Radio Controlled

Soaring Digest

October 2007 Vol. 24, No. 10

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Front cover: Dave Forbes' Tabooish shares the sunny Florida sky with a Swallowtail Kite. Two pairs of Mississippi Kites also put in an appearance on that August day. Photo by Tom Shupe.
Olympus D565/C500Z, ISO 50, 1/800sec, f4.9, 18.9mm

Back cover: Johann Snyman captured this Aermacchi MB-326K at a recent Volksrust, South Africa, slope event.
Canon EOS 350D, ISO 400, 1/1250sec, f10, 70mm

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

As many readers know, The F3J World Championships are going to be held in Turkey next year, and U.S. Team Trials for that event occurred over the Labor Day weekend. The U.S Senior Team will consist of Daryl Perkins, Ben Clerx, Rich Burnoski and Skip Miller as the alternate. The Junior Team will be A.J. McGowan, Brendon Beardsley, Jeffery Walter and Michael Knight as the alternate.

We just received word from Lionel Brink, Chairman MGASA, that the South African Team will be Craig Goodrum, Chris Adrian, Michelle Goodrum and Mark Stockton as the alternate.

FAI has received the following Class F (Model Aircraft) record claim: #14800, F3 Open (Glider, Radio controlled flight Category); N°160, Distance in a closed circuit. Course/location Crimea (Ukraine), 739.2 km, by Valery MYAKININ (Russia), 09.09.2007. The current record is 716.10 km, 23.07.1979, by Eduard SVOBODA, Czechoslovakia.

Our thanks to Mark Nankivil for the beautiful photos of the Hall Cherokee II in this issue. Mark consistently provides exceptional walk-around material for RCSD. For those interested in modeling this aircraft, be sure to consider the 1/4 scale laser-cut "short kit" produced by Tom Martin Radio Control. Based on the David Smith model, the short kit sells for $224.95. Check it out at <http://www.tmrcsailplanes.com/hall-cherokee-II-model.html>.

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.

Installment 4 of 3, Part 9 of 8

θ#!, Lb, N Part 9, DS Forces

Deux: Two fine ways to look at DS Forces—the hard way (first) and the easy way. Plus a corrective addition: How a DS glider's sink to the outside of the circle limits its acceleration. Philosphy. Mules. The Djinn of the Eastern Desert.

Where from and to, and what was left out

There are a couple ways to think about DS speed gains and the associated forces. There's the way we looked at in Part 4, which was instructive and fine, though I left out sink to the outside of the DS circle. And there's the easy way. We'll start by upgrading Part 4.

Note: Herein we'll focus mostly on the upper DS half-circle, unless stated otherwise.

Review:

In Installment Two, Part 3, we looked at DS arithmetic from two fine perspectives, groundspeed added per half-circle, and airspeed jumps at each shear transition.

We looked at how, when a DS glider penetrates up or down through a shear layer, it picks up airspeed equal to the difference of the upper and lower wind velocities, less trig effects.

When penetrating up from dead or upslope air into an oncoming wind, airspeed jumps. Similarly, when penetrating down from a tailwind into dead or oncoming air, airspeed jumps by the difference in velocities, less trig. Penetrating up or down makes the same airspeed jump.

Trig effects: Angles of exit from and entry into winds are always less than optimal.

Playing near the ground means repairs. Photo by author.

Dividing DS speed gains into maintaining speed gains from charging into an oncoming wind, and taking on the velocity of the oncoming wind

The essence of a good philosophical question is that it be stated in such a subtly non-rational manner as to make answering it nearly impossible, or at least difficult. (It keeps philosophers employed.)

In Part 4, we set up a nearly philosophical question with a few truths, and then asked it: Drag decreases groundspeed slightly on transition of a shear. As the glider transitions out of the shear into the oncoming wind, it adds that windspeed to its groundspeed, for its new airspeed. Centripetal lift forces are at right angles to its path in the upper, moving air mass, so they don't increase its airspeed. During these circles, drag slows airspeed. Yet at the end of the upper half-circle, groundspeed has again increased by the velocity of the wind. How did centripetal lift forces do that?

One answer is that the first half of the double-wind-speed jump (ignoring drags, sink, trig effects) comes from the jump in airspeed over groundspeed from punching up into the oncoming wind. As described, the second half of this acceleration is from components of centripetal lift forces (in relation to the air it turns in) parallel to actual ground-path, since the air the glider turns in drifts downwind.

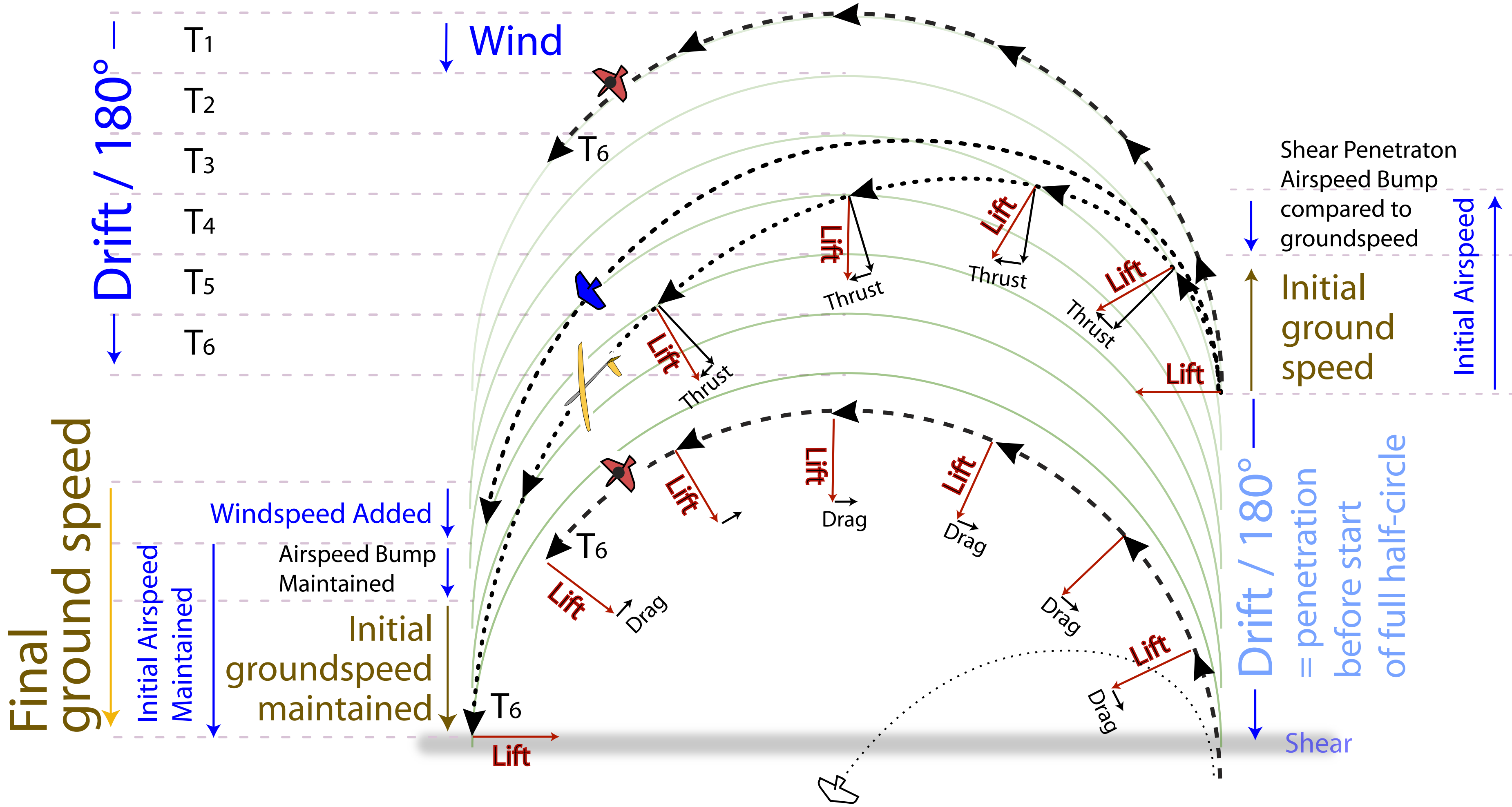
A gut level, simple way to say this is that the glider maintains most of its newly bumped airspeed in its half-circle, while by going "belly-to-the-wind," it takes on the velocity of the oncoming wind. At the end of the half-circle, they align, and add up.

Figure 9-1: Here we see several DS ground-paths. The captions to the right and left mostly apply to the ideal, yellow glider. Note that on the left we've divided the final groundspeed into initial ground and airspeeds maintained, and windspeed added (ignoring losses).

Yellow glider: The second path up is ideal, meaning we have ignored drag and sink. Note that the glider is aligned with its circular path within air, not with its ground-path, which adds drift. A component of its centripetal lift force (at right angles to its circular air-path) is parallel to its ground path, making an acceleration along the ground path. That's one of a couple ways of showing how centripetal lift, at right-angles to its circle within air, adds groundspeed.

On the right, initial groundspeed plus the airspeed bump make initial windspeed. We can divide the double-windspeed addition to final groundspeed, per upper half-circle, into initial bumped airspeed maintained, plus the drift of the airmass in which the turn takes place.

Red glider with black ballast, twice: The outside path is a short-winged glider with high drag (scuffed up on too many rocks)

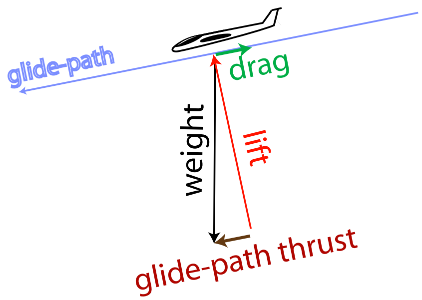


and way too much ballast, making high sink to the outside of the DS circle. To make up for its sink, it starts its DS half-circle earlier, on the the inside path. Here I've pictured its sink as so bad that its ground-path is roughly circular. Centripetal lift is at right angles to ground-path, so lift forces have zero component parallel to ground path, making no acceleration along groundpath. Just the opposite, drag makes a deceleration along groundpath. Worse, by Time T6, it still has a ways to go to the next shear. By the time it gets there, it will have lost much of its original groundspeed, though it will eventually pick up the downwind velocity.

Blue glider: This path is more realistic.

White foam thermal glider: Its has so little inertia (mass) that drag forces rapidly slow it. So it can't penetrate. But it quickly takes on the prevailing wind velocity. That is, it gets blown back.

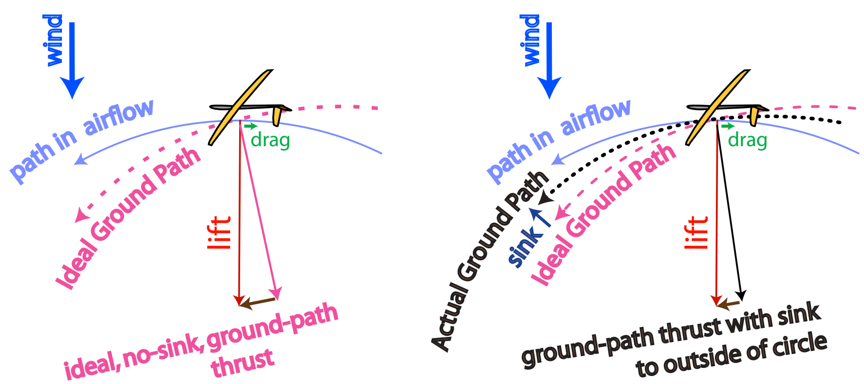
Graphics by Alex Hart, Philip Randolph



Glider thrust is the vector sum of lift and weight forces. Balanced forces make straight, unaccelerated path in air. (Side view)

DS Ground-Path Thrust: Familiar Force Pattern, Different Forces.

Sink to outside of circle lessens acceleration along groundpath by decreasing the angle between centripetal lift forces and actual groundpath



DS thrust along ground-path is the component of lift parallel to ground-path. Unbalanced lift force makes curve. Drag < thrust makes acceleration. (View from above)

Sink to outside of circle lessens angle between lift force and ground path, lessening thrust along ground path. (View from above)

Figure 9-2: Centripetal lift forces don't accelerate a DS glider in relation to the air in which it travels, but they do accelerate a glider in relation to the ground. A DS glider's ground path is different from its air path, so a component of centripetal lift forces is parallel to ground path. That's only one way to describe DS speed increases. Graphics by Philip Randolph

The correction: Sink to the outside of the DS circle is another loss, in addition to drag and the trig effects of not encountering oncoming winds squarely

A decade ago, model DS pioneer Joe Wurts observed that *sink to the outside of the DS circle limits speed gains.* You can still see the fossilized email in which he wrote this, at <http://www.charlesriverrc.org/articles/flying/dynamicsoaring.htm>

When I read this, well, the moral here is, "Ignore the voice of Joe Wurts at your own peril." I ignored the voice of Joe Wurts at my own peril. Hence this correction.

Here's how I ignored the voice of Joe Wurts: I said, "Sink to the outside of the curve is just a restating of the lift/drag ratio. Lift/drag = speed/sink. So since he paid attention to lift and drag, why say it again?" "Mistake number one, said the bi-colored python rock snake."

Here's our correction: Sink to the outside of the curve narrows the angle between centripetal lift force and ground path, reducing the component of lift force parallel to ground path, and thus lessening groundspeed increases.

Thus a DS glider's lift/drag = speed/sink curve is critical to its performance.

Gliders overweight for their speed will operate at a high angle of attack, and thus not at their optimal lift/drag, speed/sink. They'll sink too far to the outside of their half-circle. That makes a longer ground-path in which drag further saps airspeed.

Gliders that are too light don't have the inertia to maintain airspeed. They get blown back, or don't get up out of the attempted lower turn.

Any old plane that goes, "belly-to-the-wind" takes on most of the velocity of the wind it charges into. Only some gliders can maintain most of the groundspeed with which they exit a shear, or the airspeed newly bumped up by charging into an oncoming wind. Most are either too light, too heavy, or not slippery enough.

There's an easier way to think of it all:

The simple approach to DS Forces! The centripetal forces that make a glider half-circle in air add up (integrate) to a net force precisely capable of reversing the glider's direction while maintaining airspeed, even when it punches up into an oncoming wind. Losses are from drag, poor entrance angles, and sink to the outside of the circle.

In Figure 9-3 we see that the forces that make a glider do a half-circle in relation to the air in which it travels, if added up, have a net push in one direction. The higher the velocity of the glider,

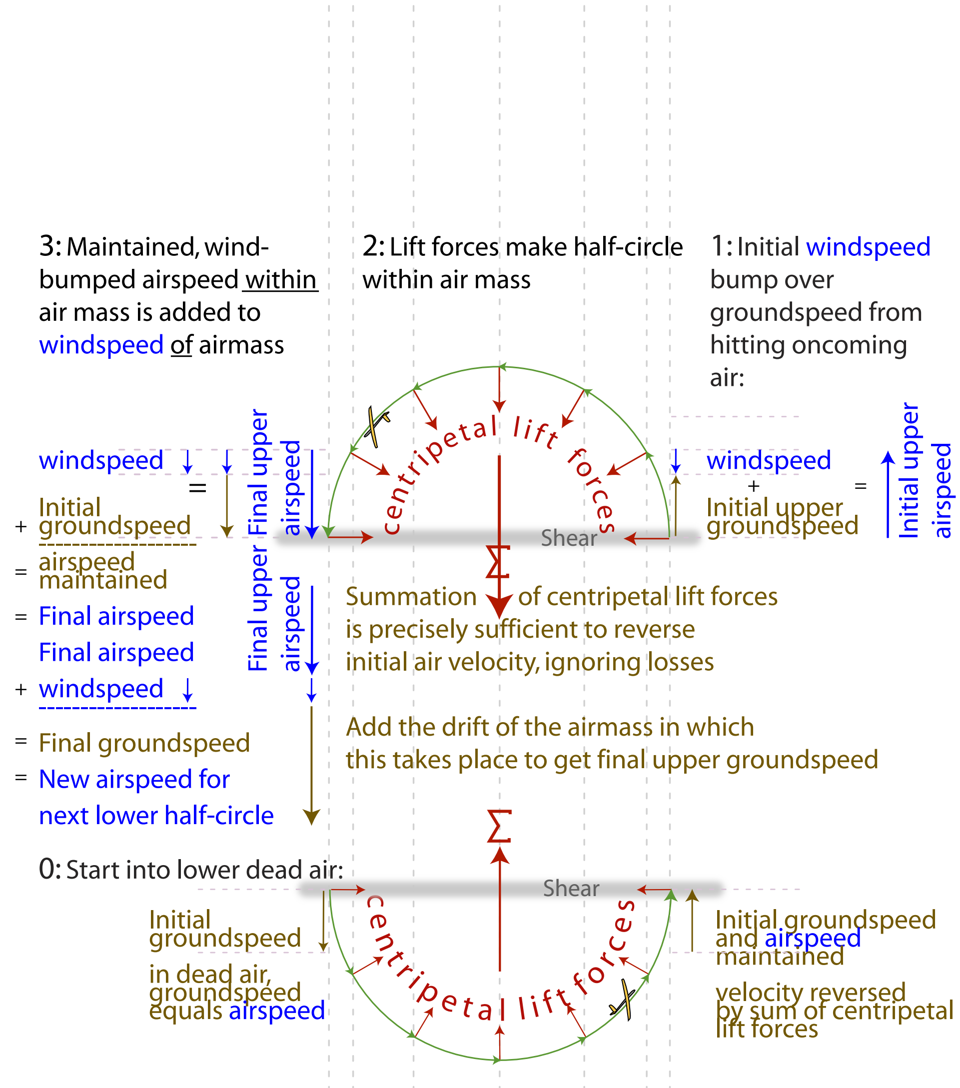


Figure 9-3: The sum of centripetal lift forces adds to a larger net force at higher airspeeds. The sum of centripetal lift forces x durations is always just sufficient to reverse the glider's new air velocity in an upper or lower half-circle, ignoring other losses. That's in relation to a moving air mass, so to get the final groundspeed, we add wind velocity a second time. Graphics by author Philip Randolph

the greater the centripetal forces, so, ignoring losses, it always reverses its velocity, keeping its airspeed.

The centripetal forces have allowed the glider to keep its airspeed (ignoring losses). This “net force” has reversed the glider’s velocity in relation to the air in which it travels, which is also moving in relation to the ground. That means the “net force” has accelerated the glider in relation to the ground. How? That’s back to Part 5, “Elastic Collisions.”

More Marble and pot simulations, plus mules, and the Djinn of the Eastern Desert

Cut your wife’s largest aluminum pot in two on your band saw. (Explain to her, “It’s for Science!” She’ll understand.) Also cut the bottom out, so you can see. Put the two halves upside down on the hardwood floor in your living room (same explanation, same joyous understanding), or if there’s a pesky carpet there, on the vinyl of your kitchen floor. Get your kid to help you. If you don’t have a kid, borrow one. (Your wife would do, but you need to be able to explain to her that this is also in the interests of education, and that she already knows everything, anyway.) Play a sort of a game of catch, with a marbles or a golf ball, where as the ball approaches one side of your half pot, you shove the half pot forward. Notice that as you shove your half-circle pot forward, the ball exits with *added* speed equal to almost twice the velocity of your half pot. That’s like punching up into oncoming air, for an upper DS half circle.

’spermint number two: The borrowed kid fires the ball at you. Let the ball slide around your half pot and exit, without shoving the half pot forward. Note that it leaves with almost the speed it arrived with. That’s like punching down into dead air, for a lower DS half-circle.

’spermint number three (demonstrating losses to sink to the outside of the DS circle): Use spherical objects of various sizes and densities. In our example, we’ll use a golf ball. Line up your half pot, like a catcher lining up his mitt, so that the spherical object will enter just skimming one side. Then let go of the pot. Note that lighter spheres exit with almost their arrival speed, as in ‘spermint two. Note that heavier, or faster spheres cause the pot to move, and lose velocity to the transfer of kinetic energy to the pot.

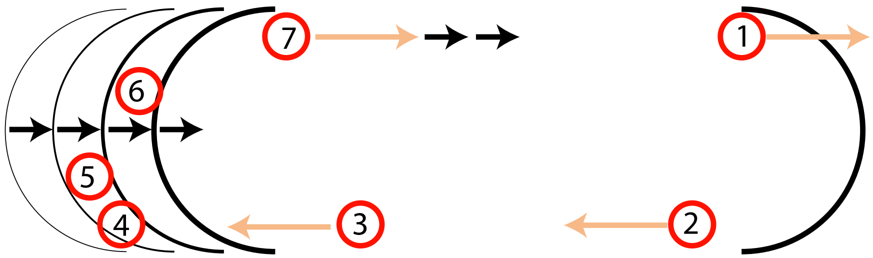
At this point, the borrowed kid will explain to you, “’spermint number two shows that centripetal forces of the pot acting on the marble add up to a net force on the marble just able to reverse its velocity, less drag.” You look at the kid like he is something outlandishly strange, like maybe the Djinn of the Eastern Desert, which he is, being a private joke of the author’s (now made public) from other contexts, in which he typically turns the author into a mule.

The kid continues, “’spermint number one showed that what gets preserved, less drag, is the speed relative to the pot. So the marble exits the half-pot with its initial hardwood floor velocity of the marble plus the velocity of the pot, relative to the pot, which is moving, so relative to the floor it exits with its initial hardwood floor velocity plus two pot velocities.” You wish he’d offer you a carrot, or scratch your nose.

He says, “’spermint number three shows that if the glider is operating at a coefficient of lift where its velocity reversal requires such a high net force on the mass of air it affects that it significantly alters the air’s velocity, it loses kinetic energy to that air, and slows. That’s why light span loading, or long wings, helps your toy glider retain energy in turns—it gets to distribute its force over a larger mass of air.”

You try to say that he is talking about elastic collisions, for which he might pleasantly refer back to Part 6, but what comes out of your long, furry, snout is a screeching, “Hee haw.” Your wife says that in the interest of less microbiological science, you’ll have to live in the garage, but that you are free to eat the lawn.

3-7: Half-pot moves to right.
Ball exits with entrance speed
plus two times half-pot velocity.
Black arrows represent half-pot speed.
This is like the upper DS circle, with the wind
from the left, losses ignored.



1-2: Stationary half-pot. Ball enters and exits at same speed. Tan arrows represent "hardwood floor velocity." This emulates dead air in the lower DS half-circle.

Heavy Ball enters half-pot not held still.
Ball moves pot, exits slower than it entered.
This illustrates losses from sink to the
outside of the DS circle.

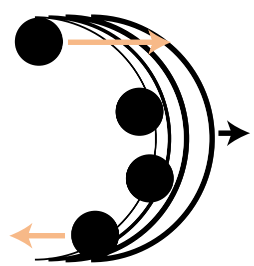


Figure 9-4: Half-pots and balls on a hardwood floor, you and a kid sliding them around and playing catch. Wow, I finally made what I consider a simple illustration of DS speed increases. Graphics by Philip Randolph

Forgotten integral calculus, but it's just fancy addition

If I could remember my calculus, I'd be able to scribble down the equation that shows that centripetal forces on an object make it go in a circle, while maintaining its speed. And then I'd take the integral of the equation from zero to 180°, which would equal a net force times the time the object took for its 180°, a product just sufficient to reverse its velocity. The rest is just questions of what the resultant speeds are relative to.

But all that integral calculus stuff is just a very streamlined way to add up... well... stuff. In this case we're adding up centripetal forces in a toy glider's half circle, and it isn't hard to figure out that they push the glider one way, and the air the opposite way.

DS Forces. It's just centripetal forces, adding up. ■

MAKE A CLUB CALENDAR

Dave Garwood, dgarwood@att.net

Would a calendar be an interesting and useful fall season project for your flying club?

Here's how the New York Slope Dogs produced their 2007 calendar.

1. Gather the photographs.

Ask your club-mates and flying buddies for candidate photographs. Gather lots, then narrow them down to the 12 best, or 13 if you want a different photo for the cover.

Digital camera output is the easiest; but film, slides or prints can be scanned.

You'll want to start with the highest resolution images available, for the best-looking final product.

2. Edit the selected photographs.

Using a graphics editing program, level the horizons, crop out distracting detail, and adjust color balance as desired.

The final output size will depend on the final size of the calendar (8.5 x 11 inches, and 11 x 17 inches are commonly available calendar page sizes), and you'll want to have images that have high enough resolution to give 200 dots per inch at the final output size.

The calendar printer can give you more detail about preparing your digital submissions.

Opposite page: The cover of the New York Slope Dogs calendar a good action shot. The lettering was added using the "layers" feature of the graphics editing program.

Right: Calendar photos might include action shots, as above, as well as more static images, like this one with both pilot and aircraft. The water background in these photos reduces clutter and provides a good backdrop.

3. Prepare lettering and artwork if desired.

You may want lettering on the front cover, and perhaps captions on each of the photographs. This is also done in the graphics editing program. If you haven't learned to use "layers" yet, this is a great project to start on.

I am particularly indebted to New York Slope Dog Tom Hick, who taught me how to use layers, and who created the final page of our 2007 calendar, a photomontage of portraits of the Slope Dogs.

We used Corel Paint Shop Pro version 9 and Adobe Photoshop Elements version 2 to edit the photos and the lettering on this project, but many suitable graphics programs are available. PSP-11 is the current version of the program, available at software suppliers or at <www.corel.com/servlet/Satellite/us/en/Product/1155872554948> for under $100. Corel has a liberal competitive upgrade policy, and gives a 30-day free trial on this and many of their programs.

Interesting fact, something that commercial calendar providers don't tell you: calendars repeat every few years, but not on a regular schedule. Here's where I found that the 2007 calendar repeats in 2018, 2029, and 2035. Identical Calendar Years <www.12x30.net/pattern.html>

May we all live so long, and keep on flying and making more pictures.

4. Upload the material to a print-on-demand shop.

When you have your graphics files completed, send

Right: In-flight photos can provide impact, as the upper photo does so well.
So who are the New York Slope Dogs? NYSD club members had their photos in a montage on the last page of the calendar.

Spectacular settings can make for fantastic calendar images.

For vivid descriptions of various techniques for expanding your model photography skills, particularly action shots, we encourage you to read Dave's article, "A Slope Soaring Action Photo Technique," in the June 2007 issue of *RC Soaring Digest*.

With a few words and many photographic examples, Dave describes several ways to improve the results you achieve. Although focused on photographing within the slope soaring environment, Dave's article is good reading for anyone who yearns to capture better RC glider and sailplane images.

them to an online print-on-demand shop. These are the places that print custom T-shirts, mugs, mouse-pads, and calendars. For this project we used and were happy with the results from Cafe Press <www.cafepress.com>, but there are other places that will do the same or similar. Cafe Press will print a single calendar if you like, and gives a quantity price break starting at 15 copies.

Cafe Press is set up for over-the-wire submission of the graphics material, and has a nifty system to let you organize your calendar. Their printing work was fast and accurate, and done for a righteous price.

If you're ordering multiple calendars, you might want to first order just one, to act as a proof, and allow for small adjustments to your graphics artwork before the final press run.

Watch particularly for fine cropping adjustments and color balance adjustments that may improve the look of the pages as you submit the final artwork for the press run.

The steps to make a club calendar are not difficult, but they can be time-consuming. Allow plenty of lead time for gathering and selecting your photos; for editing the photos, and for preparing artwork as needed to complete the calendar. Allow a few days for printing and shipping. ■

Cherokee II N4653T

Built 1964 by Budd Brown, serial number WB-1

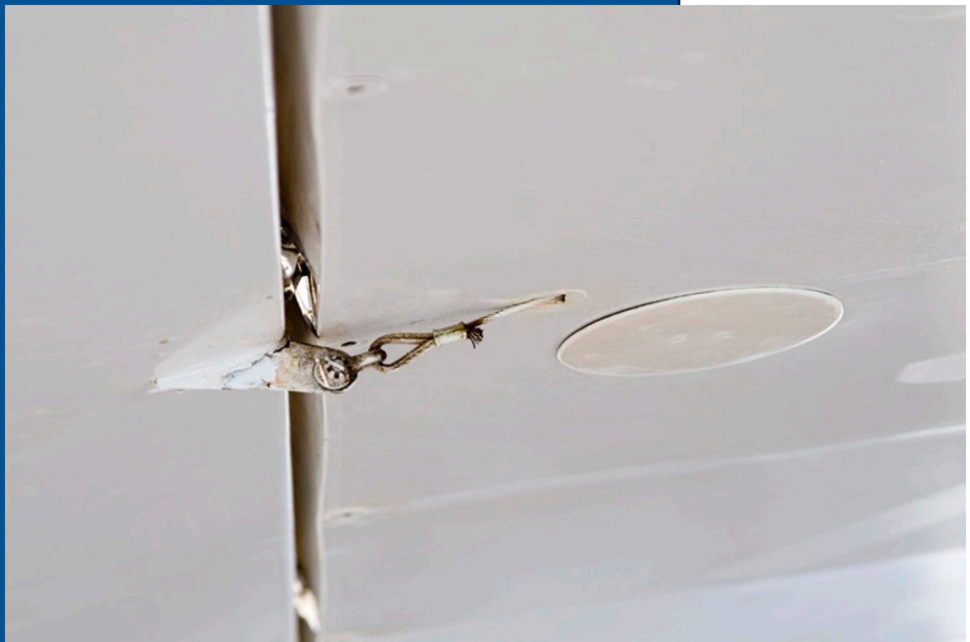
Currently owned by David L. Stanley, W. Lafayette, Indiana

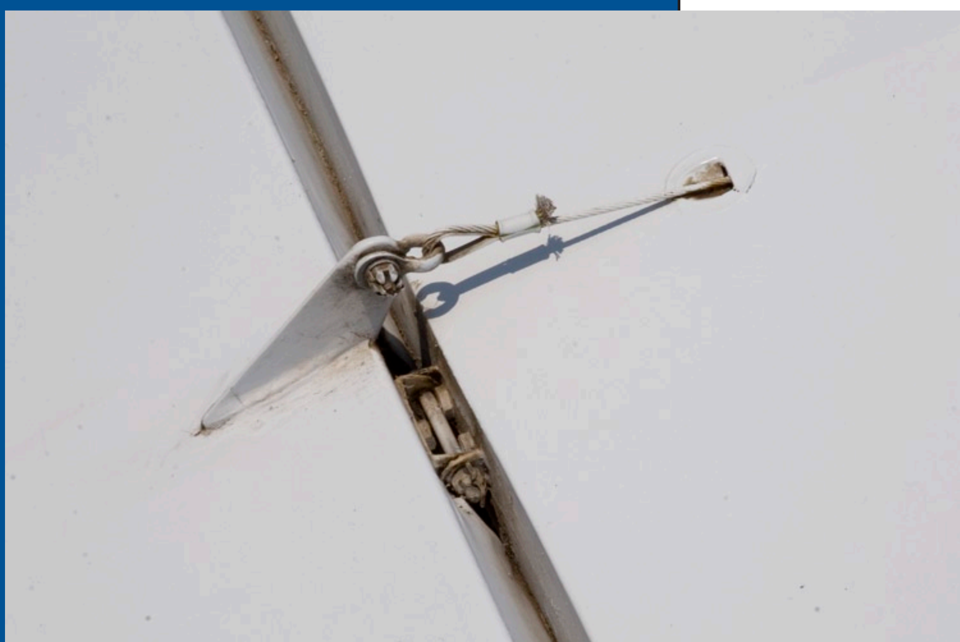
Photos taken at the Wabash Valley Soaring Association
Annual Vintage/Classic Sailplane Regatta, 2005 and 2007
by Mark Nankivil, nankivil@covad.net

GENERAL SPECIFICATIONS
Span 40 ft.
Wing area 125 sq.ft.
Taper ratio 2.5 to 1
Aspect ratio 12.8
Length 11.75 ft.
Height 48”
Horizontal tail area 14.4 sq.ft.
Empty weight 312 to 350 lbs.
Airfoil (constant) Gottingen 549
Wing twist 0 degrees
Structure wood/fabric with 2-spar wing
Angle of incidence 3.5 degrees

Max L/D 23.5 @ 46 MPH
Minimum sink 2.6 ft./sec. @ 42 MPH
Stalling speed 34 MPH
Maximum speed permitted, free flight smooth air 110 MPH
Free flight rough air 80 MPH
Aero tow smooth air 99 MPH
Aero tow rough air 72 MPH
Auto winch smooth air 99 MPH
Auto winch rough air not recommended
Maneuvers permitted: Stalls, Spins, Loops, (stressed for inverted flight)
Maneuvers prohibited: Snap/Flick Rolls
Maximum pilot weight, including weight of parachute 190 Lbs.

The Cherokee II, a Stan Hall design, was introduced in 1956. It’s a very pleasant sailplane to fly, and has proven itself with a large number of pilots and has done well in a number of contests.
There are well over 100 Cherokee II’s either completed or under construction.



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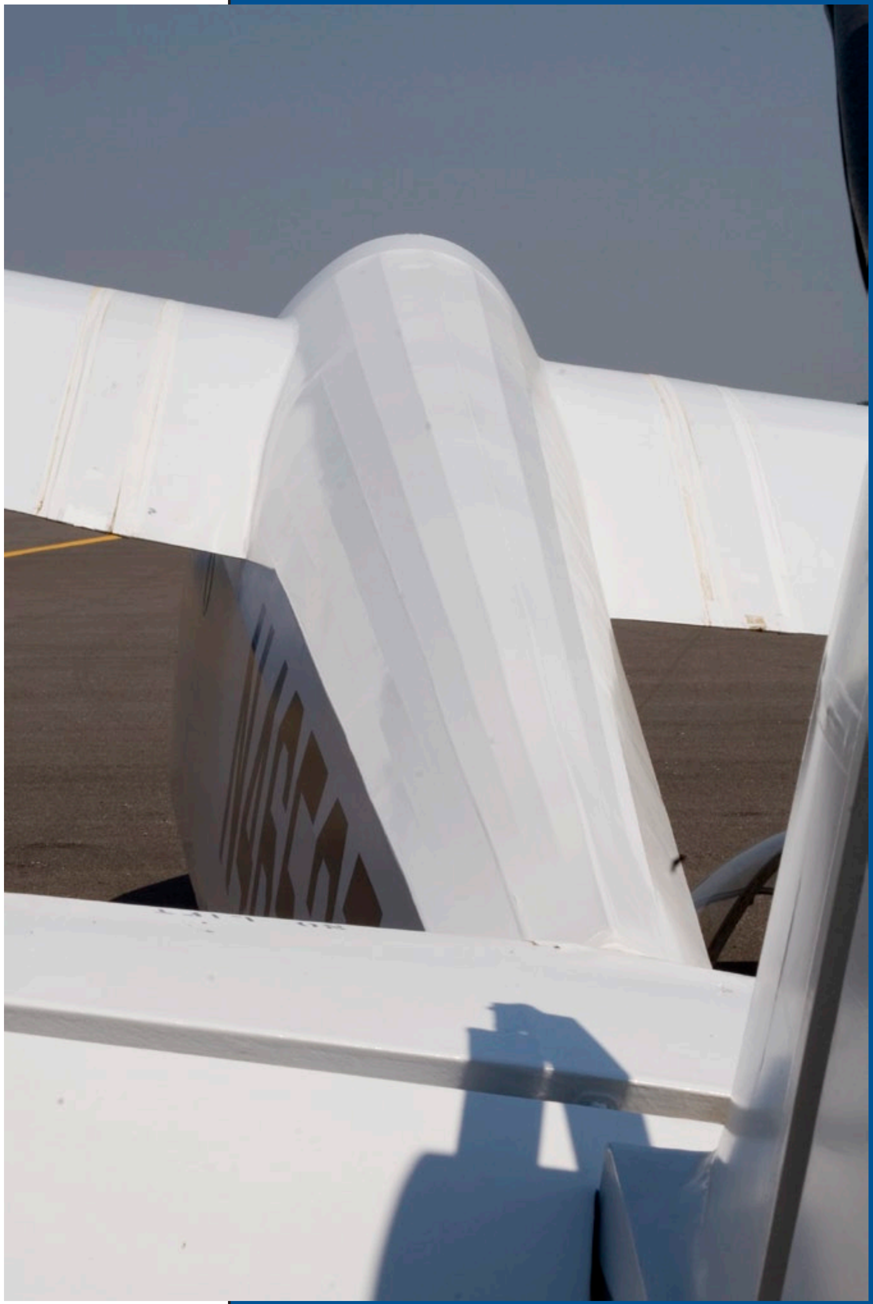

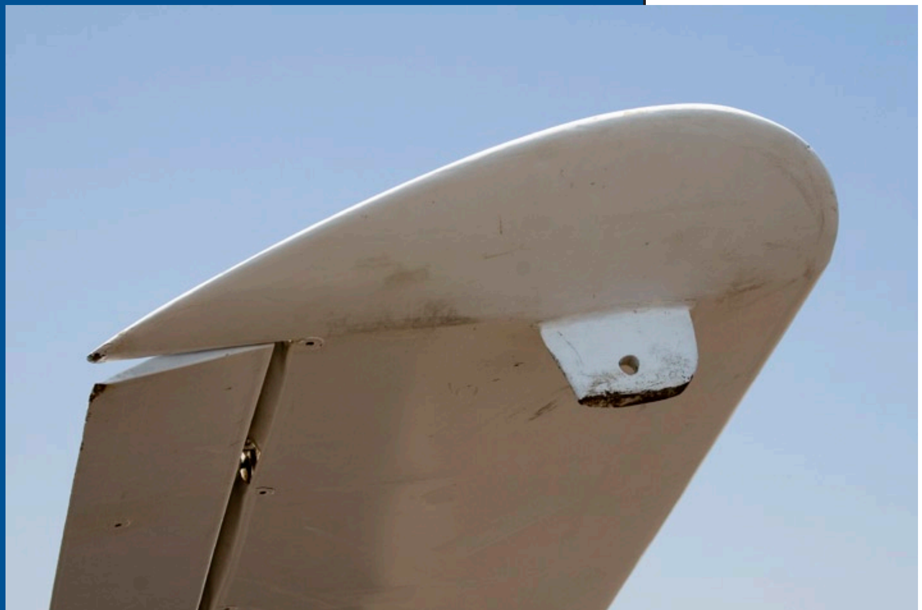


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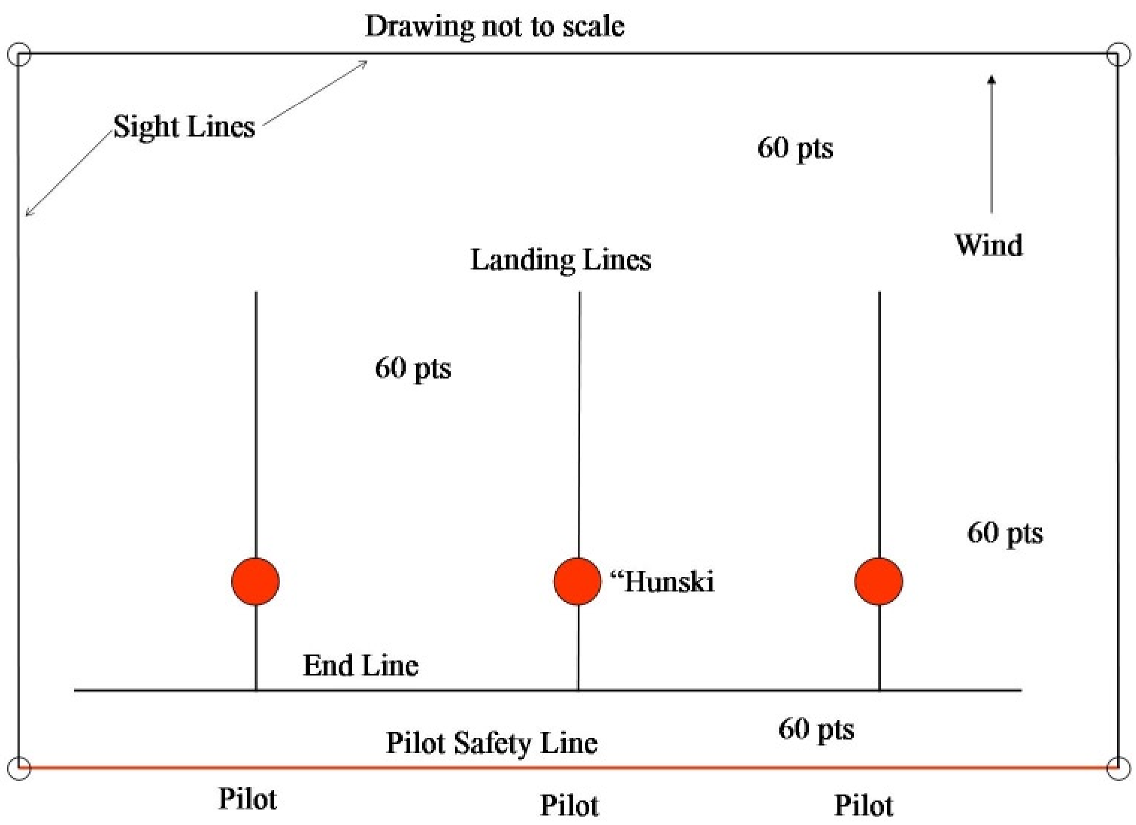
Hunt for the Hunski

A new landing task idea

Guy Russo, flyguy@roadrunner.com

The Hunski combines the traditional line and spot techniques. It encourages beginner and low time pilots with the relative ease of obtaining “some” landing points for making it into the “box” and builds on this skill to work toward precision and higher point scores by landing on the line or within the hundred point spot: “The Hunski.” This landing task is based on ideas I have seen around the soaring circuit. The “Hunski” is located about the same distance from the pilot as we encounter at Visalia and other events so our local expert pilots can be challenged and practice for larger events.

About the author: Guy Russo is a long-time (30 plus years) RC soaring pilot. He is a member of Northwest Soaring Society and the Inland Empire Quiet Flyers club. The upper photo shows him with the 2006 NWSS Tournament trophy and a number of Thermal Wizard awards. Guy recently attained LSF Level V, and the lower photo shows him with the LSF - V plaque he received just before the recent Farragut Idaho event, along with witnesses for his last task — the 10K goal and return. From left; Steve Adams, Robin Kirkpatrick, Frank Smith and John Burke.



The Hunski landing task field layout. The text provides dimensions.

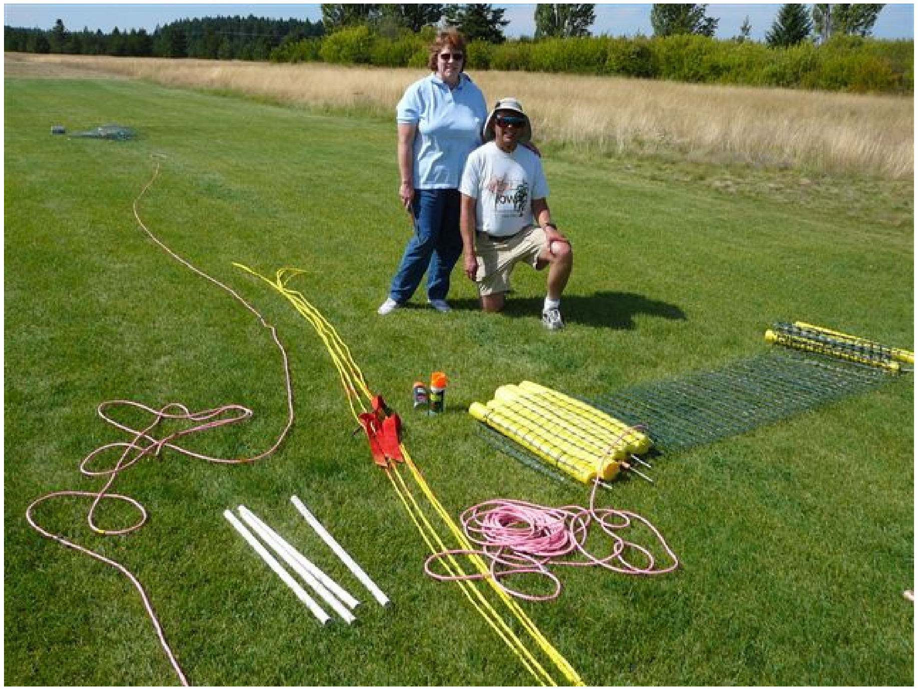
Sue Sayers (a good sport and NWSS Member) celebrates her first Hunski by donning the "I Tilla the Hunski" Hat. Text has all the details about this award.

The Box: Picture this at the mowed grass area at the end of the Farragut runway (see pictures). This area would be denoted by two upwind cones and a safety line and two cones or soft bendable "noodles" which would indicate the downwind end of the box.

The size of the box can vary to suit the location and number of contestants. In our typical Seeded Man-on-Man events, it can be 60-70 feet wide and 70-80 feet deep and accommodate four lines. Landing within this box (upright) gleans 60 landing points. Because we are placing noodles in the downwind approach which might bounce you out or inverted, hitting these noodles also gets 60 points.

Pilots must stand outside of the upwind safety line. The nose of models landing beyond this safety line would score zero landing points. Inverted models also score zero landing points. Timers would use the cones and noodles for sighting to determine if the model is within the landing box. The upwind end of the box will have a rope safety line. We typically have a rope safety line with a fence and we had some ski rope donated so we outline the entire box.

The Landing Lines: Parallel to and five feet inside the safety line will be another rope end line, which marks the upwind end of the landing lines. There will be four or five thirty-foot long landing lines perpendicular to this end line which are



Above: Art and Kathy Boysen prepare to set up the Hunski landing task. Above right: Art uses two 30" measuring poles to set the Hunski end line inside the safety line. Right: All set up and ready to rock!

about ten to 20 feet apart and about ten feet inside the sides of the landing box. Landing upwind of this line but within the box scores 60 points. To receive more than 60 points the model must come to rest within 30 inches of a landing line. A 30-inch landing measure stick will be provided for each landing line. This stick will be marker a point for each inch from 61 through 90 points. This stick will measure from the aircraft nose anywhere along a landing line as well as from the downwind end of the landing line (radius method). Landing within one inch of the landing line will score a maximum of 90 points unless the nose of the model comes to rest within "The Hunski."

The Hunski: Fifteen feet from the pilot safety line along each landing line will be a three-foot diameter circle. This circle may be painted or measured with an 18-inch radius line secured with a nail. Landing within this "spot" will score 100 points: a "Hunski."

(OPTIONAL) The pilot who scores the most "Hunskis" for the day will be presented with a special award, the "Hunski Hat." This traveling award will be a hat characteristic of something Attila the Hun would wear and be inscribed with the words "I Tilla The Hunski," as in made the most landing marks (tills) in the Hunski Spot.

Notes:

We have added a safety fence to the safety line on the upwind end of the box.

The noodles are supported by hardwood dowels with treated spikes in the ends.

Low time and beginner pilots love this event. Trying to make the box on every landing is a frequent, obtainable goal and when they stumble into a Hunski it's a real celebration.

Experts are challenged to make a controlled straight-in approach and manage energy to arrive at the Hunski spot on time. The goal of "a Hun on every one" is possible, but has not yet been achieved.

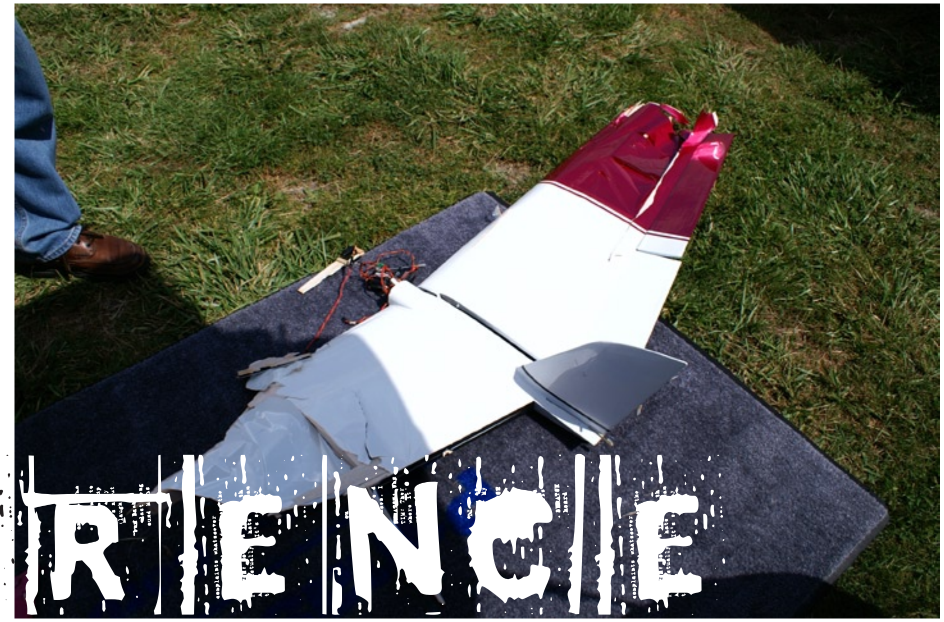
Since it's introduction last season, the Hunt for the Hunski task has spread across the Northwest and traveled to Portland, Seattle, Vancouver BC, Tri-Cities Washington, Northern Idaho and is used for the NWSS year end Tournament. It has become the task of choice for our events.

It takes a bit of effort to construct the parts, but it can be set up in 15 minutes and used often.

I hope you try this landing task. Contact me with any questions and enjoy your "Hunt for the Hunski." ■

Upper: Line up for Seeded Man-on-Man at Farragut. Lower: Mike Cole, Idaho, tries for a Hunski. Doug Russell, Washington, times.

The invisible (and usually nonexistent) enemy



INTERFERENCE

Sherman Knight, duworm@aol.com

Ever notice how the same pilots seem to loose an airplane to interference? It is a truly amazing thing. The same few pilots are always claiming they were glitched.

Before you know it, the local club posts notices concerning how several channels have known interference or are “glitch prone” and recommend not flying on them. You know what I mean — signs like “DANGER – DO NOT FLY ON CHANNEL 22,” or “CHANNEL 22 HAS INTERFERENCE.”

YIKES! This stuff is scary.

So, lets try to define the type of interference discussed in this article. When someone turns on their radio and you just happen to be flying on the same channel and you loose control, you have been “shot down.” This is not the type of interference this article discusses.

If you fly out of range or you have an antenna issue with you aircraft, that is not the type of issue this article discusses. Antenna issues will take another six or seven pages and will be part of a future article.

This article discusses the mysterious type of interference that seems to strike right before a plane crashes into the ground. The type of interference that strikes a plane when the pilot claims he was “glitched.”

“Glitched” is a word with many, many possible meanings, but it nearly always implies something mysterious. So, in this article, getting shot down is not a “glitch.” There is nothing mysterious about getting shot down.

A glitch is that mysterious interference that happens at the most inopportune times.

Personally, I believe that glitches are real, but never, well almost never, are they because of some mysterious radio interference.

Rather, nearly all glitches are caused by interrupting the flow of electrons or by routing them to the wrong place somewhere in the wiring of the sailplane or in the transmitter. Some are caused by mechanical interference within the airframe. Few, very very few, are actually interference from an outside radio source.

Typically, radio interference, when it happens, occurs over a rather wide portion of the radio spectrum, not just the single narrow channel you are flying on.

The FCC files contain some rather interesting examples of things that have caused radio interference.

An oxidized ground wire (intermittent short) in a commercial 50,000 watt FM antenna and, believe it or not, the worn-down-to-metal brake pads grinding on a metal brake drum on a public bus both wiped out wide portions of the local radio spectrum.

These situations occur, but are very rare. These events also covered a wide part of the spectrum, not just the narrow portion of the spectrum you are flying on.

The radio spectrum covers a very wide range of frequencies. If you were to spread the RC channels across the full radio spectrum, there would be room for over 55,000 RC channels.

If you are flying on channel 41 and are glitched, and the pilots flying on channel 40 and 42 at the same time were not glitched, the likelihood of interference from a mysterious outside radio source, just on your narrow radio frequency band, is extremely low. Your odds are better at Vegas.

So, when there are multiple planes in the air at one time and only one is glitched, it is the first indication that it is not caused by general radio interference. (Remember, a shoot down is not a glitch.) General interference should typically take down more than one plane.

Every single glitching problem I have investigated could be traced to an electrical failure in the aircraft or transmitter, or was simply a case of dumb thumbs.

So here are some things to think about the next time you think you were glitched. I hope they help:

• Look inside yourself. Were you just 10 to 12 feet off the ground? Did you look away and when you looked back the plane was diving into the ground like a lawn dart? You probably performed a deep stall (and have a forward CG) and maybe did not see it. Ten or twelve feet is just not enough altitude to recover, but is plenty of time for the lawn dart to bury itself up to the wing root.

• Sorry JT, but I just had to put this one in. Did you fall asleep? Inside jab and no further comment is necessary.

• If you crash hard, throw away the receiver. It is as simple as that.

• You guys that use the battery plug as a switch are simply asking for trouble. There is no excuse for not using a switch. Excessive wire movement will break the wires at the plug!

• You guys that are actually using a switch are simply asking for trouble. Because it is a mechanical connection, it is prone to wearing out and failing. But, at least the flimsy wires connected to the switch are not going to fail.

• The switch should be hard mounted. Excessive wire movement will break those thin little servo wires.

• If you have a power glitch in which the entire plane looses power, re-solder all the joints between the battery and the switch and the switch and the receiver. If still no go, replace the switch.

• There are only two ways to make an electrical connection — physical crimping or solder. Using CA or epoxy to make an electrical connection is an invitation for disaster.

Several years ago, a post-flight was performed after a crash. The electrical splicing was protected in heat shrink tubing. I pulled the heat shrink off and the wires were beautifully twisted around each other. Wait a minute, I could see the individual wires! CA was applied to the joint after the wires were twisted together. No solder to be seen! A continuity check of the connection showed an open circuit. The CA had wicked in between the wires and acted like a little insulator around each individual wire strand. The beautiful looking splice was a complete failure.

• If you glitch for no apparent reason on the ground, change the crystal or don't fly.

This does not apply if you are using JR341's or 351's or any other "high impedance" servo. Long servo leads, like the one to the aileron, will pick up enough stray RF to cause servo jitter. If you move the radio more than 15 feet from the plane and the jitter goes away, it is probably a long servo lead problem. This can be solved by placing a 150 pf to 0.001 uf capacitor between the negative and signal wire right at the servo. (Radio Shack P/N 272-125, 470pf, or P/N 272-126, 0.001uf.

• Here is an example of an interfered sailplane.

One day while shooting a competition landing, the plane suddenly rolled hard left. I successfully landed the plane, but my heart nearly jumped out of my chest. Full opposite aileron and opposite rudder barely got it wings level before it landed, hard. As we approached the plane, people around me started saying things like "You must have been hit."

What really happened was an intermittent solder joint on the wiring for the left aileron servo. During the roll out onto final, the left servo was in nearly the full up position when the solder joint opened, power to the servo was interrupted, and the servo simply stayed in that position. So when I let the aileron stick return to neutral the plane kept rolling. Opposite aileron and full opposite rudder barely leveled out the wings. The landing caused the bad connection to re-connect and the servo returned to neutral. By the time we got to the plane, everything looked good and worked fine.

It took me days to find the problem. It looked like interference, the people around me were convinced it was interference, but it was not.

• Servo connecters and battery connectors should not get warm, much less hot. If they do, cut out the entire connection and throw it away. Bad connections are typically invisible and only short intermittently. Looks like glitching, but it's not.

• Check all the connections on the battery. If any cells appear to have "leaked" or oxidized (white coating) throw away the battery pack. If any of the solders are not "shiny" you might have a cold solder joint that will only get worse over time.

• Lightly flex the battery pack while it is plugged into the plane. If the model glitches, throw away the battery.

• Cycle your battery pack on a charger that will tell you the capacity of the battery during each discharge cycle. If the discharge is 30 percent less than rating of the battery, throw the battery away.

• If you have a glitch, never assume that you are being interfered with. The Seattle Area Soaring Society field (60 Acres South) has been tested with some rather expensive gear. No interference was found. You are much, much more likely to have an electrical problem in your model.

• Over the years I have checked out a lot of planes that people claim were interfered with. Except for a well known receiver that was recalled, I have never seen a case of random interference. We always traced it back to a crystal or wiring problem.

• I fly a lot of expensive stuff. When I have something that seems like a glitch and I cannot find the problem, I replace the entire wiring harness. The glitch has disappeared every time.

• If you are getting "hit" while flying, START YELLING OUT YOUR FREQUENCY, AS LOUD AS YOU CAN. Someone using your frequency may have turned on their transmitter.

• If you are getting "hit" while flying, assume your battery in the plane is dead or dying. Start running at the plane. Take your thumbs off the sticks. Closing the distance will result in a louder signal at the plane and maybe some control.

It is my understanding that there is enough power to move the servos long after sufficient power to control the receiver is gone, but that may be changing in some of the newer receivers. A louder signal in an almost dead receiver might be enough to provide some control for a short period of time.

By taking your thumbs off the sticks and the load off the battery, the battery may rebound to a higher voltage. Once closer, try moving the sticks again. Hope you get lucky.

• If you get "hit" while flying assume the battery in your radio is dead or dying. While running at the plane, turn your radio off for as long as you can. When you turn it back on, the battery will momentarily rebound to a higher voltage than it had before. If you regain control, it will only be for a brief moment. Make the best of it.

• If you get "hit" while flying use as few servos as possible. Fly with rudder and elevator only. Reduce the load on the battery. Land quickly.

• If you switch out the receiver in a jittery plane and the jitters go away, don't assume that the problem was in the receiver. You may have simply created a better connection in that bad wire than you had before.

• I was talking with a young man the other day who was complaining about a very specific receiver and that it was having a rather interesting glitching problem. The gitching was occurring with the sailplane on the ground and the radio just a few feet away. He even went so far as to point out that when replaced with a different but same model receiver, the glitching continued, exactly as before.

The typical response is to blame it on the receiver. (It must be a bad batch or poor design.) Lets face it, there have been a couple of cases where a bad receiver design was released to the public, but this situation is VERY rare. Putting a new receiver in a glitching plane is not the proper method of trouble shooting.

• The proper method of trouble shooting is to take the receiver out of the jittery plane and put it in a different plane. If the jitters are now in the different plane, you can now assume the receiver is bad and throw it away.

How many people do this?

None that I know of. (Come on, pulling a receiver from a perfectly good plane and substituting the suspect receiver and then putting the original receiver back in is a real pain in the...) Most do what is in previous paragraph and blame it on the receiver. Could be a big mistake.

• Check your mechanics.

Here is an example. I forget who it was, but during a check out flight the test pilot tried a loop. The loop was so successful, the plane just kept on looping. No matter what we did, it just looped and looped and looped. Amazingly enough, it landed itself successfully.

How often after a frozen control ("I've been glitched!") do you get to perform a post-flight check on an undamaged plane? We had a heck of a time trying to recreate the problem on the ground because the elevator was working again. ("I've been glitched, it must be radio interference!") Of course everyone that witnessed the event said it must be interference.

It took an hour to find the problem. When you moved the stick to full up elevator the end of the servo arm jammed against the inside of the fuselage, but only when the antenna wire got in the way. We fixed the antenna to the bottom of the fuselage and out of the way of the servo arm and the glitch never reoccurred.

• Fly PCM or one of its digital versions. PCM may use an FM carrier wave, but the signal is digitally encoded. This means that when the digital signal path is corrupted, the servo simply stops moving. That's right, loss of signal means no servo movement. This also means that to get a servo to actually move differently than your stick movement requires a digital data stream that the receiver can understand. In other words, stray RF will not cause the servo to move. It requires a digital data stream that the receiver can understand to cause the servo to move differently than your stick input. How often is that going to happen?

• If you are flying a digital receiver, pay attention to your failsafe settings.

Failsafe sends the servo to a specified position upon loss of signal. There may be options. Many radios default the failsafe to “HOLD.” This means that the servo stops moving a the last position of the servo when the receiver lost signal.

You may also set the failsafe so the servos move to any position upon loss of signal you desire. Few failsafe’s move the servo to a failsafe position, or back to servo center. So if you simply turn failsafe on with out setting the failsafe position, upon signal loss, all the servos move to their center position.

Sounds good in practice.

In reality, a 10 year old boy was killed in England at a very large fun fly because of the default setting. The power plane took off and went into failsafe at a couple of hundred feet. Failsafe moved the throttle to default position. Fifty percent power rather than off. The Plane kept flying under power and slowly rolled into the spectators.

The post-flight found that the antenna was still bundled with a wire tie. Range was limited to around 400 feet when failsafe kicked in.

There is a lot of discussion of what is the best failsafe position for a sailplane. I won’t go into that discussion here.

However, if your failsafe is on you really need to check something. Turn on the model and radio. Then turn the radio off. If the elevator jumps to a different location, you need to reset your elevator in the failsafe mode. Otherwise, even a short interruption in signal will result in a pitch change in the aircraft.

One way to check if the signal is occasionally lost to your sailplane is to set the flaps and elevator to a failsafe position. Set the flaps to 40 percent or so and the elevator to provide the correct compensation. If you are flying along and all of the sudden the flaps come down and then back up, the aircraft is telling you that there was a momentary loss of signal.

And now for some additional thoughts.

As I mentioned before, if you crash hard, throw away the receiver. It is as simple as that.

Next time you have a problem, seek out the help of the older guys in the club. It is possible that one of them has had the exact problem you are experiencing and can help you find your gremlin in your aircraft.

So with all of these examples, why do most of us with a momentary loss of control always assume it was a glitch caused by phantom interference and that all the electronics are perfect?

Or if two pilots have mysterious crashes and are flying the same receiver, that it must be a design flaw in the receiver?

Are our egos so big that we go into automatic denial that maybe our soldering technique is not the best?

Why are we so unwilling to spend the time to investigate the electrical system in the aircraft and make sure that it is not the real problem?

I think I know the answer, or at least part of it. I had a physics professor state, “Someday your kids are going to ask you, ‘How does a light bulb work?’ and there is a simple answer. It’s magic. You see, no one has ever actually seen an electron. Therefore, it must be magic.” Amazingly enough, most people treat all things electronic just like the professor. It’s magic!

It is this belief in magic and that the interference is from a mysterious source that causes pilots to do strange things.

Like the pilot who just piled-in a new molded plane from 400 feet and simply brushed off that piled-in receiver and put it in his next $1500 sailplane. When the second plane went in, the pilot was heard to say, “Well, it (the receiver) looked good to me! I mean it wasn’t crushed or anything!”

So, just remember, an electron is a really really small thing. Way too small for us to see with a magnifying glass at the field. That means that to interrupt the flow of electrons only takes a gap that is also way too small for us to see.

This brings us to the real reason we blame glitching on interference. We cannot see the gap that is causing the glitching.

The professor was right. For most of us, if we cannot see it, it does not exist.

So remember this formula when you experience a glitch. One gap, so small it cannot be seen, in the wrong place, plus the wrong time, equals a dead aircraft.

All of us need to pay more attention to the ENTIRE electrical system of the aircraft.

In the future, when you experience a glitch, your first assumption should always be an electrical problem in the aircraft. Only after every other possibility, and then all the possibilities you did not think of yet, have been tested and discarded, should you look to interference as a problem. ■

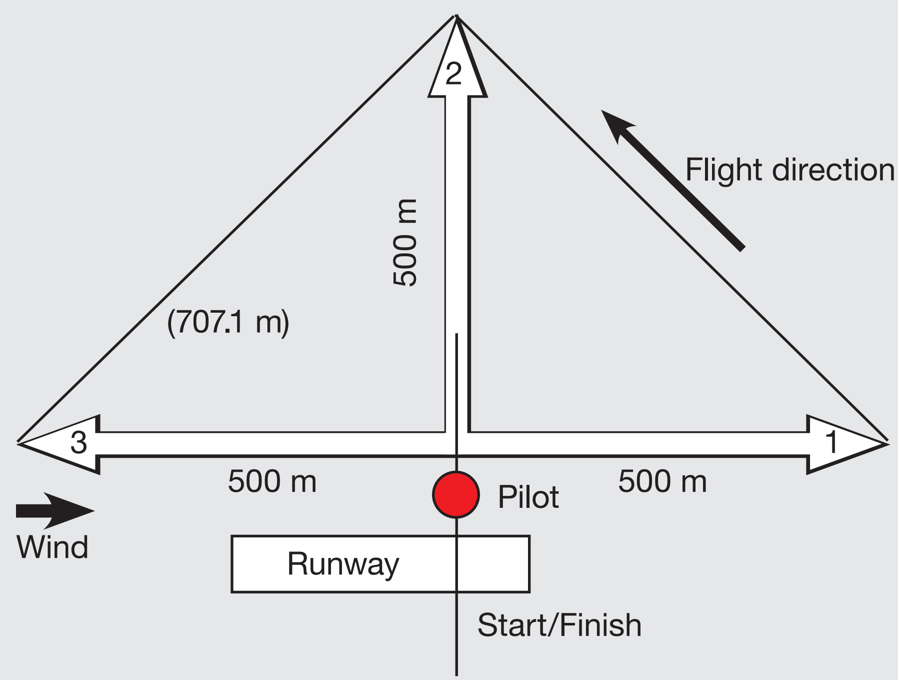
A note about the lead-in photo, the remains of Bill Kuhlman's Redwing 2M. Was this destruction caused by interference or by a glitch? Actually, it was caused by neither.

Despite using a 5-cell battery pack, the servos just could not accurately maintain control surface deflections at high speed. A dive from altitude ended at ground level, burying the nose several inches into the ground, when the servos could not counter the aerodynamic forces. Photo by Alyssa Wulick

Satellite Navigation in Aeromodelling

The latest issue of CIAM Flyer (05/07), the aeromodelling "magazine" of the FAI, carries an article which is exciting reading for RC sailplane enthusiasts. While small variometers have been in use in models for decades, only recently has a sophisticated GPS been made small enough for use in our activities. Now that the possibility has become reality, complete with downlinks to pocket PCs, a number of contest formats have been devised to both make use of this technology and to add additional challenges for the pilot.

One of the new competition categories being evaluated by FAI is what is known as Triangular Gliding. With GPS, there is no need for a complex infrastructure, and contests which test the flying abilities of the pilots are easily managed. Additionally, every flight may be accurately analyzed afterward by both the officials and the pilot and his team. The course diagrammed below requires a flight distance of 2.4 km. With the large gliders now in vogue, the 500 meter distance should not be too much of a problem.

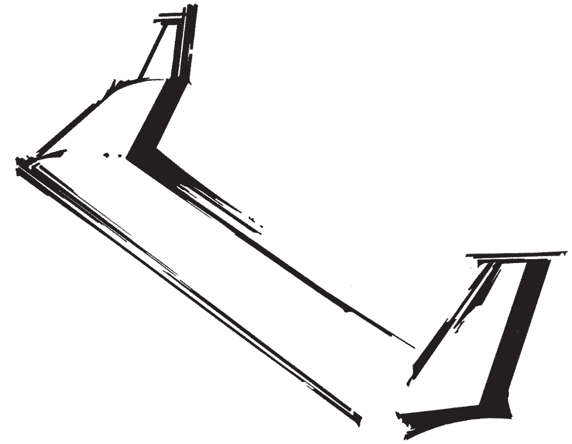


CIAM Flyer can be downloaded from < http://www.fai.org/aeromodelling/ciamflyer>.

Redwing XC, Part 4

Fuselage components, vertical fin and rudder

Bill & Bunny Kuhlman, bsquared@themacisp.net



Construction on this 'ship came to a near standstill for a couple of months, but over the last two weeks we've been able to put significant time into finishing off the structure.

The last installment, published a couple months back, covered the shaping of the exterior fuselage and construction of the keel. Hollowing the interior of the fuselage sides was a bit more time consuming this time, as we used fir rather than balsa. We started the process using drill press and a 1/2" diameter half-round router bit set to take about 3/8" from the material. Moving the material slowly, the router bit was taken to about 1/4" from the outer edge. At the rear of the fuselage pod, we ran the router blade all the way past the edge. This makes the pod hollow all the way back to the intersection with the wing.

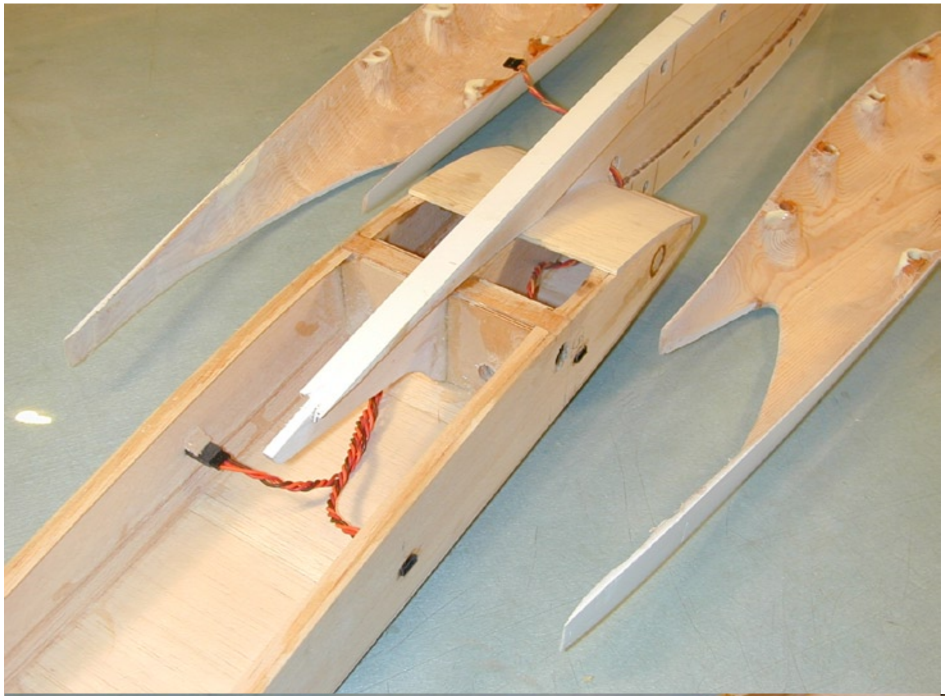
Lowering the router bit 3/8" at a time, the entire fuselage pod was roughly hollowed out. The final pass was made with the router bit set about 3/16" above the table. As the fuselage was passed under the blade, we made sure the outside of the fuselage was tangent to the table.

The two fuselage sides weighed a bit more than 18 ounces each to start. After the first pass with the router blade, the weight was down to roughly 14 ounces. They ended up at about 5 1/2 ounces each at the end of this process. The 25 ounces removed made a big pile of wood chips.

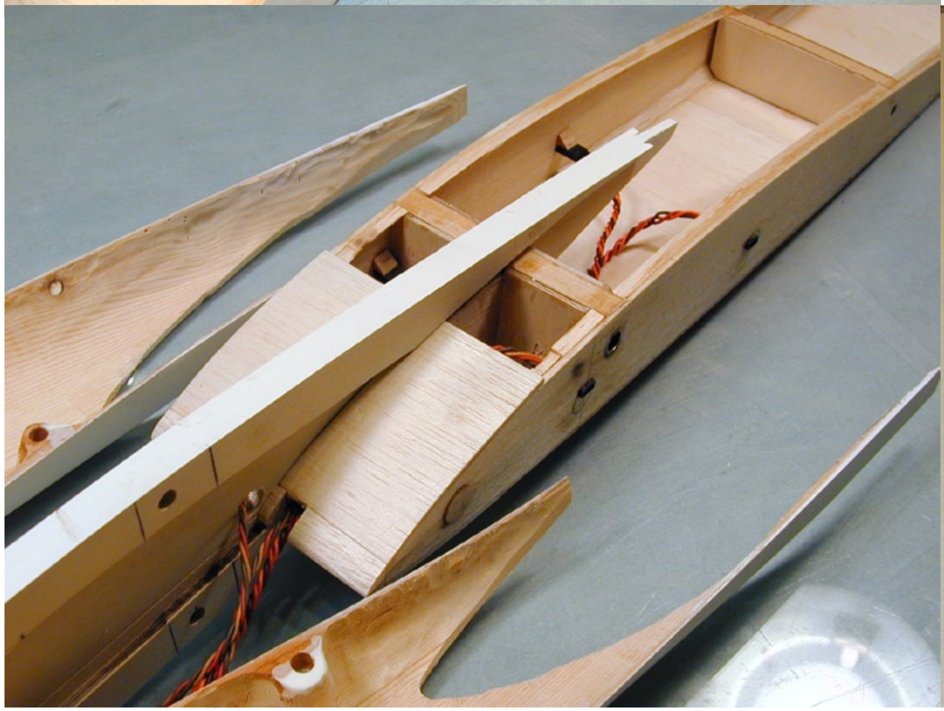
After smoothing the interior as much as possible using the router bit, we attached a flapped sanding drum to our Dremel tool and went to work making it really smooth. This process makes a lot of very fine dust, so was accomplished outside. With a wall thickness of around 1/8", final weights turned out to be 4.75 and 5.1 ounces.

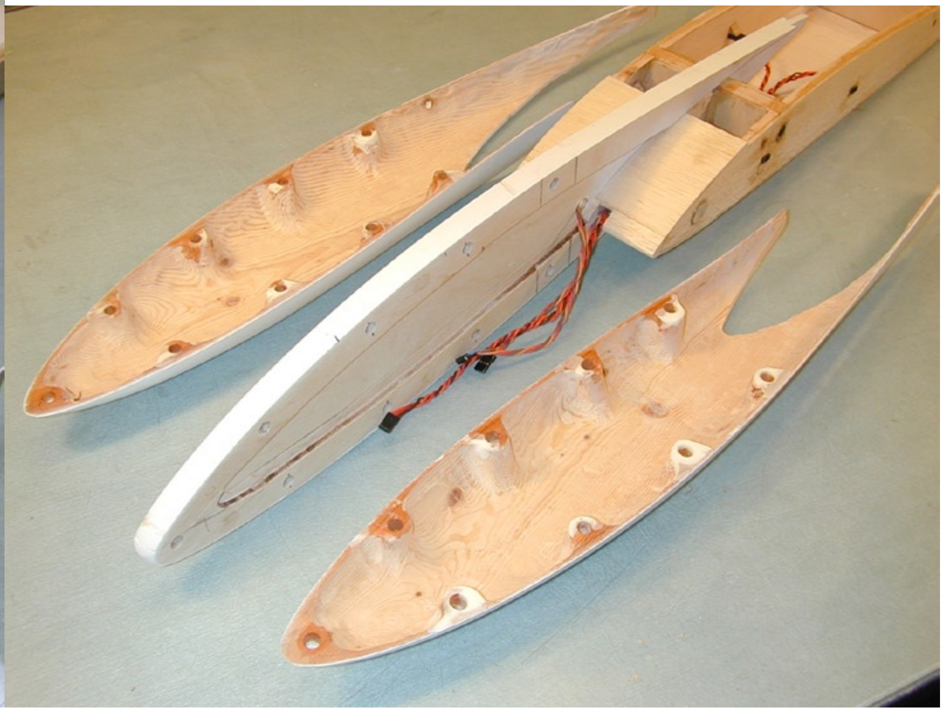
Now it was time to build the wing root portion of the fuselage structure. This involved constructing a 4 1/2" wide wing panel using the wing root rib as the sole pattern. This center section is constructed with a rib at each end of panel. Additionally, there is an abbreviated rib (leading edge to aft edge of keel) which is placed so it fits snugly against the keel. This rib is used to offer a platform for the 1/8" center section sheeting.

All four ribs were attached to the lower sheeting, and the main spar and secondary spar carry-throughs were built up using spruce spar caps, balsa webbing, and an appropriately sized brass tub. This part of the structure is attached to the fuselage keel by means of the main spar carry-through and a wood dowel which also serves as an anti-crush brace near the leading edge.



The fuselage structure consists of a forward shell which is supported by a central plywood keel, and a central wing panel which encloses the main and secondary wing rod carry-throughs. The fuselage shell halves are constructed of fir and hollowed using a half round router bit and a drill press. The keel is composed of three layers of 3/16" plywood; a central core and a frame about 3/4" wide on each side. Dowels of 5/32" diameter are mounted in the frame and match receptacles in the shell. The wing center section was built using the templates for the wing root ribs, but with allowance for 1/8" sheeting instead of the 1/16" sheeting of the wing. The elevator servo cables got through the spar carry-through, along with the rudder pushrod, not shown in the photos. The forward fuselage shell is attached to the wing section by means of the main spar and a large diameter dowel near the leading edge.



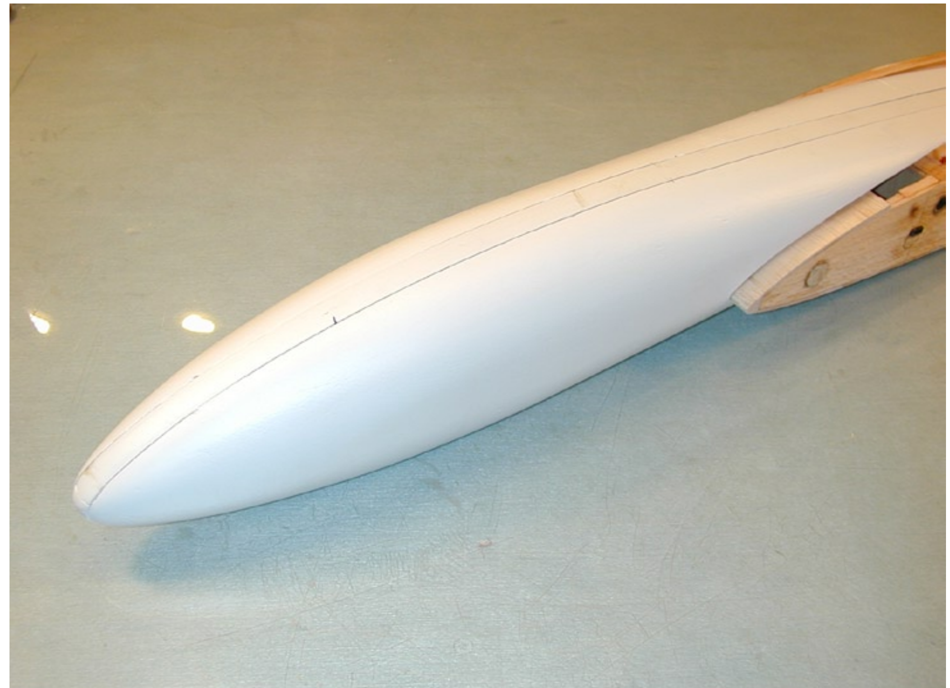


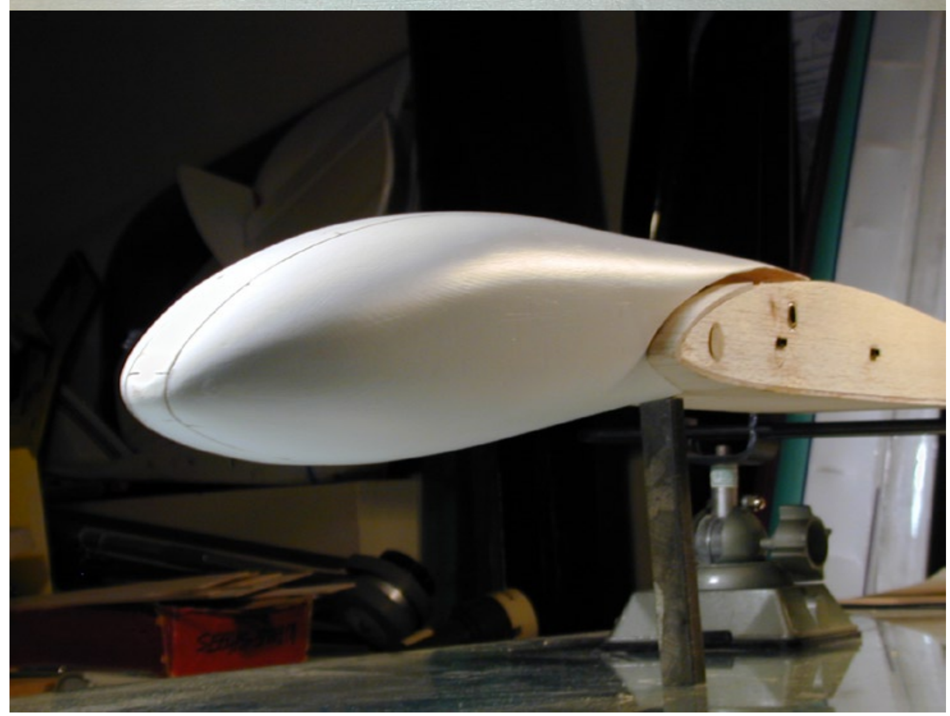
Before enclosing the rear portion of this center section, the rudder pushrod, antenna, and aileron and elevator cabling had to be routed. This meant drilling holes in the spar carry-through assemblies, but since none of the holes were larger than one third of the webbing height, a negligible amount of strength is lost.

The open ends of the wing center section and both wing panels must be sealed with light plywood so there will be no gaps when the wings are attached. We mixed up some epoxy resin and added microballoons until the mixture was very thick, much like toothpaste in consistency. This mixture was put into a plastic syringe and applied to the center section rib outline. A pre-cut lite-ply rib was placed on our glass working surface and the fuselage assembly was aligned with it. With the fuselage assembly essentially on edge, we added some weights to the upward facing wing stub. This was allowed to cure overnight. The following day, this process was repeated on the opposite wing stub.

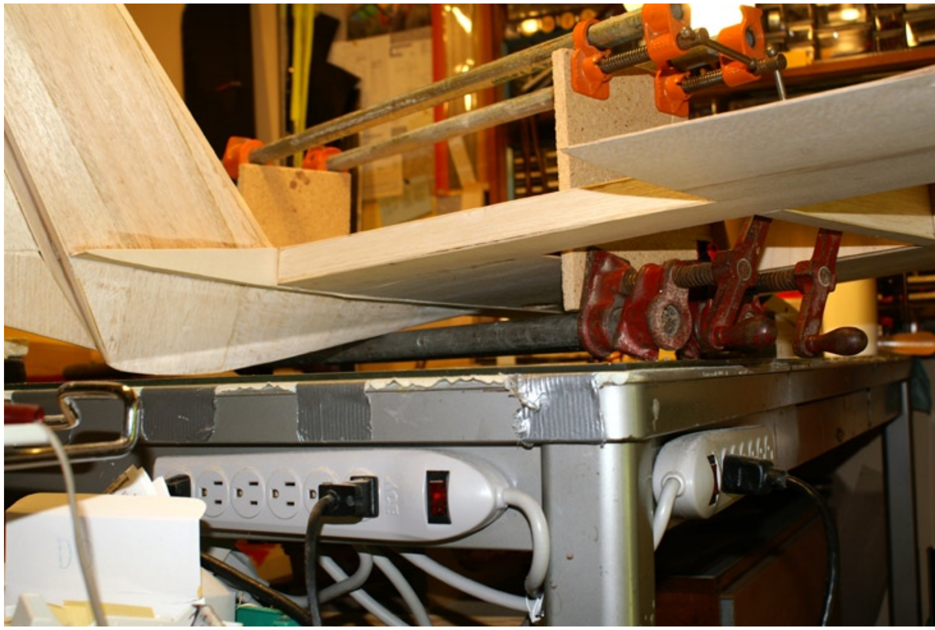
The wing center section now had the lite-ply ribs firmly in place. After trimming with a sanding bar, pre-cut lite-ply rib outlines were aligned with and attached to the center section stubs. we used thin strips of masking tape to hold these ribs in place. The same epoxy and microballoon mixture was applied to the new ribs, and the wing was then mated to it using the wing rods for alignment. This is a rapid process, so we were able to do both wing roots at the same time.

Using four pipe clamps and a couple pieces of fiberboard, the wings were lightly clamped against the wing center section. This set-up was allowed to cure overnight.

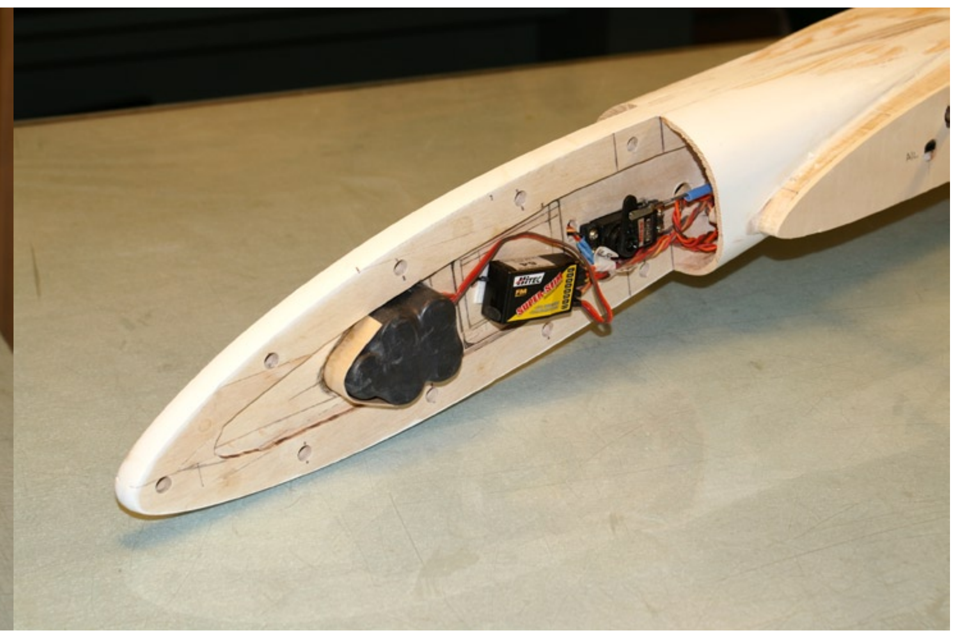




The fuselage shell, temporarily mounted to the partially completed wing center section. Gap still in evidence. Elevator and aileron servo connections are already installed.




Above: Installing the lite-ply wing root caps. Pipe clamps and fiberboard leverage the wings against the fuselage center section.
Below: Radio installation. A 5-cell 3300 mAh NiMH battery up front, rudder servo aft. The receiver, a Hitec RCD9600, is held in place with a large patch of Velcro. Servo wiring and rudder pushrod go down the left side of the fuselage, antenna down the right.

Next day, everything was taken apart, revealing a perfect matching of all three major parts.

Now it was time to finish off the fuselage by separating the removable portions of the fuselage from the main assembly and installing the radio gear.

We knew where we wanted the separation line to be, so we first cut small notches in the fuselage side where the cutting line met the keel. Using machinist squares and a very flexible ruler, we then marked the rest of cutting line. With the fuselage side back on the keel, we cut through the remainder of the fuselage side using a razor saw.

A cut-out for the battery pack was created using a suitably sized Forstner bit in the drill press. The four pointed remnants were removed with a small sanding bar. The battery pack slides in and out easily, and a small sheet of thin plywood keeps the pack in place.

The cut-out for the rudder servo was marked and the corners drilled out. A very small X-Acto saber saw connected the pilot holes.

Because of the rather rough wing rib outline cut into the hollow fuselage sides, we ended up having to put some balsa filler strips to fill the gaps between the rear of the fuselage and the wing center panel. This actually spreads the loads better than simply gluing the fuselage to that center panel. A spread of lightweight spackle smooths things out and provides a smooth clean compound surface for ’glassing.

On to the fin and rudder! We used the SD8020 for the vertical fin and rudder, and it worked out very well. The vertical surface is divided into a stationary fin and moveable rudder, with the hinge line at 50% of the local chord. A separate sub-fin is used to transfer landing loads to the more forward portion of the fuselage, so it must have substantial thickness at the trailing edge of the wing. The SD8020 has acceptable thickness where it meets the trailing edge of the wing center panel.

The fin consists of five ribs sheeted with 1/16” balsa. The rudder has diagonal ribs with cap strips. The trailing edge is composed of two sheets of 1/16” balsa with and interior bevel and a strip of 1/64” plywood to provide a sharp trailing edge.

We had originally contemplated using a pull-pull arrangement on the rudder, as we had done for the two meter version, but once we began planning the control cable routing, we opted to go with a simple pushrod system. There are three heavy duty hinges connecting the fin and rudder.

Two more items need to be accomplished before we get into final sanding, ’glassing and covering. First is to glue plywood caps to both ends of the ailerons and elevator halves and the opposing wing faces. Second is to set up the pushrods for the various control surfaces.

The plywood caps are easily cut from lite-ply. The one thing to watch for is the clearance between the control surface and the wing as the control surface deflects upward and downward. Because of the small amount of wing sweep, the control surface gaps are not consistent in the vertical direction. Viewed from above, the gaps appear to be between 1/32" and 1/16". From below, this gap is wider at the lower portion of the outer edge of the control surface. Additionally, some of the lower portion of the wing face plate for the inner aileron must be relieved to allow the aileron to deflect fully. (Because of the wing dihedral and the vertical face of the matching center section, there’s no impediment to full elevator deflection.

All of the servos in this ’ship are Hitec high torque models powered by a 5-cell NiMH pack with 3300mAh capacity. HS-605BB servos (76 in-oz) drive each elevator half (96 in^2); there’s also an HS-605BB driving the rudder. The ailerons (108 in^2) are connected to HS-635BB servos (83 in-oz).

The 605BB servos have been driving the elevons, rudder and flaps on our last Blackbird XC without problem. The control surfaces on the Redwing XC are

Almost ready for ’glassing, covering and painting. To give an idea as to size, the exposed area of our steel building table is 68 by 38. At this point the aircraft, with radio gear installed weighs almost exactly eight pounds. It will turn out somewhat heavier than our most recent Blackbird XC (8 lbs. 6 oz.), due mainly to the more robust spar system.

larger, hence the move to 5-cell battery pack.

It bears repeating that the airfoil on these “plank” planforms have significant reflex, so there is an aerodynamic downforce trying to move the servo when the surface is in its neutral position. A move to digital servos for these large aircraft is definitely in our future.

For the rudder, we installed the more rigid blue Gold-N-Rod with a clevis at the servo arm and a ball link at the rudder horn. The ailerons and elevator halves use custom made printed circuit board control horns and the more robust helicopter ball link assemblies. These pushrods are attached to the heavy duty servo arm using 4-40 clevises.

That’s about all for this time out. With the deadline for this issue of *RCSD* approaching, we’re going to have to relate the ’glassing and covering processes, along with flight testing, in the next installment.

SLED DRIVER CHRONICLES

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"It sucks what?"
Vacuum Bagging Part 2

Note: This series of articles uses the work "suck" gratuitously. If you are offended, get over it. It is just part of the vernacular of the vacuum bagging community.

Ever finish putting something together and just play around with it for awhile?

I remember when I finished building my first vacuum system I played with it for quite awhile. I'd plug in the vacuum system and the motor would start running. Then I would put my finger of over the end of the plastic tubing from the system and let it suck down to the vacuum switch set point, while I watched the vacuum gauge. The vacuum switch would turn off the vacuum pump at the set point, I'd release my finger and air would hiss as it was sucked into the end of the plastic hose until the motor started running again, and then I would do it all over again.

While I was being mesmerized by my just completed first vacuum system, the girlfriend at the time walked by and incredulously asked, "What is that thing?" I explained what it was and her response was, "It sucks what?" To which my reply was "It is something for model airplanes." She rolled her eyes, started walking away, and said "Oh."

We weren't together much longer after that...

I don't think this exchange was a contributing factor to our failed relationship, so don't worry if your significant other doesn't think you new vacuum system is neatest thing since sliced bread, either.

Let's say you have obtained a vacuum system, whether you borrowed, bought, or built it.

If you borrowed it, your buddy probably gave you a vacuum bag or two for you to use and showed you how to use it, unless he has never used it and is now hoping that you will figure it all out for him.

But, let's say you poorboyed it and built your own vacuum system with bailing wire and chewing gum. At this point, I would encourage you to run with the poorboy mindset and experiment with bagging materials you can purchase at a DIY store. I discuss some commercially available bagging supplies that I like to use at end of this article.

Here are the things you need for make your own poorboy vacuum bags:

Bagging Material – 6 mil polyethylene sheeting. This stuff is typically sold as “drop cloth” in the DIY store painting department. If you have 4 mil thick material in the garage, that is usually good enough. Polyethylene sheeting can be kind of porous, so if you make a couple bags and they all leak for no apparent reason, try a different brand of material.

Bag Sealant – Caulking works for bag sealant. I use both rope caulking and the latex with silicone caulking in squeeze tubes or caulking gun tubes. In the composites world, bag sealant will often be called tacky tape.

Bleeder – Paper towel works just fine for our relatively small projects.

Wick – Cheep nylon rope is a good air wick. Paper towel bleeder provides enough of an air wick pathway for small bags that don’t leak, but in real world situations where bags often leak a little, having an air wick is important, particularly for larger or longer bags.

Chances are you might have some or most of this stuff around the garage or shop, maybe in that corner where you’ve had all the stuff to paint the dining room for a couple years.

Here is my suggested series of experimental exercises that you do to get comfortable with sucking down a vacuum bag:

Suck Down Nothing – Make a long vacuum bag that you can cut the end off and reseal a few times. Suck the bag down with just the bleeder and a wick inside. Make sure the bag is sealed, i.e., that the vacuum pump does turn on again for at least 20 minutes between runs to maintain the vacuum. Learning how to seal a bag is the primary lesson here.

If you are lucky, your bag will leak and you’ll have the opportunity to learn how to get it to seal without having a real part in the bag. Often you can hear leaks, if the motor is not running all the time and you have the Black Sabbath on the stereo turned off.

A simple first task, but kind of cool to see if you never seen a bag suck down... a great first great tangible step down the composite construction path. If you are a kid at heart and have a couple broken airplane bits around, put an old built-up stabilizer or something in your bag, it makes this exercise a more educational.

Suck Dry Parts – In this experiment you are going to suck down a bag on parts without any adhesive. Ideally, you’d have some foam cores and core beds available to work with for something like a stab that you want to sheet with wood veneer or fiberglass. But, you can use about anything you want. At the minimum I would suggest using a piece of 1/4" balsa for a core and two pieces of 1/16" balsa for sheeting that extends about an1/8" around the entire core. It is educational to see how the bag sucks around items, particularly overhangs and corners.

Put the wood to it – Go ahead and smear some 30 minute or laminating epoxy on some wood skins and vacuum bag them on to your cores. If you have foam cores and beds, this can be a really good exercise. Arguably, after the skins is wet out with resin, assembling the sandwich of skins and cores and getting it all into the bag and sucked down in the cores beds is the hardest part of the actual bagging process.

Make a Shiny Surface – If you have access to some fiberglass and laminating resin or even 30-minute epoxy, bum a scrap of Mylar from a friend or find a smooth piece of plastic to use as a laminate carrier and try bagging some glass to a balsa surface. When you peal that carrier away and see that shiny surface you just created… you’ll probably be hooked, if not, it’s OK to "buy and fly."

Let's talk about commercially available vacuum bagging materials. For wings, I like use the commercially available nylon bagging tube, bag clips, and the little vacuum bag fitting ACP sells. I like the bagging nylon bagging tube because it is quick, clean, and folds up for convenient storage. Polyethylene bags typically have to be hung somewhere for storage and mine tend to look like there was some kind of horrific accident with the caulk.

For more complex work, e.g., vacuum bagging laminate into molds, I do use peel-ply, tacky tape and nylon bagging film, which are materials made for the composites industry. We might cover bagging into molds, vacuum infusion, and some other techniques in the future, if there is any interest.

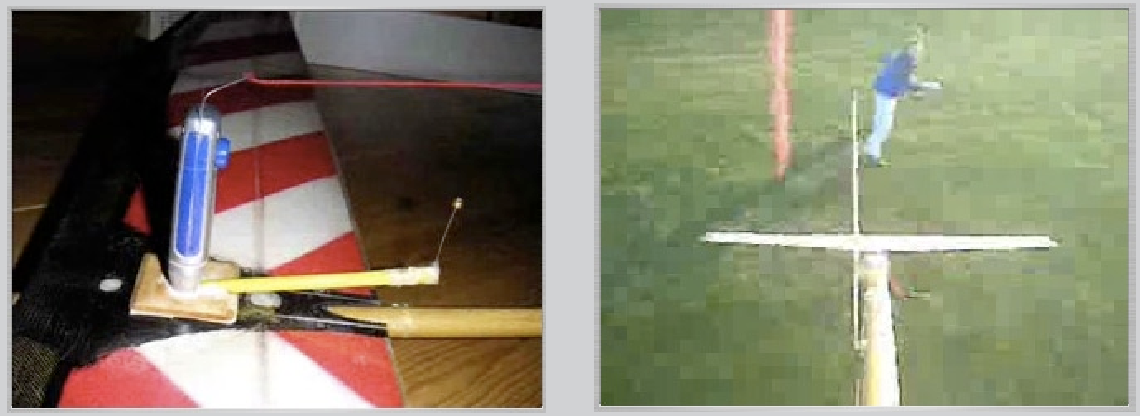
Well, I don't know about you, but I'm feeling pretty good. Why you ask? Because I've been deluding myself into thinking that there is at least one person out there who built a vacuum system with the last article, at least one who pulled his first vacuum bag with the help of this article, and that there are at least a few folks reading along and who have picked up a couple ideas. Those folks have accomplished and learned quite a bit and may have just entered the world composite construction.

So, come on in, the water is fine. ■

DLG Onboard Video — with acceleration and yaw indicators

by Martin Kopplow/Akamodell Braunschweig

<http://it.youtube.com/watch?v=Go6GBZUAEOw>



Left: Camera, acceleration indicator, and yaw string mounted to top of the wing and directed aft. Right: A typical frame from the video showing yaw and side acceleration a fraction of a second after release (seven examples). The entire assembly was also turned to show the wing tip, as in the frames below (nine examples). Images © 2006 Martin Kopplow. Used with permission.

Above: Catching a wing tip and immediately going into another launch. Images © 2006 Martin Kopplow. Used with permission.