fin to the stabilizer, rudder to the fuselage, and the two control horns - one on the elevator and the other one on the rudder. Then install the electronics.

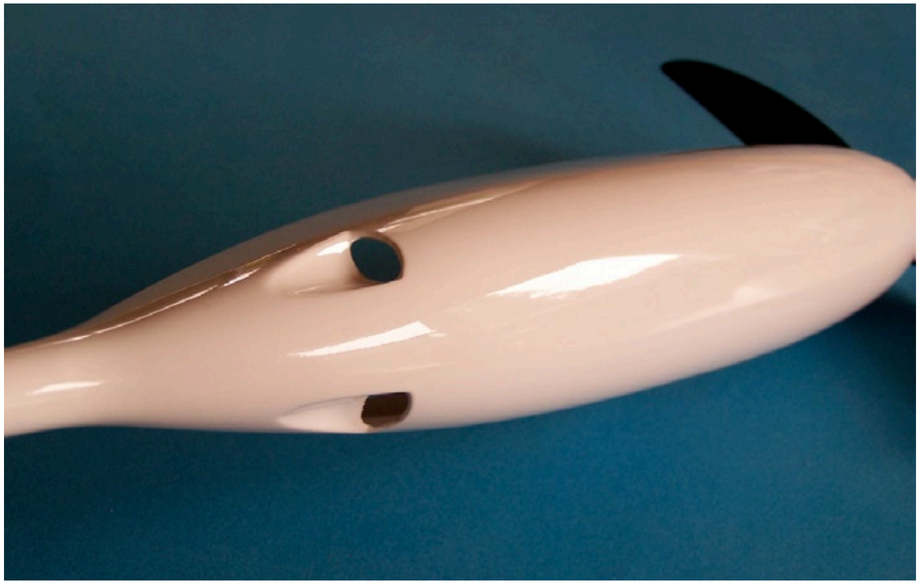
Miscellaneous

Not in the Instruction manual... I suggest that you run a 4-40 tap through the wing hold down nuts in the fuselage to remove any over-spray paint that may be inside the nuts. If you were to screw the wing hold-down bolts in place without removing any of the over-spray paint, you could jam the wing hold down bolts and break the wing hold down nuts loose and then have to replace them. The wing comes in two parts for easy transportation. I tape my two wing halves together to make a one-piece wing.

Center of Gravity

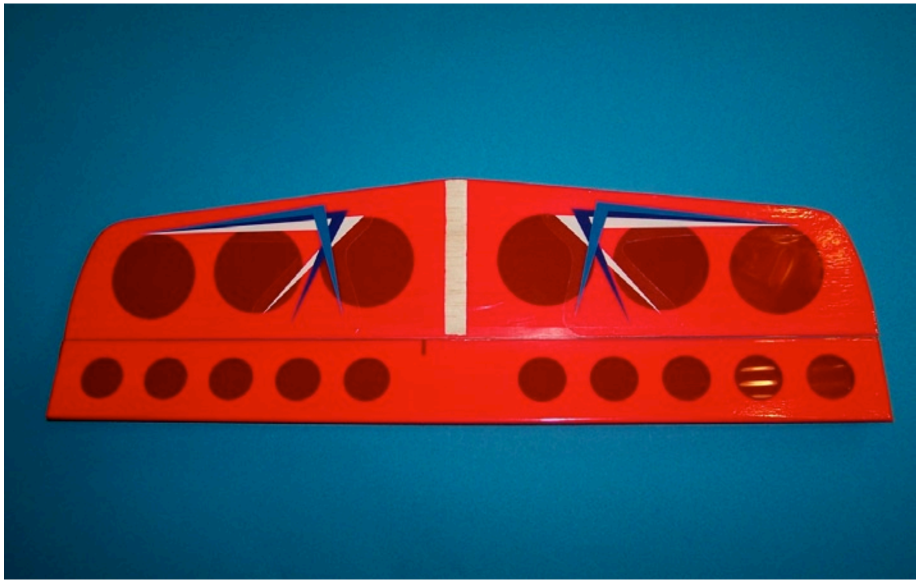
Almost ready to go flying. But if you are a first time builder turn to page 17 in the Instruction Manual. Read about the balance. The balance point or the

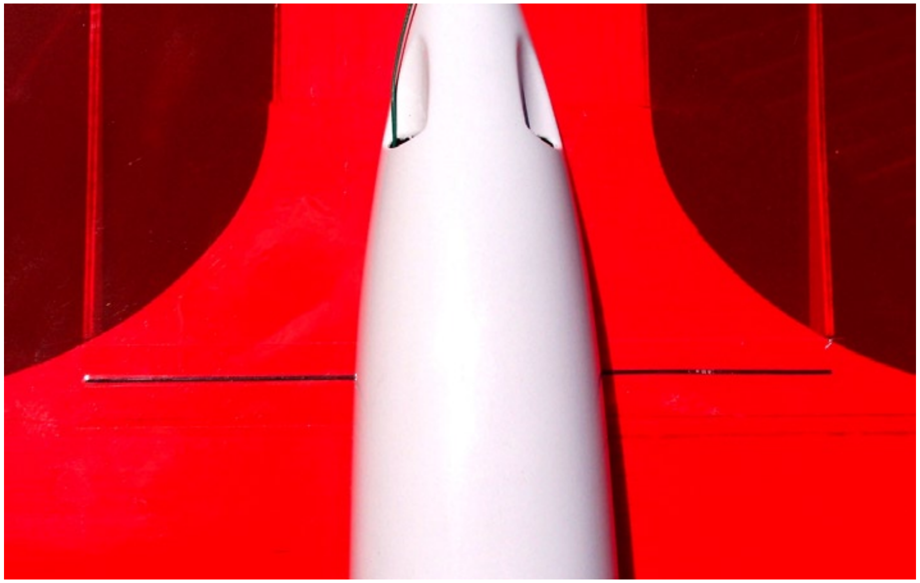




Top: A very good ARF covering job shows off the relatively thin undercambered airfoil.

Above: Air exit holes work in concert with a canopy opening for good internal air flow.
Right: The fairly spacious fuselage interior.





Above left: Horizontal stabilizer. Note the cutaway covering for gluing. Right: Black lines mark CG location. Note air exit holes.
Below left: Thin lead strips under stab cure slight nose heaviness. Right: The front end. Folding prop, air inlet in shaded canopy


Ascent

CG (center of gravity), is 2 3/8 inches back from the leading edge of the wing. If you don't understand this section, balance, find yourself an experienced model builder and ask for some help. It's important that the balance be correct, believe me.

When it came time to balance my model, I found that it was heavy in the nose. This doesn't happen very often. Most of my models are usually tail heavy. Being nose heavy I added some strips of solder to the tail until the model was balanced as per the manual.
Also at this time I found that the left wing tip was a bit heavy, too. So I added a small bit of weight to the right wing tip until each wing tip was of equal weight.

Flying

Ready to fly, but the weather here on the north coast was rotten - foggy, overcast and windy for several weeks. But then one day I saw the sun. Off to the flying field, but the wind was 11-21 mph.

On the Ascent's maiden flight in winds of 11-21 mph I had no trouble flying this model. It handled the wind with ease. I was careful not to let it get downwind of me.

After about 10 minutes of flying I landed the model, wanting to save it for a better day, but I broke the manufacturer supplied folding 7dX3p propeller. On the way home I stopped at my local hobby shop to pick up a replacement propeller. The only folding propeller they had in stock was a Graupner 9dX5p propeller. What the heck, I took it.

After 30 minutes of flying I landed so that someone else on the same frequency could fly.

After two more weeks of fog, the weather broke. There was sunshine, blue skies, and little to no wind. Off to the flying field I went with Ascent armed with its new 9dX5p propeller.

On launch I did a 30 second motor run and this got me to about winch launch height. I then shut the motor off and glided around the field for several minutes. After gliding for a while I found a small thermal and began to circle. My 19 oz. Ascent was starting to go up. Not very fast, but it was going up. I couldn't take it any longer so I advanced the throttle a little bit, about 25%. What a boost. I was really going up now. After about five turns I shut the motor off again and glided some more. After 30 minutes of flying I landed so that someone else on the same frequency could fly.

Conclusion

To start, why did I deviate from the manufacture's suggested equipment list and up grade some items, like a 20 amp ESC to a 30 amp ESC, and the 7-8 cell, 500-800 mAh Ni-Cd battery pack to a 3 cell 11.5 volt, 2100 mAh battery pack? No reason except I had these items sitting on my workbench doing nothing, so why not use them!

I think going from a 7dX3p to a 9dX5p propeller is an improvement. I'm going to stay with the 9dX5p propeller even though I ordered a 7dX3p replacement. I'll keep it for a back up.

So why did I go out and buy this model, the Ascent-ARF by E-Flite? One of the other club members has one and it impressed me and I had to have one. In the hands of a newbie, beginner, advanced or an expert flyer, this is one fun little airplane to fly.

Anyone want to go have lunch? I'm flying!

Wei Wu Wei

A Brief History Of WeaselFest

by Steve Lange

The Taoist concept of *wei wu wei* is often translated as "doing - not doing". Like most tenets of Taoism, its precise definition is difficult to pin down, but in the larger sense it refers to knowing when to act and, more importantly, when not to. *Wei wu wei* was the phrase that immediately jumped to mind when I was asked to write an article about the history of WeaselFest, because though I've actively helped to plan and participate in each one, I am by no means responsible for their existence or continued success.

In truth, the story of WeaselFest is that of an organic, self-organizing "happening" spurred on by interested parties and facilitated by modern communications technology. In my view, WeaselFest has proven to be popular and compelling precisely because there is no one individual or group trying to control it. Each participant can and does make as small or as great a contribution to the outcome as they wish, and it all just seems to work out in the end. This makes WeaselFest very different from almost all other organized R/C activities, but after five consecutive years of Weasel pilot gatherings and unanimous positive feedback, whatever this approach is (or is not), it seems to be working.

The original seed for what would eventually become WeaselFest derives from a message titled "Get the Weasel Out" by David Martin. David sent this message to the flyWeasel Yahoo Group on June 9, 2003, when he and his brother Roger were looking to fly with a group of other Weasel pilots. At the time there were very few Weasels outside the Santa Barbara area.

David's post sprouted a discussion on the flyWeasel group that led to a small "Weasel Fly-In" being held at Ellwood Mesa on Saturday, June 14, 2003. It was attended by a few of the local Santa Barbara flyers (including Bart Cubbage, Dustin Boudreau, Michael Richter and myself) as well as David Martin and Jason Ingham from Los Angeles. The conditions were rather poor, but everyone had a great time and enjoyed a small get-together afterwards at the Rusty's Pizza Parlor on Storke Road in Goleta.

While this "fly-in" was never explicitly referred to as a "WeaselFest" by name, that was the term that Michael Richter and I used when referring to the idea of having Weasel pilots get together and do a fun fly. Furthermore, I did make passing reference to this meeting as "a Weaselfest" in one of my flyWeasel mailing list responses to David Martin on June 9, 2003. To the best of my knowledge, this was the first time the word was publicly used in reference to R/C gliders. With that said, this event was much more of a "buddies getting together to fly" rather than the sort of intentional gathering characteristic of later 'Fests, so to avoid chronological confusions it's probably best to think of this as "WeaselFest: Zero" or the "Proto-

2003

2004

2005

WeaselFest." A prequel, if you will.

On April 18, 2004, Joe Zepeda (then still a newbie with the RCGroups handle "ZagiCrazy," but who would later go on to become very well known as "KingOfTheHill" for his accomplishments in Dynamic Soaring) issued a call for a Weasel get-together in the RCGroups.com Slope forum. After a good deal of discussion amongst the various individuals interested in participating, the date and site were set for June 19th and 20th at Ellwood Mesa.

This was billed as the "2nd Annual WeaselFest," but in fact was the first public use of the WeaselFest name to describe an intentional gathering of Weasel pilots. It was also the first time that a WeaselFest was organized through RCGroups. Not surprisingly, turnout was much better than the first year, with approximately twenty pilots showing up from as far north as Fresno and as far south as San Diego. The conditions were also better, with a lot of great flying on both days. This was also the first year of the Richter's fantastic barbecues, hosted at their home in the foothills above Santa Barbara. A ready-to-fly Alula, a Weasel-pro kit and other assorted sundries were raffled off to an enthusiastic crowd. This event became the model that all subsequent WeaselFests followed, and for all intents and purposes should rightly be considered the "First WeaselFest."

Steven Fineg, aka "Pegasus" on RCGroups, organized a simultaneous WeaselFest in Austin, Texas that took place on the same dates as the California gathering. About four or five pilots attended, including Kai Yang of Santa Barbara who was in Austin for the summer. Unfortunately, the wind didn't cooperate for the event at all, so they mainly just hung out and flew electrics.

Justin Gafford, known as "Mr. Innocent" on RCGroups, issued the call for WeaselFest 2005 in a January 8, 2005 post to the WeaselFest 2004 thread. The official thread for WeaselFest 2005 was started by Santa Barbara local Dylan McDaniel, known as "Madhatter227" on RCGroups. As with the 2004, much discussion ensued and ultimately the interested parties agreed to meet up at Little Mountain in San Bernardino on April 16th and 17th, 2005. Turnout was very good (at least thirty pilots) and the wind was excellent, too. The conditions were so good, in fact, that later in the day a significant percentage of the planes up were of the "go fast" variety, and many of the Weasel pilots who still had their planes in the air had ballasted them with anything and everything available.

WeaselFest 2005 also saw the debut of the now-infamous "Anarchy Weasel" logo by Pete Schiess (aka "SchiessCo" on RCGroups). Pete kindly offered his design freely to the community and lots of cut vinyl stickers and t-shirts have been made with it ever since. The logo is evident in profusion wherever Weasels are flown and has come to be the officially unofficial emblem of the Axis of Weasel, which is itself the unofficially official Weasel fan club.

On October 9, 2005, Rene Wallage, known as "Up&Away" on RCGroups, posted a thread about a small WeaselFest-like gathering held in Israel. He wrote that after more than a year flying separately, they had finally managed to get three of the four Israeli Weasels together. This was the first known WeaselFest held outside the United States, and hopefully it will not be the last.

WeaselFest 2006 was spearheaded in a post aptly titled "Weasel Fest 2006" on January 2, 2006 by David Field, aka "Minhuahua" on RCGroups. This time, the participants decided to return WeaselFest to Ellwood Mesa, with the date set for April Fool's Day, 2006. Happily, the wind wasn't fooling around and the WeaselFest attendees were treated to some of the very best lift Ellwood has to offer. Turnout was again excellent, with approximately forty pilots participating. Another great barbecue at the Richter residence followed... one of the highlights of every WeaselFest, to be sure.

WeaselFest 2006 was doubly special as we celebrated the 10th anniversary of the Weasel's production. This little plane has come a long way since its beginnings at


2006

Las Positas Park as an EPS wing with a long nose and standard size servos!

In order to properly recognize this milestone, Jon Ludwick (aka "jludwick" on RCGroups) officially took over as the unofficial WeaselFest t-shirt impresario. Thanks to his efforts in organizing the artwork, printing and delivery, WeaselFest 2006 saw the most attractive t-shirts yet, featuring a great design by one of Jon's designer buddies, including an exclusive "10th Anniversary" version of Pete Schiess' "Anarchy Weasel" logo.

Which brings us to the most recent WeaselFest, held April 14th and 15th, 2007. Thanks to another bit of excellent luck with the wind, participants got to fly at both Ellwood Mesa and the Ruins, the mountain flying site in Santa Barbara. The Ruins featured especially great lift, with both Saturday and Sunday having almost flawless conditions. We could not have had better fortune in terms of conditions.

Turnout was again very good, and the barbecue at Michael's house was a big success, culminating with a very fun and intimate raffle in the Richter's kitchen (held indoors this year since it was so cold and windy outside). As always, Ruth and Emil's hospitality is nothing short of amazing, which they're glad to do as a way of showing thanks to all the people who've helped make the Weasel a success.

If nothing else, the story of WeaselFest is the story of the many Weasel pilots who make it happen year after year. The Weasel attracts a very special subset of the slope soaring community, people who are dedicated to the spirit of fun and cooperation that this wonderful little glider seems to engender in all who fly it. I believe that WeaselFest continues to succeed because these people have been empowered to take lead roles in its planning, organization and execution. The organic structure that evolves from their participation results in a truly wonderful R/C soaring experience.

The fifth anniversary WeaselFest is next year; here's looking forward to what the Weasel pilots come up with next!

Links from the article:

- Richter R/C: http://www.dream-flight.com/
- RCGroups Slope Forum: http://www.rcgroups.com/slope-97/
- flyWeasel Yahoo Group: http://groups.yahoo.com/group/flyWeasel/
- SBslopers (WeaselFest photos & video): http://www.sbslopers.org/

2007

WeaselFest Israel

Friday, April 13th, 2007

By Rene Wallage, rene_wallage@yahoo.com
Photographs by Ariel Erenfrid

After reading for the past three years about the Weaselfest in California, and how much fun everyone had, I figured it was about time we had something similar here in Israel.

Since the first Weasels arrived in Israel in early 2004, many more have been spotted. On the Bat Yam slope alone there are about 10 Weasel owners. The trick was to get them all on the slope, at the same time! So as soon as the 4th Weaselfest was announced on RCGroups, I posted a message on the Israeli Glider forum (hosted by the Israeli MSN website), inviting all and sundry for our very own first Weaselfest. As the California dates were April 14/15, I decided to keep it close, and aimed for Friday April 13th (it's bad luck to be superstitious).

Starting Tuesday April 10th weather forecasts were studied almost religiously. And they looked iffy at best! Any wind direction between WSW to WNW was fine. Most of the time both force and direction looked do-able but not ideal. Until Friday morning. NW was now forecasted, but plenty of it. There is a small "dip" on the north side of the slope that makes close quarter sloping possible, but it would be cramped. After a few phone calls we decided not to call it off. And a good thing it was, too!

Needless to say we had an indecent amount of fun. Now with my at last properly trimmed out and Tx'ed out Miniweasel (it's all in the expo…) I could stay up forever! My Easyglider had about 15 minutes airtime, and only because a non-sloping friend came around to see what this sloping lark was all about. My Unicorn didn't even get out of the car! That's a first.

From left to right: the brothers Yossi & Snir Guetta (at least one of them is flying their Weasel), Paz Erez, Rene Wallage, and Liran Levin having a rest in the background.

Since the forecast showed less than good conditions, many of the Weaselers decided not to come to Bat Yam. Only six of about 15 showed up. As we had a "window" of a total of about three hours flying, we made the most of it and had way too much fun (did I say that already?). Again, because of the faulty forecast, some of us arrived later, and others had to leave early. So we had a turnover of constantly three or four Weasels in the air. That also made it impossible for a proper group picture, apart from this one. So you'll have to do with our pretty Weasels in the air.

Now, who was there? In no particular order...

There was Ariel Erenfrid (the photographer) with his red & black Weasel.

Eli Sayag (the first flying WeaselPro in Israel) with his Weasel re-covered in a white livery with some red pointy stripes.

Liran Levin who is still getting the hang of his new yellow & blue Weasel. He still has to tuck away the aerial.

Paz Erez, all the way from Be'er Sheva, about 1.5 hours drive away. Paz has great ambitions to become a gardner; occassionaly he tries to cut the grass with his yellow & red striped Weasel.

The brothers Yossi and Snir Guetta with their patriotic blue & white Weasel

Oh yes, I was there too with the one and only Israeli MiniWeasel.

The silly grin did not leave my face 'till I went back to work on Sunday. It definitely did leave us with a taste for more. So next year, all being well, when you guys have your 5th Weaselfest, we'll be aiming for our second.

A small footnote:

I have been asked why my MiniWeasel flies so much better now.

Well... (says Grandpa as he warms his hands on a hot mug of tea...) when I started flying my Mini it was trimmed out, and flew great (in my eyes). Having had very little slope experience, compared to my 48" Unicorn's sedate behaviour, this is how I thought the Weasel should fly: Bloodpressure up, white fingers clutching the transmitter in a deathgrip, the Mini at full speed zipping through the melee of other slopers. Great

Ariel Erenfrid

Eli Sayag

Paz Erez

Liran Levin

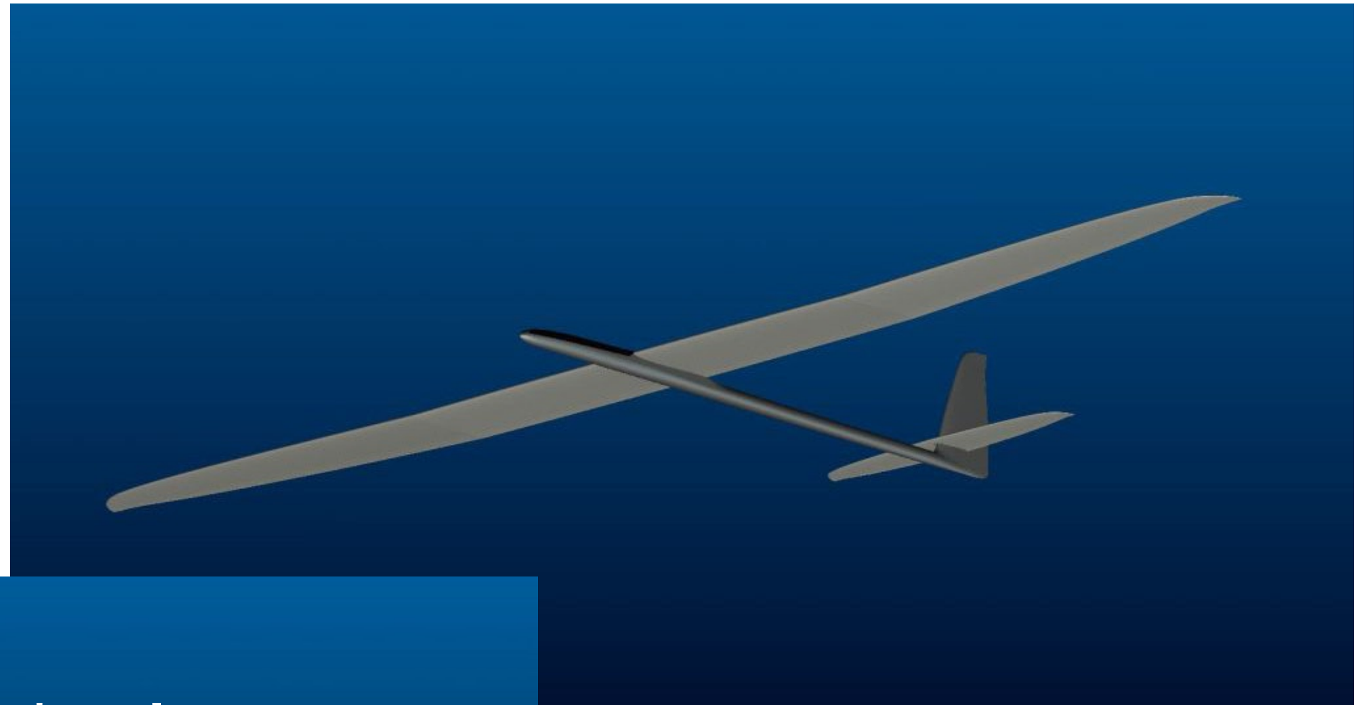
Yossi and Snir Guetta

Rene Wallage

fun, but not very relaxing, and after a 5 minute flight a rest was needed. After flying two years like that, one of the really experienced slopers asked me if he could have a go (wind was about 12Kn that day). After a short hop we taped a coin just in front of the receiver bay, lowered aileron throws by 2mm, and raised the expo. Later another coin was added. Aileron throw low rates are now 10mm, high rates 14mm, elevator high and low rates are 5mm. Exponential is –40% on ailerons and –55% on elevator. AUW is 162 grams. CG as per plan.

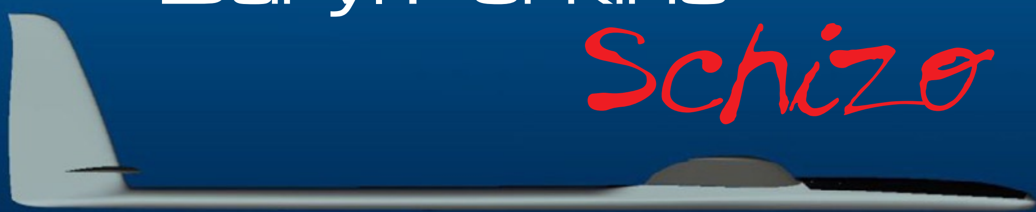
The result — the MiniWeasel is tamed, but can be wild on command...

Shalom, and happy landings! ■

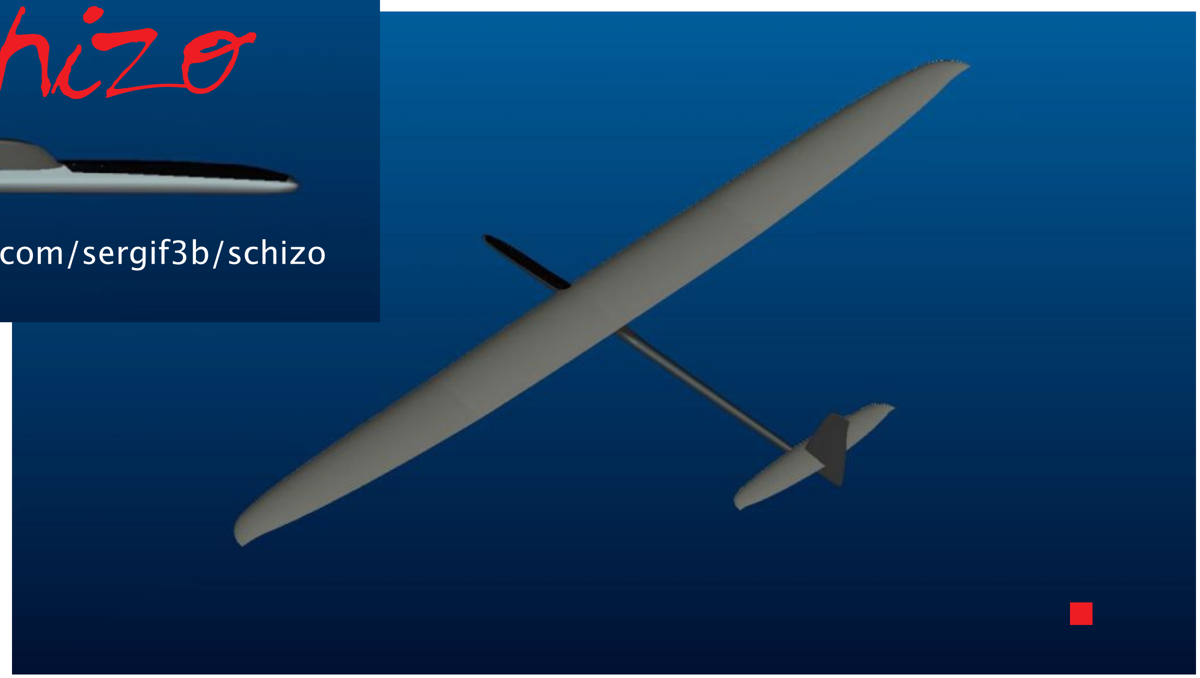


sneek peek

Daryl Perkins' Schizo



Sergi Valls Batalla / http://www.pbase.com/sergif3b/schizo



Converting a car starter motor for REVERSIBLE operation

Paul Hills, talulah@ntlworld.com

From http://homepages.which.net/~paul.hills/Motors/Starters/Starters.html
and
http://homepages.which.net/~paul.hills/SpeedControl/SpeedControllers.html

1. Introduction

Car starter motors offer several advantages over other 12 Volt DC motors available to the roboteer, including very low cost (there are hundreds in every scrap yard!), a very high starting torque, and ruggedness. In contrast, there are some disadvantages that need to be overcome before they can be used in a typical robotic application. Before going into the detail of how they can be used, let's examine the properties of the small DC series field motor.

All motors require two magnetic fields, one produced by the stationary part of the motor (the stator, or field), and one by the rotating part (the rotor, or armature). These are produced either by a winding of coils carrying a current, or by permanent magnets. Car starter motors do not generally use permanent magnets (although some do).

1

2. Disconnecting the field winding

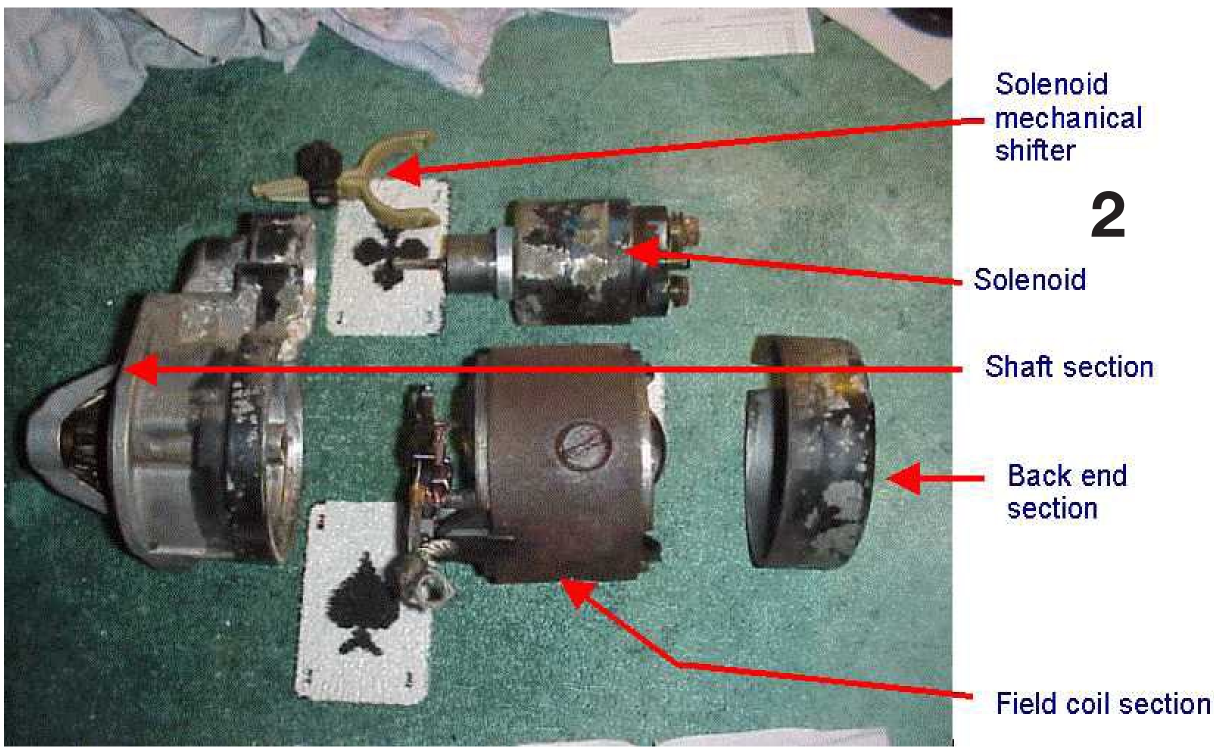
Photo 1 The motor I will describe here is from a 1985 Ford Fiesta 1.4L. This is a fairly typical motor, and most other motors are very similar. This car is very common in scrap yards, so if you want to stick with the same motor I used you shouldn't have too much trouble obtaining them. I would like to thank W.J. Dijkstra for providing the excellent photographs of the dismantling process.

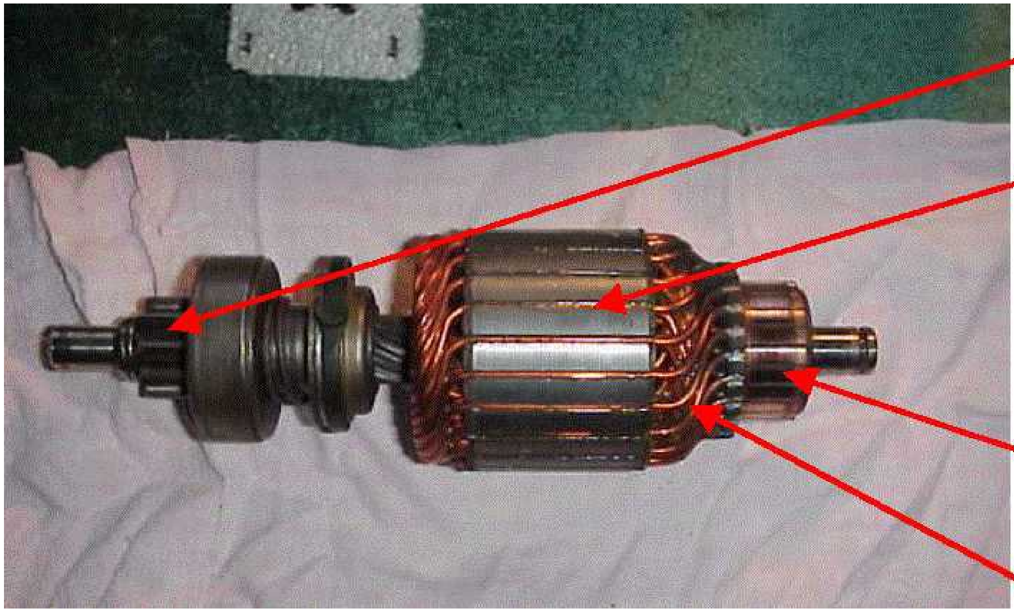
Let's first have a look at the motor as you buy it from the scrap yard:

Photo 2 The main parts are identified in the diagram. The outer case is made from three sections. The left hand section holds a bearing, and supports the back end of the shaft. The centre section holds the field coils in place, and the front section, which is made from cast aluminium, holds the front bearing, and shrouds the shaft gear wheel.

Let's take it to pieces! The first thing you'll need is spanners and screwdrivers of the correct size, and plenty of WD40! At the back end of the motor there is a small end cap held in place by two small screws. Take this off. Next there are three long retaining bolts which run the entire length of the motor, shown in the diagram. These shouldn't be too hard to undo - take them out completely. Now the three sections of the casing should come apart. You will probably need to hammer a screwdriver or chisel in the crack between them and force them apart if they are bunged up with oil and rust. This should allow you to get all the separate parts out, which should look something like the photo below.

The solenoid on the side of the motor is not needed, and once taken to pieces can be discarded, (it may be useful in another part of your robot). The last diagram shows all the stator parts (non-rotating parts).





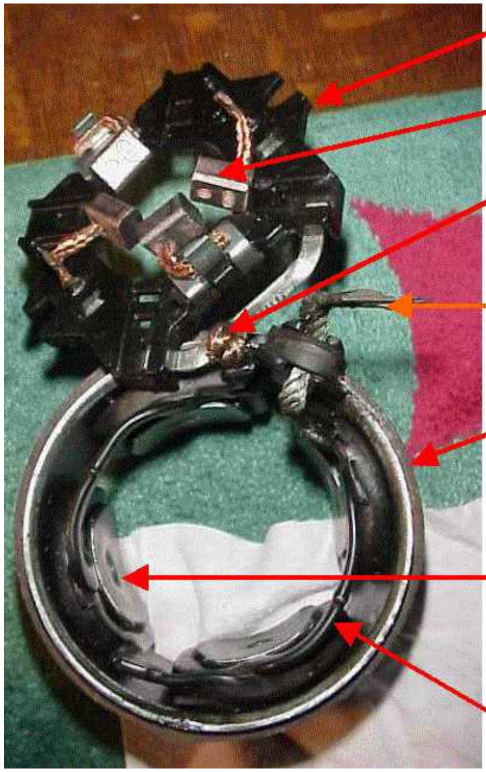


Photo 3 The rotor looks like this.

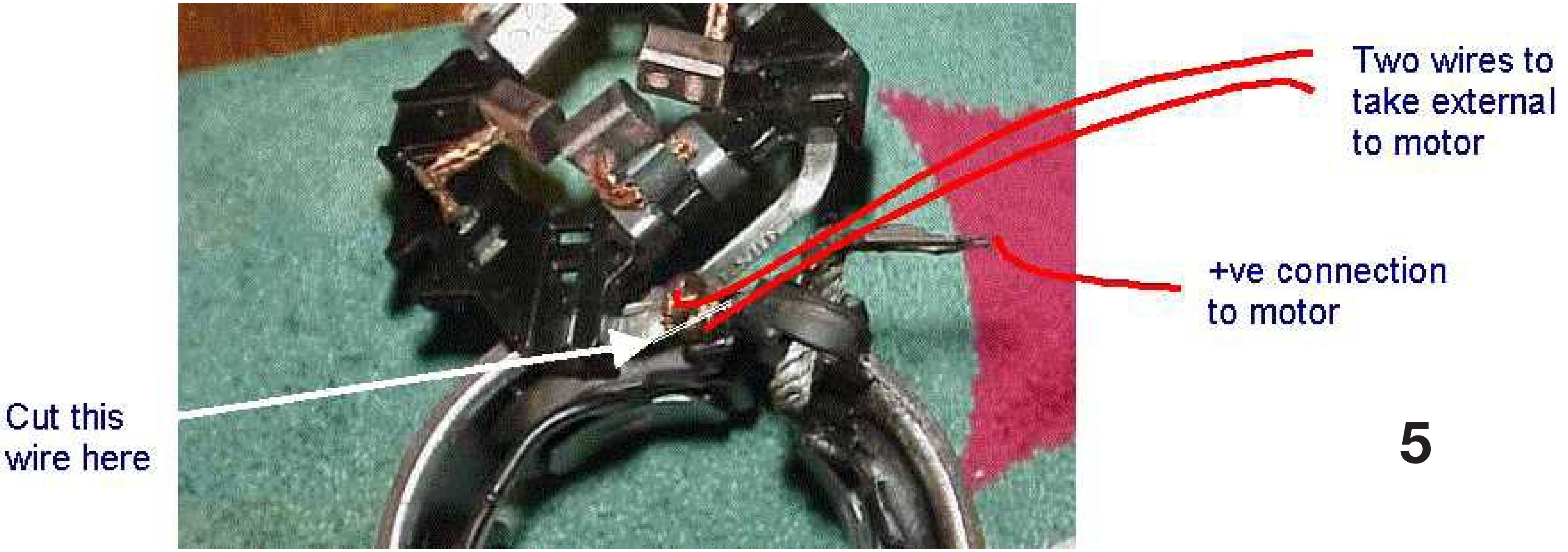
While the the motor is apart, it is a good idea to clean the commutator and brushes with WD40, to reduce the resistance Rb.

The first thing to modify will be the case at the front (business) end of the motor. Here there is a gear wheel, which can move up and down the shaft a little, which is half covered by shroud on the outer casing. If, like me, you are going to weld a sprocket onto the shaft, this shroud should be sawn off with a hack-saw. The brass bearing at the end of the shroud should be kept so you can remount it on the frame of your robot (the motor should not be used without this end of the shaft securely in the fixed bearing). Just pop the bearing out of the casing. See also Section 4, Modifying the front end.

Now the electrical part must be modified.

Photo 4 The centre section should look like this.

Photo 5 You should be able to trace the incoming wire which goes through the outer case (through a rubber or plastic grommet), and onto the field winding. At the other end of the field winding, it attaches to two of the four brushes. The current then goes through the commutator segments, through the rotor, back through the commutator segments and onto the other two



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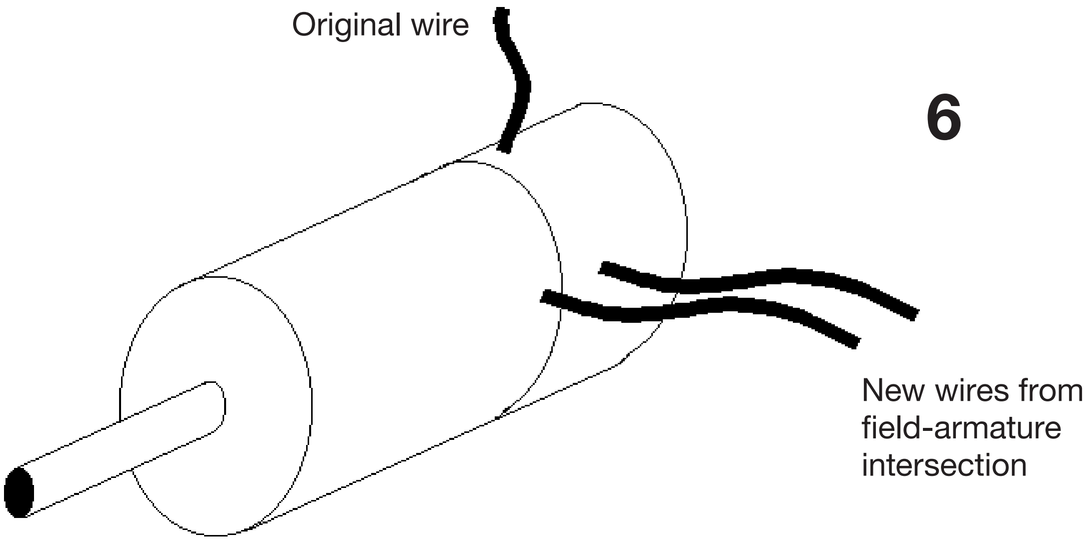

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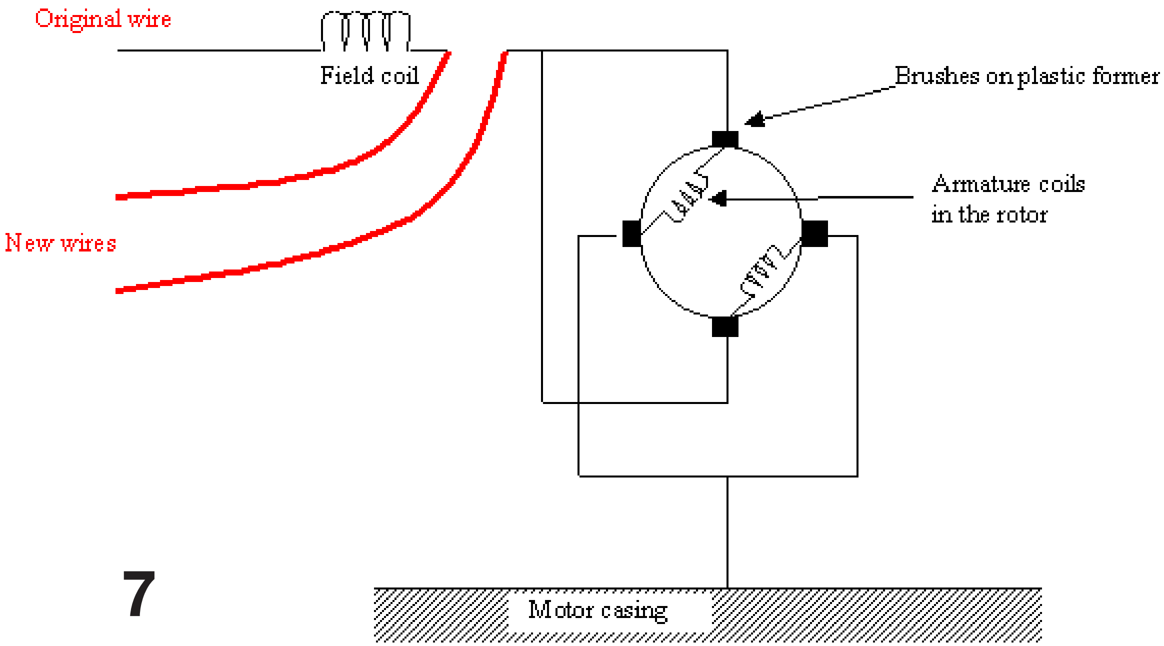
brushes, where it eventually attaches to the motor casing (negative earth). We need to cut the wire between the field winding and the brushes:

Both resulting ends of this wire need to be taken out through the casing. Drill two holes in the rear casing, wherever it is convenient. Note that these holes will need rubber grommets fitting so the wires do not short against the casing. Using as thick wire as you can obtain (Maplin CW71N earth bonding wire is cheap), attach the wire to the two ends of the cut wire, by soldering, or spot welding. Pass the wires through the newly drilled holes.

Illustration 6 You should now have three wires coming from the motor.



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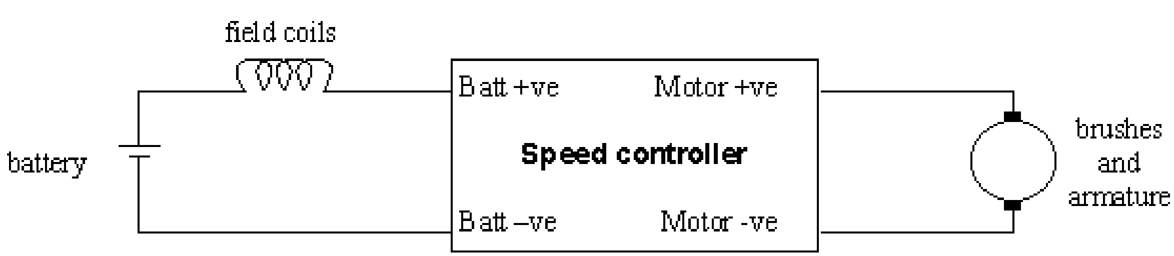

3. Wiring to the speed controller

How do these wires correspond to the circuit diagrams shown in the speed controllers page?

The following diagram explains:

Illustration 7 The motor can now be connected to your speed controller as shown in this diagram. Note that the current always passes through the field coil from left to right, but the speed controller is able to chop and reverse the current going through the armature coils. Thus the motor is now fully reversible.

Illustration 8 If the starter motor you are working with has more than one field coil, they may be connected in parallel, and fitted in the same position as shown in this diagram.

4. Modifying the front end

Now we must make the shaft on the front end of the motor accessible. You must first decide how you want to fix you sprocket or gear wheel to the shaft, and how you want the front motor bearing to be positioned.

You may want to weld the sprocket or gear wheel to the shaft. This may or may not be an easy welding job, and the strength of the result will depend very much on your welding ability, and the exact metallic composition on the shaft and sprocket/gear wheel. You will also have to extend the shaft, or retract the

9

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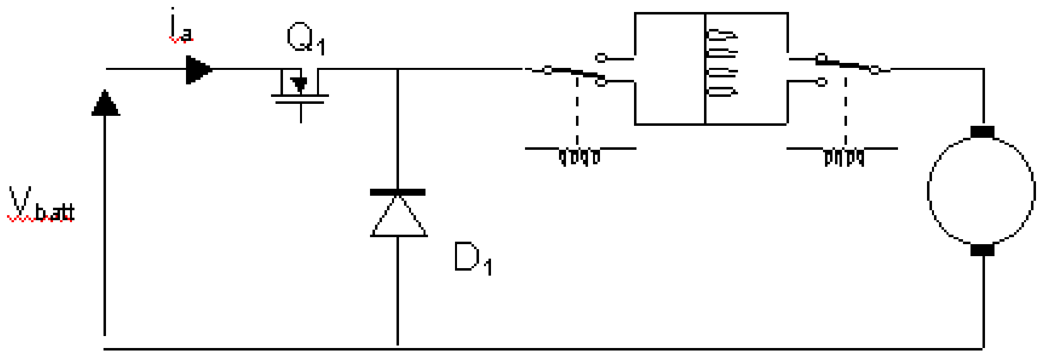
front bearing and casing to be able to perform the weld.

Alternatively, you may want to machine the front section of the shaft with a flat to take a cotter pin, or machine it fully square to take a square-bore sprocket or gear wheel. Grub screws are not a realistic option due to the very large torques that will be present, unless a hole is drilled all the way through the shaft and the grub screw is fed right through the gear wheel hub and motor shaft. Either way, the front casing is probably in the way.

Photo 9 This is made of cast aluminium and is very easy to saw with a hack-saw. The complete shrouded section may be removed, in which case the phosphor-bronze bearing must be removed from it, and then must be fitted into your robot frame to support the front end of the motor. Alternatively, if the section at the very front containing the bearing is sawn in half, it may allow enough shaft to protrude so that a sprocket or gear wheel can be fitted to it.

Photo 10 If the whole front casing is sawn off and the bearing mounted in the robot frame, this allows the gear wheel already mounted on the motor shaft to be used as the drive wheel. However, since this can slide up and down the shaft by a couple of centimeters (the solenoid of pre-engaged starter motors simply pushes this gear wheel up the shaft to engage with the engine crank wheel), it should be welded in its protruded position (nearest the end of the shaft).



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Another option is to leave the front casing as it is, and use a gear wheel with same pitch as the gear wheel on the motor shaft as the drive. The motor will need to be speed-reduced by gearing (or sprocket and chain) anyway, from anything between 3:1 to 20:1, so a gear wheel driven by the existing motor gear wheel (which has approximately 16 teeth) with from 48 to 320 teeth would provide the necessary speed reduction.

5. Reversing

To reverse a DC motor, the supply voltage to the armature must be reversed, or the magnetic field must be reversed. In a series motor, the magnetic field is supplied from the supply voltage, so when that is reversed, so is the field, therefore the motor would continue in the same direction. We must switch either the field winding's supply, or the armature winding's supply, but not both.

One method is to switch the field coil using relays.

Illustration 11 When the relays are in the position shown, current will flow vertically upwards through the field coil. To reverse the motor the relays are switched over. Then the current will be flowing vertically downwards through the field coil, and the motor will go in reverse.

However, when the relays open to reverse the direction, the inductance of the motor generates a very high voltage which will spark across the relay contact, damaging the relay. Relays which can take very high currents are also quite expensive. Therefore this is not a very good solution. A better solution is to use what is termed a full-bridge circuit around either the field winding, or the armature winding. We will put it around the armature winding and leave the field winding in series.

Editorial note: *Simon Nelson's retriever, described in detail in the May 2007 issue, requires a reversible motor. Simon used a motor from a winch designed for use on off-road vehicles. Such motors have the electrical circuitry necessary for reversing the motor rotation. The starter motors we use on our sailplane-launching winches do not have such circuitry, but can be modified according to the directions provided here.*

The directions for hooking up the modified motor to a speed control was included to provide the more electrically inclined with an impetus to perhaps go a bit further and construct a retriever system with more operational latitude.

For the more "intimidated by anything electrical" among us, it is also possible to simply hook up the modified motor to two separate circuits - each essentially equivalent to the single circuit we use on our winches - which can be operated in a mutually exclusive manner. If you look at the photos of Simons control box, you'll see two large button switches. One completes the circuit to drive the motor in one direction, the other completes the circuit to drive the motor in reverse.

We're now looking for someone to draw up such a circuit in detail for a future issue of RC Soaring Digest. ■

FAI World Air Games 2009/Aeromodelling/Class F6D

The World Air Games is the marquee event of air sport. This multi-disciplinary event is the only official competition that brings together the various different air sports. It is a combination of elite competition and spectacular demonstrations which exemplify the very best that air sports have to offer. The venue will be Turin Italy. <http://www.fai.org> and < http://www.worldairgames.org/>

FAI Sporting Code

Fédération Aéronautique Internationale

Section 4 – Aeromodelling

Volume F6
Airsports Promotion Classes

2007 Edition
Effective 1st January 2007

F6D – HAND THROWN GLIDERS

Extract Pages 21-23

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RADIO CONTROL HAND THROWN GLIDERS

6.4. CLASS F6D – HAND THROWN GLIDERS

6.4.1 General

A contest where RC gliders must be hand thrown to altitude. The organiser must provide a sufficient number of timekeepers in order to allow enough simultaneous flights at all time. In principle, each competitor is allowed one helper who should not become physically involved in the flight. Handicapped persons may ask their helpers for assistance at launching and retrieving (catching) their glider. The organiser should provide a transmitter impound where all transmitters are kept in custody while not in use during a flight or the corresponding preparation time.

6.4.2. Definition of hand thrown gliders

Motorless model aircraft, with the following limitations.

- Wingspan max. .... 1500 mm
- Weight max. .... 600 g

Radius of the nose, minimum 5 mm in all orientations (see F3B nose definition for measurement technique).

The hand thrown glider must be launched by hand and are controlled by radio equipment acting on an unlimited number of surfaces.

The hand thrown glider can be equipped with holes, pegs or reinforcements, which allow better grip of the model aircraft by hand. The pegs must be stiff and remain a firm part of the model, neither extensible nor retractable. Devices, which do not remain a part of the model during and after the launch, are not allowed.

The competitor may at any times change his model aircraft as long as they conform to the specifications and are operated at the assigned frequency.

Each competitor must provide ***five*** frequencies on which his model aircraft may be operated, and the organiser may assign any of these frequencies for the duration of any round or the complete contest.

6.4.3. Definition of the flying field

The flying field should be reasonably level and large enough to allow several model aircraft to fly simultaneously. The main source of lift should not be slope lift. The organiser must define the launching and landing area before the start of the contest and all launching and landings should happen within this area. Any launch or landing outside this area is scored zero for the flight.

A typical launching and landing area could be a rectangle 100m x 50m oriented with longer side perpendicular to the wind direction.

6.4.4. Definition of landing

A landing is considered valid if:

- the glider comes to rest and at least one part of it touches the launching and landing area;
- the competitor catches the glider by hand (or if competitor is handicapped, his helper, if launching was made by this person), while standing with both feet inside the launching and landing area.

6.4.5. Flight time

The flight time is measured:

- At task 1 from the moment the glider leaves the hands of the competitor
- At task 2 from the end of the launching interval

The flight time is measured to the moment the glider comes to rest on the ground or ground based object or the competitor catches the glider by hand or the working time expires. One point will be awarded for each full second the glider is flying, up to the given maximum flight time One point will be deducted for each full second flown in excess of given maximum flight time.

The flight time is official if the launching happens from inside the launching and landing area and the landing happens inside this area.

6.4.6. Organisation of rounds

The competitors are arranged in groups. A group should be a minimum of 5 pilots. The contest is organised in qualifying, semi-final and fly-off rounds.

At qualifying rounds the task 1 and 2 is flown. The start and end of the working time are announced with a sound-signalling device. The results are normalised within each group, 1000 points being the basis for the winner of the group.

To the semi-final rounds the best pilot from each qualifying group proceeds. Other pilots, up to the number of 24, proceed to semi-final according to their normalised results. In case of tie at last proceeding places a draw decides.

At semi-final the pilots fly task 2 in three groups.
To the final group the best pilot from each semi-final group proceeds. Other five pilots proceed to final according to their normalised results. In case of tie at last proceeding places, the pilot with better result from qualifying round proceeds.

At fly-off eight pilots fly in one group. All pilots with non zero score proceed to the following round. Usually the number of pilots is reduced by one at each consecutive round, so that at the last round only two pilots compete for the total winner. If in any round all pilots get zero or maximum score the round is repeated.

For each round, the competitors receive at least 2 minutes preparation time, as announced by the organiser. During the preparation time, the competitor is allowed to turn on and check his radio, but is not allowed any launch of his glider, either outside or inside the launching and landing area.

6.4.7. Total winner

The winner is the pilot with best result from the last round at which two pilots were flying. The third place gets the pilot who has been flying in the last but one round...>

6.4.8 Tasks

6.4.8.1. Task 1 “Last flight”:

During the working time, the competitor may launch the glider an undefined number of times, but only the last flight is taken into account to determine the final result. The length of the flight is limited to 5 minutes. Any additional release of the glider annuls the proceeding timing. When the competitor announces that he has completed his last flight (his official flight for this task), he must leave the launching and landing area, together with his timekeeper. Working time - 7 minutes.

6.4.8.2. Task 2 “All up”:

All competitors of a group must launch their gliders simultaneously, within 3 seconds. The signal for launching comprises from three short beeps each second and a continuous tone lasting three seconds. During continuous tone the glider has to leave the hand of the pilot. Releasing the glider earlier or later results in zero

score for this flight. Maximum flight time is 3 minutes. Each flight time of the 3 attempts of each competitor is to be added up and will be normalised to obtain the final score for this task.

Example:	Competitor A:	45+50+35 s = 130 s =	812.50 points
	Competitor B:	50+50+60 s = 160 s =	1000 points
	Competitor C:	30+80+40 s = 150 s =	937.50 points

6.4.8.3. Task for fly-off rounds

All competitors of a group must launch their model aircraft simultaneously, within a three second period. The signal for launching comprises a three second countdown with a single beep for each of those three seconds and a continuous tone lasting three seconds. During the continuous tone the model aircraft has to leave the hand of the pilot. Releasing of the model earlier or later results in zero score for this flight. Maximum flight time is 3 minutes.

When the first model lands or at three minutes flight time a thirty seconds interval starts. All models must land within these thirty seconds.

The pilot whose model landed first receives a zero score or a pilot who released his model before or after the three seconds interval for launching or whose model landed outside the landing area or landed after the thirty seconds interval receives a zero score too.

LSF Australia followed the F6D rules for the RC-HLG portion of their annual Jerilderie event, 8 - 11 June 2007. As this issue goes to press, we have just received a number of photos of the F6D flying from Greg Potter and Chris Adams, and we are eagerly anticipating arrival of a report by Marcus Stent, Contest Director. Barring complications, the full Jerilderie F6D report - text and photos - will be in the August issue of *RC Soaring Digest*.

Adding a launch blade to an Alula

Bill Kuhlman and Jerry Slates

After literally thousands of launches, the left EPP foam wing of Bill's three servo Alula not only had to be recovered (all of the tape was worn off the grab point), but thinned Goop was brushed on the wing tip upper and lower surfaces to add reinforcement.

This got us to thinking about some sort of launching peg, essentially converting the side-arm launch of the original to a discus launch. Jerry Slates and I built our newest Alulas - Jerry's first, Bill's third - with a blade type peg constructed from 1/8th inch light plywood. To give an idea of the size, the blade has a 5/8th inch root chord, tapering to roughly 3/8th inch at the tip. As you can see in the photos, there are also mounting lug extensions fore and aft of the blade itself.

The blade was cut out with a band saw and a fine tooth blade, then sanded to an airfoil shape. The foam was cut back so the blade base would match the wing tip contour, and initially attached with 5-minute epoxy. See (a) in Column 3.

Unwaxed dental floss ties the blade to the foam wing. The dental floss was threaded through the wing a couple of inches from the tip, and thin CA was dripped along the entire length of the floss and into the holes. Because of the underlying EPP foam, the blade does flex a bit, but this does not seem to be a problem. See (b) in Column 3.

To achieve lateral balance, a length of solder was epoxied into the opposite wing tip. To do this, the airframe was placed upside down on a straightedge, and a length of solder was cut down until balance was obtained.

Good discus launches can now be made, and the difference in launch height is definitely in evidence. As usual with hand launched gliders, free flight or RC, more height is gained with a smoother launch.

The side loads on the fuselage are much stronger than those applied during a side-arm launch, so make sure you apply carbon fiber tow to the fuselage sides under the leading edge of the wing! Two inches fore and aft of the wing leading edge works well for us.

If we were to do this again, we'd (a) better align the blade with the centerline of the wing, and (b) reduce the flex caused by the soft underlying foam.

(a) Slightly insetting the blade into the wing tip allows for better alignment, as the blade is significantly toed in by simply following the wing outline. While the toe-in does not appreciably affect performance, it does "bug" us enough to make the change next time.

(b) We'd drill a hole in the center of the blade and insert a suitably sized dowel directly through the blade and into the wing tip two or three inches, spreading the load.

The Alula... Definitely more fun than Man was meant to have! ■

Radio Controlled Soaring Digest ARCHIVES