

AUGUST 2009


# SPORT Aerobatics

A purple and white aerobatic plane is shown in flight, banking sharply to the left. It has a sleek, aerodynamic design with a high wing and a T-tail. The background is a clear blue sky with some light clouds.

MAGAZINE OF THE INTERNATIONAL AEROBATIC CLUB

## Freestyle Design Tips

A large red Oracle aerobatic plane is shown in flight, banking sharply to the right. It has a high wing and a T-tail. The background is a clear blue sky with some light clouds.

- Aileron Roll Techniques from a Pro
  - Broken Linkage = Bad Day
  - Inverted Flight Can Save Your Life
- 
- A red Oracle aerobatic plane with a checkered pattern on the wings is shown in flight, banking sharply to the right. It has a high wing and a T-tail. The background is a clear blue sky with some light clouds.



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*The Collaborators* streaking across the sky during AirVenture Oshkosh.

–Photo by Phil Weston



# SPORT Aerobatics

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*Reggie Paulk*

## LETTER from the EDITOR

by Reggie Paulk

## Continuing the Creative Process

Every month, this magazine comes together from a seemingly ethereal place. And every month, I'm amazed at the fruits of so many people's labor. From the photo on the cover to the stories inside, a magazine is the product of a continuous creative process. For *Sport Aerobatics*, that process begins with an editorial calendar.

Once a month, I have a phone call with Vicki Cruse where we discuss the upcoming issue and figure out what we would like to see in the magazine. This call is important because it gives us a chance to look at the layout and discuss any changes that need to be made. In addition, we plan for future issues and figure out how to get the material for the stories we'll be running.

The call with Vicki really begins to solidify the next issue and brings it into its initial existence. All of the stories that we'll be running must be copy-edited and photos sourced. Once this is done, my job is to make sure all of the material is uploaded to EAA's FTP server so that our art director, Phil Norton, may begin to work his graphic magic. My challenge has always been timing. Phil and I have been working together for nearly a year, and he's ever so slowly pressing me to get things in a little earlier.


I recently asked for more feedback from the readers and was pleasantly surprised by the response I received. Many of you took a great deal of time to let me know what you like about the magazine, what you'd

like to see, and what could be done better. One of you gave me a laundry list of ideas that could easily fill a few issues. I appreciate this feedback; it doesn't fall on deaf ears. I've been working every month to try to bring a magazine that speaks to all of our members as best as it can. The magazine is a great resource, but it's not the only one.

For those of you who are new to the IAC, there is a veritable avalanche of information available to you through our experienced membership. If you need advice, from what engine/

*Many of you took a great deal of time to let me know what you like about the magazine, what you'd like to see, and what could be done better.*

propeller combination to use on your Pitts, to how to perfect a loop, you'll find numerous members who not only know how to do it, but also can explain it in terms you'll understand.

This magazine is perceived as the greatest member benefit. Those of you involved in the passion of this sport know that the dedicated individuals who make up this club are the true benefit. 

Please submit news, comments, articles, or suggestions to: [reggie.paulk@gmail.com](mailto:reggie.paulk@gmail.com)

## PRESIDENT'S PAGE

by Vicki Cruse • IAC 22968  
E-mail: [vcruse@earthlink.net](mailto:vcruse@earthlink.net)



*Vicki Cruse*

## How the IAC Works

The numbers may surprise you.

One of the perks of being president of the International Aerobic Club (IAC) is answering e-mail from members and being asked questions about how things work within the IAC. As a result of these questions, and one IAC member who suggested this information ought to be made public, I thought this would be a good time to debunk some of the myths surrounding how the IAC runs.

Most of you know we have Trish Deimer as our manager at the headquarters in Oshkosh. She is not our only paid employee. There is also Reggie Paulk, the editor of *Sport Aerobatics*, and Phil Norton, the graphic designer who does the layout each month. In addition, we also pay for copy-editing services through EAA. These are the people who make sure the writers spell out "two" instead of using the numeral 2 and many other style items for the magazine.

IAC board members are responsible for paying their own way to board meetings and other IAC events, such as Sun 'n Fun and Oshkosh. The IAC does not reimburse the board members for meals, travel, or lodging. I am reimbursed for expenses up to \$3,000 per year, which hardly covers my expenses. The policy regarding board expenses was put into place under President Gerry Molitor when the IAC was struggling financially, and it is still in place today because the IAC cannot afford board expenses.

The IAC's yearly budget is just under \$400,000, almost half of which comes from the \$45 you pay to be a

member. This is why maintaining our membership numbers is so important. We also derive income from the Nationals and some of our programs. If the program doesn't at least break even, we have to reconsider how beneficial it is. Our treasurer, Doug Bartlett, keeps a tight rein on expenses for the club and updates the board at every board meeting. He is adamant that the IAC has a balanced budget every year and does not dip into the \$200,000 reserve.

Keeping within the budget is mandatory, and the IAC cannot add new programs without the income to support them. As an example, last year Lightspeed Aviation sponsored the regional series trophies, and as a result, every winner received a Lucite trophy. This year we currently do not have a sponsor, so the trophies will likely be paper certificates.

While the club sells \$20,000 in merchandise each year, the cost of the items and the postage to ship them leaves a profit of about \$2,500. Last year at AirVenture we started ordering smaller quantities of merchandise and varying the merchandise between Oshkosh and Sun 'n Fun to have more variety. We've also started running a merchandise ad almost every month in *Sport Aerobatics* to help boost sales. Both of these measures should help improve the bottom line on merchandise.

Our biggest expense just happens to be our biggest member benefit—*Sport Aerobatics* magazine. The magazine costs us about \$143,000 a year to produce, which includes printing, postage, Reggie, Phil, and the copy editors. Last year the IAC lost \$75,000 on the magazine alone, largely due to the fact that advertising sales came nowhere near paying for the production of the magazine.

One common myth is that EAA supports the IAC financially. The IAC maintains its own finances, separate from EAA. We are a separate corporation with a Letter of Agreement with EAA. The IAC pays

*Our biggest expense just happens to be our biggest member benefit.*

EAA for services rendered such as accounting, marketing, and membership services. The IAC also pays EAA for contest insurance, to the tune of about \$35,000 per year, through

contest sanction fees.

The general membership does not subsidize the competitors, and the competitors could not have the depth of competition without the support of the general membership. Both of these sides of the club need administrative support, and neither of them could afford it without the other. The bottom line is that every member is important to us. Thank you for your support. 🇺🇸



# NEWSBRIEFS



## 2010 Aerobatic Aircraft Poster-Calendar

**S**hare the thrill of aerobatics and decorate your hangar in style! The IAC is proud to introduce a new aerobatic calendar for 2010. Our calendar is designed and illustrated by Margo Chase, an internationally recognized graphic designer who competes in the Intermediate category. The calendar features stylized illustrations of 12 different aerobatic aircraft. Each calendar is 11" x 17", spiral bound and printed on high quality paper with dates that may be trimmed off to allow for framing and hanging as poster art. The calendars are \$24.95 each and may be ordered through the IAC online store at [http://shop.eaa.org/index\\_iac.html](http://shop.eaa.org/index_iac.html), or by calling (920) 426-5912.

## The 2009 United States National Aerobatic Championships

**N**orth Texas Regional Airport (KGYI), Sherman/Denison, Texas, Sunday, September 20–Saturday, September 26, 2008. Online registration is now open, including practice slot reservation. The online registration deadline is Friday, September 18. On-site registration opens Saturday, September 20. Technical inspectors will be awaiting pilot arrivals for instant on-site technical inspections. The contest will host competition for all categories in both power and glider classes. This is an advanced team selection year for the 2010 Advanced

World Aerobatic Championships (AWAC). Advanced pilots may optionally declare their candidacy for the U.S. Advanced team. Undergraduate students enrolled at an accredited college, junior college, or vocational program, such as an FAA-approved Airframe and Powerplant (A&P) Mechanic program, receive discounted registration in Primary, Sportsman, and Intermediate power categories, and all glider categories. Volunteers are welcome to come and help at the event. This year promises to be a great contest with new sponsorships and a new banquet facility.

## Gone West: Chandy Clanton

**O**n Friday, July 10, 36-year-old Chandy Clanton was killed when she crashed into a bean field piloting her Zivko Edge 540 during an air show training flight near Tarkio, Missouri. Chandy was a three-time member of the United States Unlimited Aerobatic Team, and leaves behind her two young sons Harrison and Drew. In addition to being type-rated in the DC-3, and Lear Jet, she spent more than 12 years on the air show circuit. In 2003, Chandy had the distinction of being the youngest female pilot at the World Championships in Lakeland, Florida. Anyone who wishes to make a donation to the Chandra Clanton Memorial Fund may do so through any branch of Union Bank & Trust, located in Lincoln, Nebraska. The family will distribute these funds among charitable organizations that were close to Chandy's heart.



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# freest







# style!

## designing your first program

*Steve Johnson, IAC 20081*

**t**here have been several articles written recently about how to fly the current IAC Known sequences, mostly for the Sportsman and Intermediate categories, because newer aerobatic pilots have a desire for additional knowledge and skills. Though there is still no substitute for good coaching from the ground to make figures and sequences look correct and score well, these articles provide valuable information about the Known sequences—which must be flown as drawn.

But what about Freestyles?



Freestyles allow the pilot the freedom to design and fly a sequence that fits his skills and airframe performance. These sequences are designed to meet the rules for required figures, including specific rolls, spins, and hammerheads, and must be flown well by the pilot to be competitive. A well-designed Freestyle will help a pilot maintain a rank in the scoring, but a poorly designed Free will send a competitive pilot to the bottom of the list. So, what is required to design and fly a good Free program? This article will assist the newer pilot in designing and flying a Freestyle program that will become a competitive sequence.

### things to avoid

The ideas and suggestions in this article can be used for any Free program, but I will start at the beginning for newer pilots designing their first Sportsman or Intermediate Free—the concepts are the same. If you have seen Joe Haycraft fly 90-percent scores in his Sportsman Freestyles, you will have seen these concepts at work at the Sportsman level. In a recent series of *Sport Aerobatics* articles (March and April 2009), Gordon Penner describes the full loop and other partial loops in the 2009 Sportsman Known, of which four are required. As Gordon states, loops are very difficult to fly well and rarely score well, so in designing a Free program keep loops, goldfish, Cuban-eights, and reverse Cuban-eights out of your sequence as much as possible. Use Family 1 lines and angles instead.

For example, a bowtie figure (Figure 1) will generally score better than the similar half-Cuban (Figure 2), even though it has a higher K value.

Similarly, try not to use full rolls, or any full four- or eight-point rolls, as repeating exactly four or eight points is difficult. If the rules require a 9.4 (four-point roll) figure, it does not mean an entire four-point roll is required. Two points of the four-point roll, or 2x4 in the new terminology, meet the requirements. Remember that the initial portion of any looping or rolling figure sets the stage, and the rest of the figure must duplicate the first portion. Eliminating these “duplicated portions” eliminates downgrades. Many first-time Freestyles, mine included, have had fancy figures such as an avalanche or full lay-down 8 because they are fun to fly, but they score horribly, so keep it simple.

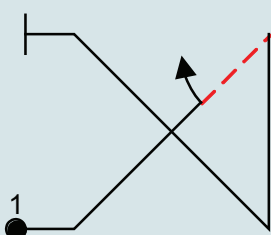


FIGURE 1: Total K = 22

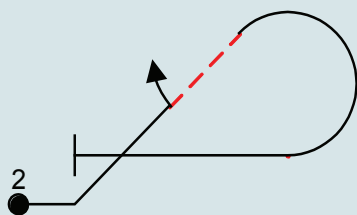


FIGURE 2: Total K = 14

*To start a Free program, always make the first figure a high-energy figure near the center of the X-axis, right in front of the judges.*

### taylor-made

Now that you know a little about what not to do, think about tailoring your program to your specific aircraft. Are you flying a fire-breathing monoplane, a high-end biplane, or something with a little less power and performance? This makes a huge difference in the style of Free program you design. Higher-performance aircraft can fly rolls on the vertical lines to increase the K as needed, while lower-performing aircraft require rolls on horizontal or 45-degree lines. This is not all bad for the lower-performing aircraft, as they have more time flying across the box than higher-speed mounts. This won't work 100 percent of the time, but it's a great place to start the initial base figures.

To start a Free program, always make the first figure a high-energy figure near the center of the X-axis, right in front of the judges. This lets you make a high-speed entry so the judges can aurally and visually acquire the aircraft. This also shows aggressiveness, which judges like. Placing the first figure near the center of the box also allows you to determine what the wind is doing in the box. It is my perception that the first two or three figures prime the mind-set of the judges about the remainder of a flight—make sure you nail these first figures. As discussed in previous articles, make Figure 1 into 1B. Figure 1A should always be your entry. I start my entry figure on the base leg just outside the edge of the box, 1,500 feet above my planned start altitude. I slow to about 80 or 90 knots, and then roll to about 135 degrees and pull the nose around to the point I picked on the opposite edge of the box, while accelerating on a 45-degree downline.

During my dive into the box, I make my three wing-wags, which signals my intent to start the sequence. Make your wing-wags distinctive. I roll 90 degrees toward the judges, pause, roll wings level still on the 45-degree downline, and repeat this two more times. Your wing-wags should look aggressive like the rest of your initial Figure 1A entry.

I accelerate, using throttle as needed, so that I reach my target altitude at  $V_{NE}$  (never exceed speed). The rules of basic geometry tell us that when flying a 45-degree downline losing 1,500 feet vertically, I will also travel about 1,500 feet laterally. Since I started just outside the box, I should now be very near the center of the box on the X-axis. A quick three-count straight line after the dive puts my first pull very near the center of the box. Winds will affect this line, as they will affect my starting point along the Y-axis, but wind-correcting is a subject for another article. I practice the entry with every flight, just as with any other figure. For newer pilots, if you don't like your start altitude, airspeed, box position, or anything else, don't start any aerobatic figures until you are comfortable. Simply turn around, climb back to altitude, and restart, complete with wing-wags. There are no penalties for not starting (though you may begin to annoy the judges if this goes on repeatedly).

As a reference point, in my Pitts S-2B I generally start Figure 1 after the entry (on a Free program at around 2,500 feet), with a climbing and descending figure such as a humpty, hammerhead, wedge, or similar maneuver. This transitions the energy gained during the entry dive to an aggressive, well-flown figure. I always try to put any vertical up-rolls in this figure, so I have the energy to make the lines and rolls look good.





*Always put the spin entry going into the wind. The stall break will appear cleaner, and the forward motion left at the stall will appear to be nil, showing a much better scoring entry.*



### classic lines

All Freestyle programs require a spin. In the Pitts, I try to put the spin early in the sequence while I am still relatively high, as the spin generally loses more altitude than any other figure in that aircraft. Always put the spin entry going into the wind. The stall break will appear cleaner, and the forward motion left at the stall will appear to be nil, showing a much better scoring entry. Downwind spin entries appear to settle, have soft breaks, and have the appearance of forced entries because of the tailwind and residual forward motion of the aircraft.

In higher-performing aircraft, 45-degree lines will use a lot of box, so be very careful with these lines, especially on downlines where the aircraft is accelerating. Never have one figure end with a descending 45 and then have another climbing 45 line, or vice versa. As a general rule, a descending 45 line requires about  $2/3$  of the box, and a climbing 45 line requires at least  $1/2$  of the box. Together, this combination of lines ( $2/3 + 1/2$ ) is larger than the total area of the box. In windy conditions, it is difficult to determine when to pull for half-Cuban-eights or reverse half-Cuban-eights. If you pull too early on the upwind line for a half-Cuban-eight, the 45 downline will be rushed, especially if there are multiple or opposite rolls on the line. It would be better to fly a wedge or shark's tooth figure so the pull or push to vertical can be made right at the edge of the box. Higher-performing aircraft can have a difficult time keeping 45 lines in the box, so it is best to eliminate them if at all possible. Alan Cassidy of Great Britain designed a nice Advanced Free for the 2006 Advanced World Aerobatic Championship with no 45 lines at all. He did have several pushes, but he had no issues with the edges of the box, even with a wind blowing.

Remember that all Free programs require at least one figure from Family 7: Loops & Eights and one from Family 8: Combination of Lines and Angles & Loops. These families include the figures we are trying to avoid, but they also include other figures that meet the rules and will make the Free program fly better. Still, you may need to have one of the "less desirable" figures in your Free. Keep in mind aircraft that move more slowly across the box can get away with 45 lines, but it is better to start a half-Cuban on a downwind leg, and a reverse half-Cuban into the wind so that the 45 lines are into the wind, and don't use so much of the box. Make sure the figure after a half-Cuban is an end-box looping or vertical maneuver, so the 45 line does not have to be hurried. Similarly, keep point rolls or opposite rolls in mind, and ensure they are flown into the wind whenever possible, so that the aircraft moves less distance across the box during these figures.

### more is better

Use the maximum number of figures allowed for the Free program in your category. By maximizing the number of figures, the total K of each figure will be lower, and thus less damaging if flown poorly. Think of it as spreading the risk around, so no one figure is a “make or break” figure. I like to use a cross-box figure every four or five figures, so I will have two separate chances for better box placement in a 12- or 15-figure Freestyle. In the long run, each aerobatic pilot should learn to place his airplane in the box, where he needs it for the next line of figures. Having the cross-box figures in the sequence makes this much easier and reduces pilot workload. Cross-box figures typically come in pairs, so the flight axis can be returned to the X-axis. Don’t put looping figures on the Y-axis because they won’t look round and won’t score well. If you want, use a P-loop with a quarter-roll as a cross-box figure. Just be sure the looping portion is on the X-axis, so it will score better—if you fly it well.

I like to try to “balance” my sequences. For example, if I put a looping figure at one end, I try to put a looping figure at the other end, and the same concept goes for vertical lines. I use no center-box figures except the initial figure. This used to be known as a California Freestyle, but more pilots are using this style across the country.

The total K for each Free program is determined by the rule book. Make your Free meet the exact maximum K allowed for your category. If the total K for your Free program is lower than allowed, you will never reach the maximum points or percentage available, which is how competitions are scored. There is an IAC rule for a Free Point, which allows a free program to have 1 K over the allowable maximum. This 1 K is deducted from the highest K figure in the program, to reduce the total K to the maximum allowed. Other ideas to consider are changing a half-roll to a 2x4 to add K, or change the 2x4 to a half-roll to reduce K value. Additionally, quarter-rolls can be changed to 2x8 and vice versa to add or reduce K value by 1 point if needed. Most of the time, changing the rolls as discussed above will make the sequence have the proper K value. If not, a base figure may need to be changed, but don’t worry about it; it will come together. Sometimes leaving and coming back to the sequence gives a new perspective.

### wrapping up

Lastly, Intermediate pilots appear to be worried about the snap-roll required in their Freestyle program. You need to decide at what airspeed the snap should be done, and then set the figure or two before that so the required airspeed is met. The traditional three-figure sequence is an Immelmann, then a snap, and then a split-S. This violates the “no center figures” rule, and does not allow you much time to set the snap speed or split-S speed. Typically, after the Immelmann, you must accelerate aggressively to get to snap speed and then decelerate hard for the split-S. A better decision might be to fly a wedge with a 45 downline, keeping in mind the earlier caveats about 45 lines. Then the snap can be flown at the proper airspeed with no rushing into the next figure. Another idea might be a one-and-a-half-snap or a half-roll and full-snap at the top of an Immelmann. Both of these figures allow you to worry only about the snap, without hurrying the complete figure.

## final points ■ ■ ■

- **Make the box entry and wing-wag the first figure, and make it aggressive.**
- **Spin entries should be early, high, and into the wind.**
- **No full, 3/4, or 5/8 looping figures if possible; use lines and angles instead.**
- **Reduce 45-degree lines as much as possible, and never have two 45 lines together.**
- **Make point or opposite rolls into the wind.**

**Good luck designing and flying your first winning Free program!**

These are the techniques I have found that work. The type of airframe you fly and the figures you are comfortable with will establish the basic style of your Free program. After you draw the Free on paper, practice it to determine if the sequence can be flown safely and in the box without losing too much altitude. Then, get some coaching from the ground for flow and presentation. If your coach is happy, you are all set. Don’t worry if you decide to make small changes during the season. I nearly always do, and then I have a Free program that is good for a few years until the next rule change. 🍀




Modern Competition

# Aileron Roll

Technique





*By Ben Freelove with photos by Ron Sellers*

**I**n competition aerobatics all aileron rolls are deemed “slow” rolls. Every competitor knows that the term slow has nothing to do with the actual roll rate being used—it simply describes the style of roll being flown. The goal with any slow roll is to rotate the aircraft perfectly about its longitudinal axis, maintaining the original line of flight throughout. The technique to accomplish a perfect slow roll is well-documented in many aerobatic texts, particularly with regard to lower-performance aerobatic aircraft. What is rarely discussed is the difference in technique when a slow roll is performed at high rates of roll in modern aerobatic machines. To avoid confusion about roll rate, I’m going to refer to the maneuver as the competition aileron roll, and not the traditional slow roll. The following technique will work well in any modern monoplane and even at most airspeeds in a stock Pitts.





Ben Freelove joined the Tutima Academy Team to continue his dream of flying aerobatics. He is a serious aerobatic competitor flying in the Advanced category. Ben flies the Tutima Extra 300L for the Collaborators shown here demonstrating the aileron roll.

### AILERON - ALL OF IT!

Although the competition aileron roll criteria do not address how much aileron (and therefore roll rate) is to be used, there are some powerful arguments for using full deflection in most competition rolls. Using full aileron provides for maximum rate of roll, which shortens the time spent in the roll and therefore decreases the ease at which anomalies can be observed by the judges. It also ensures that, unless a large airspeed change occurs during the roll (which is less likely if the duration is short), the rate will remain the same throughout. Some exceptions do exist. For example, during an eight-point roll, depending on roll rate available and the amount the stick needs to be moved, you won't have enough time to get the stick to the stop and back before each 45 degrees of roll is completed. Also, while performing certain vertical rolls, the change in airspeed while ascending may initially require less than full aileron to match the available rates while flying slower higher on the line.

Using full aileron also provides a key piece of control feedback: the aileron stop. Using the hard metal stop to apply pressure against will dramatically improve your awareness of precise elevator placement. This becomes very important while perfecting vertical rolls.

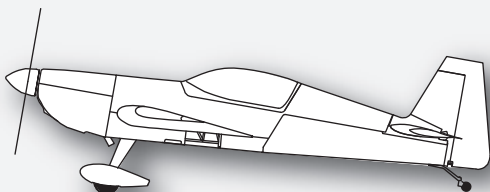
### FAST HANDS

A commonly held myth is that for maximum roll rate, you want to smoothly apply the ailerons, accelerating the rate of deflection as you go. This is believed to keep the ailerons from stalling or "acting like spoilers." I have done some research into aileron setup and technique and, using tufting on the wings and ailerons, have seen no evidence to support this theory. My research incorporated a lot of video analysis measuring roll rates. I found moving the ailerons quickly (full deflection in less than 0.2 seconds) could improve the roll response by 50 percent or more, which equals about a 20 percent increase in the roll rate within the first 360 degrees. There is also no noticeable increase in the adverse yaw produced by rapid deflections.

If any weirdness or stalling is felt in the stick with fast aileron application, it is usually caused by the inside wing stalling due to yaw being present during the roll (incorrect rudder use) or the ailerons "bumping" due to aerodynamic balancing/aileron setup.

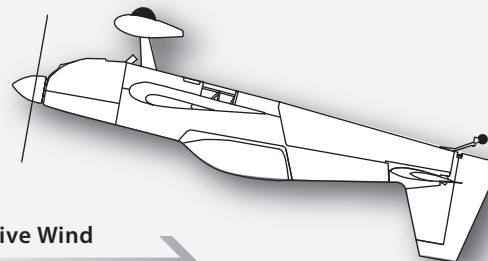
**FIGURE 1: 360 degree/second roll about the longitudinal axis**

Starting Attitude



Relative Wind  
+5 Degree AoA

1/2 Second Later - Neutral Elevator



Relative Wind  
-5 Degree AoA

Fast hands are also a benefit when it comes to stopping the roll. The faster you move the stick to neutral, the more "crisp" the stop of the roll. With the fast roll rates of modern aerobatic aircraft, these effects are nearly impossible to detect by the pilot flying the roll. An astute judge or video replay may be required to determine if you really have a clean, hard start and stop. When I first transitioned into the Extra, every roll I flew seemed incredibly crisp and fast to me, until I got comments about the roll slightly easing to a stop. Video replay showed my hands moving much slower than I thought, resulting in a weak stop, despite my perception otherwise. It seems you can always make your rolls start and stop a little faster. You just need to develop as much speed on the controls as possible without sacrificing precision and clean technique.

**Tip:** In learning maximum rate rolls, do not focus on stopping wings-level every time. Focus on stopping the roll fast, crisp, and clean. The timing required to stop the wings at a precise bank angle will come with practice. Developing the correct muscle memory without a habit of bobbling is very important. To quote my coach Bill Stein, "It's not where you stop; it's how you stop!"

*Video replay showed my hands moving much slower than I thought, resulting in a weak stop . . .*

#### ELEVATOR

The single largest difference in technique when rolling fast is that the elevator should remain in the neutral position throughout the roll. Some people prefer to unload the stick to neutral and then roll. I prefer to move the elevator to neutral while I'm deflecting the ailerons. Either way works fine. Once in the neutral position, the elevator will not move until after the roll is stopped. Then, it should quickly move to whatever position is required to hold the line.

The aerodynamic reason this works is that when an aircraft rolls rapidly, it rolls around its longitudinal body



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axis. If the airplane has a symmetrical wing, let's say it's flying at a positive 5 degrees angle of attack (AOA), and you roll it quickly to inverted, the wing will now be at a negative 5 degrees AOA and producing the same amount of lift inverted as it did upright. (See figure 1.) As long as you continue the roll and do not remain inverted, no elevator adjustment is needed to hold that position. You can prove this to yourself by flying a level, maximum rate roll using nothing but the ailerons. You will feel yourself hang from the belts momentarily as you pass through inverted, and if you reset the *g* meter before you start, you'll see roughly +1/-1 when you're finished.

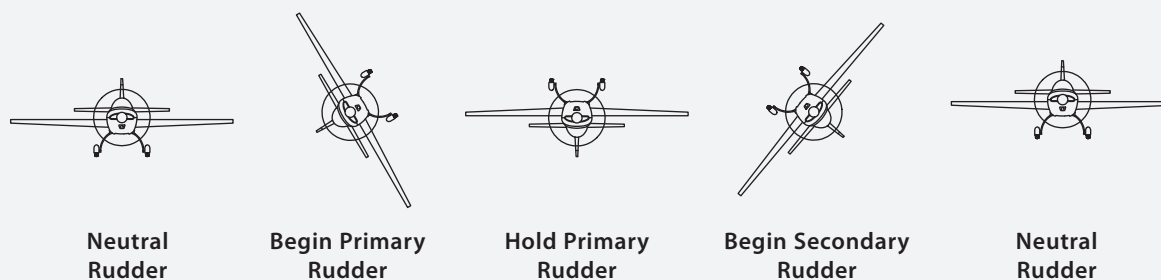
It may take some time to find where the best "neutral" position is, and this will also depend on the trim setting (I recommend zero *g* trim), but once you develop the needed muscle memory, not having to adjust the elevator simplifies the roll immensely.

## RUDDER

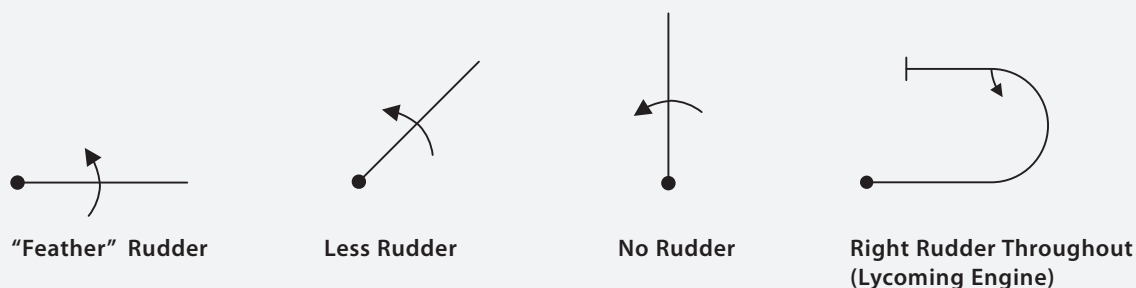
Rudder use when rolling fast is slightly different than when rolling slowly. The basic function becomes less about holding the nose up against gravity while knife-edge, and more about counteracting adverse yaw and yaw damping. Do not worry about applying same-direction rudder at the beginning of your rolls. The short amount of time it is required can be imperceptible, and any uncorrected adverse yaw will simply help to hold the nose up through the first 90 degrees. Because we are rolling quickly, the airplane has little time to begin descending while knife-edge, and you will not need to apply any top (primary) rudder until past the 90-degree point. Once the roll proceeds toward inverted and the wing begins to experience a negative angle of attack, the initial rudder input is now functioning to oppose adverse yaw and will need to stay in until 30-45 degrees past inverted. At this point the rudder is reversed (secondary rudder) and held

**FIGURE 2: Approximate rudder timing for high rate competition roll**

NOTE: All rudder usage smooth and blended.



**FIGURE 3: Amount of rudder during aileron rolls on various lines**



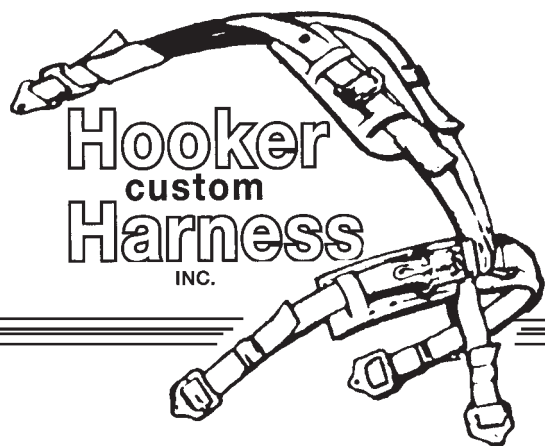
until the roll stops or, in the case of multiple rolls, until 30-45 degrees past wings level. (See figure 2.)

These rudder inputs are usually quite small and smooth (just think about “feathering” the pedals) and will be proportional to the amount of loading on the line. For example, a level roll needs the most rudder, a 45-degree line roll needs less rudder, and a vertical roll needs none. Using the same logic, rolls at the top of loops will need less rudder since the airplane still carries some upward ballistic energy. The amount of rudder required is also inversely proportional to the rate of roll available. Slower roll rates will require more manipulation with the rudder. Rolls done at very slow airspeeds will require a constant rudder correction to oppose the slipstream effect. In a Lycoming-powered aircraft, the amount of right rudder

required to cancel out the slipstream becomes the zero sideslip, or new “neutral” rudder. (See figure 3.)

You can judge whether or not you are using the correct amount of rudder by using the *g* meter. Too much primary rudder at the first knife-edge and the meter will read more than -1*g*. If too much secondary rudder is used, the *g* meter will show greater than +1*g*.

The above technical information is a complex explanation for a maneuver that, with practice, should be easy and require no thought to execute. Primary focus should be on the quick use of the ailerons to start and stop and on neutral elevator throughout. Rudder use will need to be practiced until completely smooth and instinctive. Remember to enjoy the learning process and fly high! 🛩️



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# Rudder Trouble

A broken linkage almost ruins the day





*Aaron McCartan*

My instructor once gave  
a word of caution that  
sounded more like a  
witticism than a truism.

He said that bad things  
always seem to occur when  
the nose of your airplane is  
pointed toward Earth.

I later discovered he was  
absolutely correct . . .





I had a delayed start to the 2008 aerobatic season. In early April I found myself in the wrong place at the wrong time and was hit by an unconscious oncoming motorist. The injuries I sustained left a bleak outlook for any future aerobatic activities. After three months' recovery time, I was left with a few words of caution from the doctors and permission to resume normal activities, including aerobatic flight. In July I resumed practice and devised a plan for the remainder of the season. I decided to attend as many contests as possible to make up for lost time earlier in the season. My first event of the season was also my first contest in the Sportsman category. I flew the Doug Yost Challenge without any major issues to speak of. Two weeks later, I made the trek to Kansas with the intention of competing in the Harold Neumann Barnstormer contest.

The flights were going well at the "Barnstormer" contest. I had flown the practice, Known, and Free flights without any indication of trouble. During the third flight of the Sportsman category, I experienced a mechanical failure at the worst possible moment. Prior to the flight, I performed a preflight inspection just as I always do. I spent a few minutes warming up the engine, performed a run-up, and departed for the hold. Like the previous flights, I entered the box and began flying the sequence with no indication of trouble. For the record, I was flying the 2008 Sportsman compulsory sequence for all three flights.

I executed the first three figures without a hitch. I entered figure 4, the 1-1/2 rotation spin, with left rudder. I reached my heading to initiate opposite rudder and started a brisk application of right rudder just as I've done so many times before. As the right rudder pedal approached the stop, I was greeted with a horrific snapping sound and the accompanying sound of a tension-loaded cable going slack. My right foot proceeded to lose feedback, and the right rudder cable lightly slapped against my leg in the



Photos courtesy Aaron McCann

The airplane was unceremoniously towed from the runway after landing.

cockpit. The right rudder cable had broken away from the pedal during a left rudder spin. At this point, the pedal spring on the left rudder pedal took over and applied a burst of *left* rudder while I strongly desired right rudder to stop the spin. In an instinctive reaction, my right foot repeatedly kicked at the non-responsive pedal hoping for some sort of response.

This is a situation where all of that expensive aerobatic training pays for itself. When I began pursuing aerobatic dual with John Morrissey in his Pitts S-2A, one of the early lessons was spin recovery. We had practiced flattening a spin with out-spin aileron. Conversely, as an emergency measure, it was drilled that in-spin aileron could be used to arrest a runaway spin or assist in recovery if the opposing rudder is not effective. John was quick to point out that if the airplane is turning left (left rudder upright spin) and you panic, your instinct is to roll right to stop the turn. This action will only aggravate the maneuver. Hence, he makes a point in the lesson to teach the effects of aileron during spins.

Meanwhile, back in the cockpit, I had a chance to prove this lesson in my own airplane. The spin had started decelerating when the cable detached from the pedal; however, with a slight amount of left rudder, the airplane wasn't going to stop rotating. I abruptly applied

in-spin aileron (left). Wow, it actually worked! My spin should have exited to the south, but by the time aileron was removed, I was closer to an eastbound exit. I was later told that this particular spin was scored very poorly by all of the judges. In a panic, I keyed the microphone and yelled, "I just broke a rudder cable!" At this point I was transitioning from a dive into a gradual climb and gently adding throttle. Due to the aircraft's limited yaw control, I established a climb with approximately half throttle.

Someone broke the silence on the box frequency and asked who radioed distress. I have since spoken with Bob Buckley, who was the chief judge for Sportsman at this event, and he did not hear this call on the ground. At this point the aircraft was beginning a semi-controlled climb, so I made a second call on the radio saying that it was me, I was in the box, and I had lost rudder control stopping the spin.

Bob Buckley's voice broke the silence: "Handle it, dude!" Bob ran up the judging line and found a Pitts guy who could potentially assist in coaching me and dropped a handheld radio in his lap.

I was able to pass the stick to my left hand and wrap the rudder cable around my right hand to sustain yaw control. I was starting to look around for a spot to ditch the airplane when the voice of John Morrissey came across the radio. He calmly asked what my plan was and



*I was greeted  
with a horrific  
snapping sound...*



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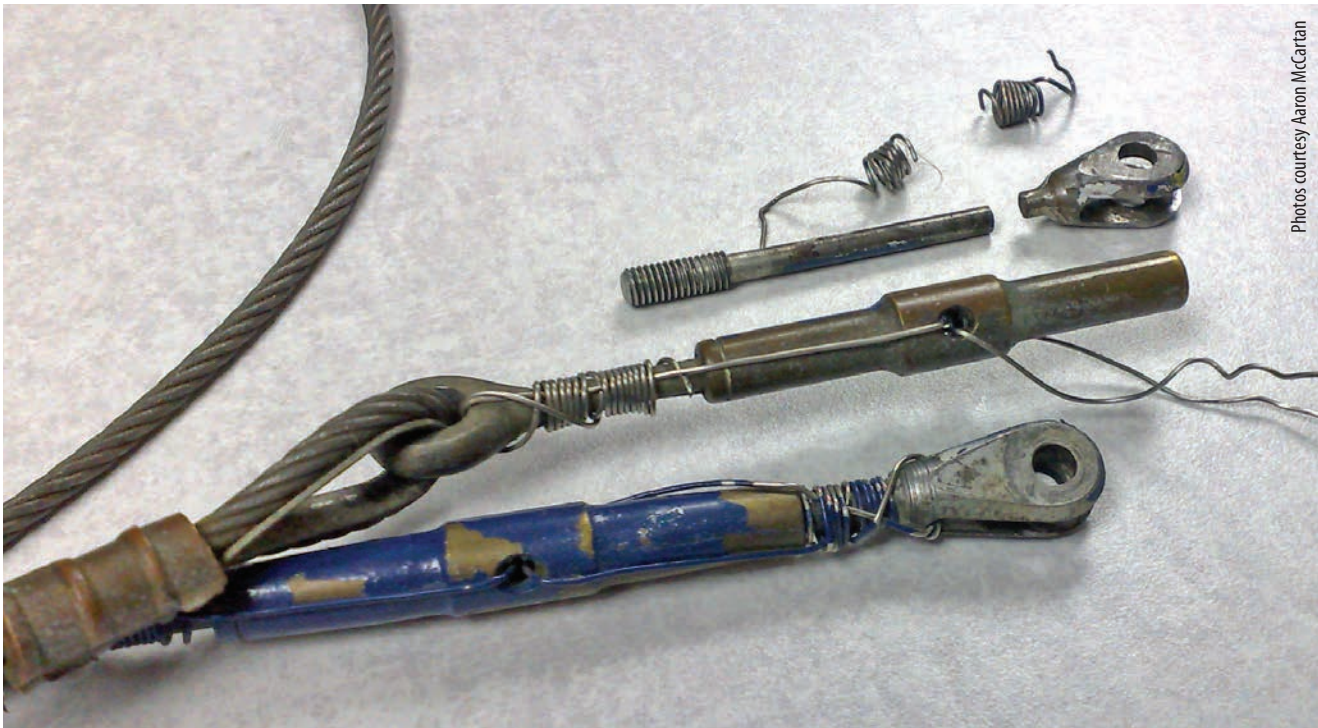


*The right rudder cable had broken away from the pedal...*

started to help me analyze the severity of the problem. We discussed the possibility of landing the aircraft and several potential outcomes. I continued to climb and leveled at 5,500 feet above ground level, making gradual left and right turns in a quasi-hold pattern a short distance from the airport. After a crash crew was positioned mid-field I was called in to try a landing. Having a few minutes of flight time and completing several circles with my new rudder control scheme afforded me the ability to learn proper yaw coordination using a hand for right rudder instead of a foot.

For all the Pitts pilots out there, you know how blind these little airplanes are when trying to make a straight-in approach. Due to the aircraft's limited control, John recommended that I forgo the turning approach and shoot straight in. With the elevator trimmed for neutral at around 100 mph indicated and being extra high, I was able to make some minor pitch oscillations to gain view of the runway over the nose and verify runway alignment. Luckily we were operating off a 7,300 by 150 foot wide runway with parallel taxiways. Landing and rollout actually worked out surprisingly well given the situation. To my surprise, I was able to keep the aircraft on the centerline and roll to a stop with nothing more than minor corrections.

You may be wondering what actually broke. My experimental Pitts had turnbuckle assemblies on each rudder pedal as adjustments. The fork on the right rudder turnbuckle was the culprit here. Looking at the part in person, you could see that the shaft was cracked and had been partially failed for some time. On close inspection, there is a tiny amount of shiny metal directly through the center of the shaft. The shaft leading up to the fork had been hanging on by a very thin margin for a good while. One may argue that this component of the rudder linkage was not necessary or that it was not of adequate diameter to



Photos courtesy Aaron McCartan

Safety wire covered the broken turnbuckle (top), making it nearly impossible to detect during preflight.





Aaron McCartan's training and quick thinking, along with solid advice on the ground, led to a positive outcome.

support the duty that it served. The orientation of the most forward cable fair-leads also placed a small side-load on the turnbuckle assemblies. This makes for a destructive combination.

You may be asking why this failure wasn't detected. I do have large Lexan inspection windows by the rudder pedals, and I do use them during preflight inspections. Unfortunately for me, the failure point was hidden under the safety wire that wraps the turnbuckle, making detection impossible.

What about the turnbuckle on the left side? That's a good question! After surviving this little adventure I decided not to leave things to chance. I requested that the mechanic replace everything on both left and right rudder linkages. He did one better and opted for new cables with forks attached using a swaging tool and not even messing with the turnbuckles. I am perfectly content having fewer potential points of failure. The adjustment isn't really necessary for my airplane.


I don't know that all of my actions were necessarily the best course of action, but in the end everything turned out just fine. Several key points are worthy of mention.

An extra gallon or two in the tank is worth the weight penalty. During

preflight I was okay for a quick aerobatic flight, but I added 2 gallons in case of a delay in the hold. This certainly came in handy while trying to sort out the controls.

There is no substitute for a thorough preflight. While my failure was arguably impossible to detect, how many accidents could have been prevented by giving the entire airframe a good preflight inspection?

In the event of a problem, *climb*. If you have a broken control linkage, experience a fuel leak, or suspect fire, try to get altitude and figure it out. If you try to force a landing and things get worse, it may not end so well. It's easy to descend if everything is fine. It's far safer to use your parachute if you've got extra altitude.

Try not to lose your head in a panic. If you do have a problem and you are not sure what to do, refer to my previous point. When I lost the turnbuckle and got the airplane climbing, my first instinct was to jump out. After hearing John's voice on the radio (he was calm and collected), I was able to settle down, reattach my head to my shoulders, and get back to flying. The extra gas from the first point and the extra altitude margin from the third point will give you time to get your head straight. 

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# Inverted Flight

*It just could save your life*





*Gordon Penner, NAFI MCFI-Aerobatic, FAA Gold Seal Instructor*

**I**nverted flight is something that engenders a love/hate relationship in many pilots. Understandably so, it sure is an uncomfortable way to fly. For those who compete, sustained inverted flight is part of even the Primary and Sportsman categories. It must be practiced over and over. For many who fly aerobatics recreationally, however, negative *g* flight is practiced and flown less and less as their initial aerobatics training program fades into the past. I would like to suggest, even for non-aerobatic pilots, that negative *g* flight has a demonstrated ability to save lives if things go wrong. That's enough for me to consider it a skill that should be maintained.



By negatively loaded flight, I mean any time that maneuvering the aircraft forces blood to the head instead of the feet, or any time the *g* meter moves into the minus numbers. There is rarely a time when a competition flier does not have to practice negative *g* flight to get ready for a contest. Conversely, recreational fliers can go for years and not do negatively loaded flight, which requires quite a bit of forward stick. Even though they do maneuvers where they get inverted, some amount of positive *g* is usually maintained. They just don't need to push into negative *g* territory. They do often perform the half-Cuban-eight, but in my observation many pilots begin the half-roll immediately after the looping portion is complete, avoiding the negatively loaded portion of the maneuver.

To be fair, some airplanes cannot do negative *g* flight because they are not built for it. Some are not equipped with inverted fuel or oil systems. For safety, however, a pilot should still train for emergencies requiring negative *g*'s for recovery, even if another type of airplane, or even instructor, must be temporarily procured. The experiences of two famous pilots, Sammy Mason and Eric Muller, are highlighted below to show the value of maintaining inverted flight skills to the point that they become automatic.

Sammy Mason was a Lockheed test pilot and an aerobatic instructor working for Tex Rankin during World War II, in the Stearman. He was also an air show pilot in the Hollywood Hawks air shows in an orange-and-white checkerboarded 450-hp Stearman named *Checkers*. Eric Muller was a Swiss aerobatic champion and the winner of many national and European titles. He is also recognized as the originator of the Beggs / Muller spin recovery method.

Sammy Mason and his boss, famous Lockheed test and race pilot Tony LaVier, were in a company V-tail Bonanza traveling from the L.A. basin to the airport in Palmdale, California, in the high desert by Edwards Air Force Base. They were 2 miles behind a DC-4 in the pattern for landing when the DC-4 began a go-around close to the ground. The account is detailed in Mason's book, *Faith and Flight*, published in 2003 by Mason's family after his death.

Mason writes: "...Planning my approach to land short and make the first turn-off to the Lockheed Hangar, I slowed the airplane to minimum approach speed and dropped the landing gear and flaps. It was easy to exercise exacting control in the calm, smooth air. Then, about 50 feet over the ILS shack, we hit a vortex from the DC-4 and were flipped upside down!

"From my years of air show flying at low altitude, I reacted automatically—I simultaneously poured on full power and shoved the wheel forward to keep from diving into the ground, and applied full aileron against the roll."

Mason and LaVier got so low and blew up enough dust during the recovery that people initially thought they crashed! Their quick reaction saved both of their lives. They climbed out inverted, then rolled upright as soon as they were clear of the ground.

Eric Muller and Annette Carson wrote *Flight Unlimited 95*, a fantastic aerobatic book that should be in every aerobatic pilot's library. In Chapter 4, titled "Preparation," they write: "If you should ever have a blocked or hampered elevator control in flight that prevents you from pulling sufficiently, always think of this possibility and half-roll to inverted, if you can, before you decide to exit by parachute. I know of at least two incidents in which, if the aircraft had been turned inverted, it



might not have been lost—because the offending object would probably have been dislodged and freed the controls. That is not at all a reproach to the pilots concerned, but there is always something to be learned from these mishaps.

*I suddenly found  
that I couldn't get  
the nose up from  
the diving attitude  
upon recovery.*

"I myself didn't manage to save my Acrostar, but I did manage to save my life when I was faced with a blockage in the backward stick travel during my air show of 1982 in Pau, in the Pyrenees region of France. Having started the display with my multi-turn flat spin, which I usually hold for forty-odd revolutions, I suddenly found that I couldn't get the nose up from the diving attitude upon recovery. There was no question of using the parachute, because the unguided aeroplane would have ploughed right into the middle of the crowd, so I was forced to think like lightning before the inevitable crash.

"What I remembered in those crucial moments were the elevator blockages I have just mentioned, with the possible solution of inverting my aeroplane, and also the famous occasion when the British aerobatic pilot Neil Williams inverted his Zlin Akrobat and made a safe landing after one wing had folded in a practice flight. I decided to do the same. But Neil had a fully functioning motor and I had cut mine on entering the spin (no starter—Ed.): so when I half-rolled the Acrostar all I had was an extremely cumbersome glider, and one that could only be controlled by the stick when it was upside-down!

"From this point until the landing I had about ten seconds in which to figure out the best method of approach in this new (to me!) kind of aircraft, so that I could half-roll smartly back, as low as possible, while keeping my wing clearance from the

ground: "like tossing a pancake", as one observer put it afterwards. It was a hard landing of about 20 G's, and the Acrostar did not survive—but I did. The cause in this case was not a loose item jamming the control, as it usually is, but from a failure of a welding joint."

Muller says another lesson learned was, "...the value of heeding intuition—as I had done that day when something made me decide, as I entered the spin, to recover 600 feet

earlier than usual. I always have a lot of respect for intuitive promptings on the side of safety, and the extra margin of altitude was a life saver."

I submit that the two above events, plus the famous Neil Williams wing-folding accident, show the value of maintaining some kind of negative -g proficiency. I suggest becoming proficient enough so that in an emergency, inputting maximum forward stick when upside-down is an automatic response. Fly safely! 🛩️



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# Calendar of Events

If hosting a contest, let the world know by posting it. For complete and up-to-date information, visit [www.IAC.org](http://www.IAC.org).

## Hill Country Hammerfest (South Central)

**Friday, August 7 - Saturday, August 8, 2009**

Practice/Registration: Thurs., August 6 - Friday, August 7

Power: Primary through Unlimited

Location: Llano Municipal (KAQO): Llano, TX

Contest Director: Andrew Wright

**Tel.:** 512.394.4396

**E-Mail:** [akwright@acm.org](mailto:akwright@acm.org)

## Beaver State Regional (Northwest)

**Friday, August 7 - Saturday, August 8, 2009**

Practice/Registration: Thursday, August 6

Rain/Weather: Sunday, August 9

Power: Primary through Unlimited

Location: Eastern Oregon Regional Airport (KPDT):

Pendleton, OR

Contest Director: Robert Harris and Robert Toppel

**Tel.:** 503.757.1247

**E-Mail:** [rboydt@comcast.net](mailto:rboydt@comcast.net)

**Website:** [www.iac77.org](http://www.iac77.org)

## Kathy Jaffe Challenge (Northeast)

**Friday, August 14 - Sunday, August 16, 2009**

Practice/Registration: Thurs., August 13 - Fri., August 14

Power: Primary through Unlimited

Location: Flying W (N14): Lumberton, NJ

Contest Director: Ron Chadwick

**Tel.:** 732.865.1610

**E-Mail:** [bubbaron@comcast.net](mailto:bubbaron@comcast.net)

**Website:** [www.iac52.org](http://www.iac52.org)

## Aspen Leaf Acro Challenge (South Central)

**Saturday, August 15 - Sunday, August 16, 2009**

Practice/Registration: Friday, Aug. 14 - Saturday, Aug. 15

Gliders Categories: Sportsman Intermediate

Power: Primary through Unlimited

Location: Sterling (KSTK): Sterling, CO

Region: South Central

Contest Director: Bob Freeman

**Tel.:** 303.709.6465 • **E-Mail:** [bfree.man@comcast.net](mailto:bfree.man@comcast.net)

**Website:** [www.iac12.org](http://www.iac12.org)

## Doug Yost Challenge (Mid-America)

**Saturday, August 15 - Sunday, August 16, 2009**

Practice/Registration: Friday, August 14

Power: Primary through Unlimited

Site: Spencer Municipal Airport (KSPW):

Spencer, IA

Contest Director: Mike Niccum

**Tel.:** 952.239.7114

**E-Mail:** [pgnic@aol.com](mailto:pgnic@aol.com)

**Website:** [www.iac78.org](http://www.iac78.org)

## Harold Neumann Barnstormer (South Central)

**Saturday, Sept. 5 - Sunday, Sept. 6, 2009**

Practice/Registration: Friday, September 4

Power: Primary through Unlimited

Location: New Century AirCenter (IXD): Olathe, KS

Contest Director: Brenda Lea

**Tel.:** 913.908.3362 • **E-Mail:** [info@iac15.org](mailto:info@iac15.org)

**Website:** [www.iac15.org](http://www.iac15.org)

## Illinois State Aerobatic Open (Mid-America)

**Saturday, Sept. 5 - Sunday, Sept. 6, 2009**

Practice/Registration: Friday, September 4

Rain/Weather: Sunday, September 6

Power: Primary through Unlimited

Location: \* (\*): Airport location to be determined, Illinois

Contest Director: Jim Klick

**Tel.:** 815.609.7165 • **E-Mail:** [jimklick@sbcglobal.net](mailto:jimklick@sbcglobal.net)

**Website:** [www.iacchapter1.com](http://www.iacchapter1.com)

## Rebel Regional Aerobatic Contest (Southeast)

**Friday, Sept. 11 - Saturday, Sept. 12, 2009**

Practice/Registration: Thursday, September 10

Power: Primary through Unlimited

Location: Everett-Stewart Regional Airport (UCY):

Union City, TN

Contest Director: Mike Rinker

**Tel.:** 731.796.0849 • **E-Mail:** [mdr@vaughnelectric.com](mailto:mdr@vaughnelectric.com)

## East Coast Aerobatic Contest (Northeast)

**Saturday, Sept. 19 - Sunday, Sept. 20, 2009**

Practice/Registration: Friday, September 18

Power: Primary through Unlimited

Location: Warrenton-Fauquier (KHWY): Midland, VA

Contest Director: Scott Francis

**Tel.:** 703.618.4132 • **E-Mail:** [s.franis@ieee.org](mailto:s.franis@ieee.org)

**Website:** [www.iac11.org](http://www.iac11.org)

## U. S. National Aerobatic Championships (US Nationals)

**Sunday, Sept. 20 - Friday, Sept. 25, 2009**

Practice/Registration: Saturday, Sept. 19 - Sunday, Sept. 20

Rain/Weather: Saturday, September 26

Glider Categories: Sportsman through Unlimited

Power: Primary through Unlimited

Location: North Texas Regional Airport (KGYI):

Sherman/Denison, TX

Contest Director: Chris Rudd

**Tel.:** 850.766.3756 • **E-Mail:** [akrudd@gmail.com](mailto:akrudd@gmail.com)

**Website:** [www.usnationalaerobatics.org](http://www.usnationalaerobatics.org)

## 2009 Mason-Dixon Clash (Northeast)

**Friday, October 9 - Sunday, October 11, 2009**

Practice/Registration: Thurs., October 8 - Fri., October 9

Rain/Weather: Friday, October 9

Power: Primary through Unlimited

Location: Farmville Regional Airport (KFVX): Farmville, VA

Contest Director: Michael Davis

**Tel.:** 434.251.9467 • **E-Mail:** [Michael.Davis@areva.com](mailto:Michael.Davis@areva.com)

**Website:** [www.iac19.org](http://www.iac19.org)

## Rocky Mountain Invitational (South Central)

**Saturday, October 10 - Sunday, October 11, 2009**

Practice/Registration: Friday, October 9

Gliders Categories: Sportsman Intermediate

Power: Primary through Unlimited

Location: Lamar Municipal Airport (KLAA): Lamar, CO

Contest Director: Jamie S. Treat

**Tel.:** 303.648.0130 • **E-Mail:** [JamieTreat@Q.com](mailto:JamieTreat@Q.com)

**Website:** [www.iac5.org](http://www.iac5.org)

## Borrego Akrofest (Southwest)

**Friday, October 16 - Saturday, October 17, 2009**

Practice/Registration: Thursday, October 15

Rain/Weather: Sunday, October 18

Power: Primary through Unlimited

Location: Borrego Valley Airport (L08):

Borrego Springs, CA

Contest Director: Gray Brandt

**Tel.:** 970.948.0816 • **E-Mail:** [graybrandt@yahoo.com](mailto:graybrandt@yahoo.com)

**Website:** [www.iac36.org](http://www.iac36.org)



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*Allen Silver*

## Ask Allen

A master rigger answers your questions about parachutes.

By Allen Silver, IAC 431160

**Q:** How do I hook my personal locator beacon or my survival kit to my parachute?

**A:** In the past few months I've seen a disturbing trend; people are attaching their SPOT locator beacons or the survival/locator beacon kit that I manufacture to their harnesses in the wrong areas. Never attach anything to your harness without consulting your parachute rigger.

If an emergency arose and required the use of your parachute, this could very easily lead to a malfunction during deployment. Don't make a bad day worse by attaching your locator beacon to an area of your harness that could prevent your parachute from deploying properly. You should *never* attach anything in the shoulder area. The risers (see photo 1) must not be restricted from fully deploying. Photo 1 shows the riser (the webbing that holds the suspension lines of your parachute) and a kit attached incorrectly over the riser and the riser cover (see photo 2). Hopefully, it would break free during deployment and the riser cover would be able to open, releasing the riser and allowing your chute to fully deploy. Of course, if it does break the plastic ties, you've lost your survival kit/locator beacon, but at least you're alive. I'm fairly certain that in this scenario the riser would not be able to spread apart properly as shown in photo 1. This would more than likely put the parachute (and you) into an unrecoverable spin that could cause serious injury or worse.

The next example shows a SPOT Satellite Personal Tracker (see photo 3) that came into my shop attached directly to the riser cover that runs over the top of your shoulder. The area it covered (see photo 4 where I'm pointing) must be able to spread apart like in photo 1. This was another potential accident waiting to happen. Each of you can help. If you see anyone with locator beacons,

survival kits, rifles, or the kitchen sink attached in the shoulder area of his or her parachute, explain the dangers and tell that person to contact his or her parachute rigger. Don't use the chute until it's been checked.

The use of personal locator beacons or my SMAK Pak survival kit (with or without a locator beacon inside) can add to your safety, but you *must* have them installed properly. Don't get creative here and think you're saving a buck by installing it yourself. Most parachute riggers will probably assist you for free. After all, we want to collect our bottle of spirits for a job well done if you ever have to use your parachute in an emergency. To collect that bottle you first must survive. 🍷





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things don't always go  
according to plan!**



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