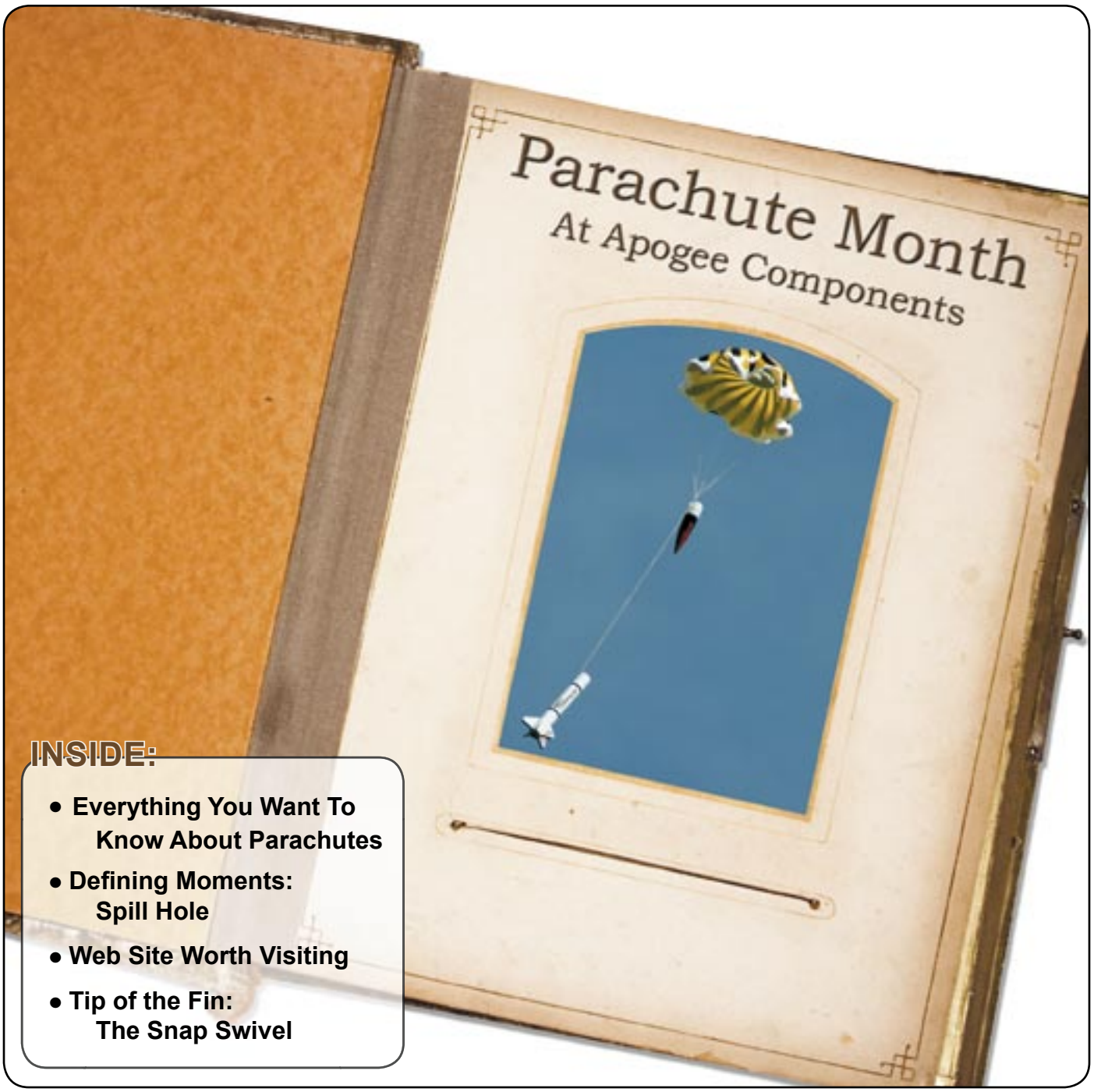
ISSUE 184 - May 22, 2007

APOGEE PEAK OF FLIGHT NEWSLETTER



INSIDE:

- Everything You Want To Know About Parachutes
- Defining Moments: Spill Hole
- Web Site Worth Visiting
- Tip of the Fin: The Snap Swivel

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It's Parachute Month at Apogee!

By Dave Virga

I hope you've all noticed this month's special offer by now. If you buy the DynaStar Rising Star, you can get a 24-inch nylon parachute thrown in for just a buck! Go to http://www.ApogeeRockets.com/may_special.asp to order. In keeping with this month's theme at Apogee, I'll be discussing a few aspects of parachutes – the most common and also the most problematic – form of recovery.

The rocket's recovery system is the most important part of the entire vehicle. It doesn't matter how big or small the rocket is, what size motor you're using, how many fins of what material, or whether you gave it an acrylic, lacquer, enamel or crayon finish. If it doesn't return safely, all else was for naught.

Let's Review the Basics

The parachute's job is to slow the rocket to an acceptable descent rate so that it lands without damage. The descent must be stable; the rocket should not swing back and forth under the parachute, as any lateral motion can also cause damage upon landing. The parachute must be as lightweight as possible, but it must also be strong enough to withstand the forces it will encounter when deployed.

Parachutes are made out of two basic types of material – plastic sheet or nylon cloth. There are trade-offs between size, strength, bulk and mass; large, strong nylon parachutes are heavy and bulky, whereas small, lightweight plastic parachutes are very compact but also weak in comparison. For each rocket flight, you must weigh the size requirement (for proper descent rate) against the available storage space in the rocket. For example, you may have to use a more lightweight parachute in order to fit the proper size in the given space, but you may risk overstress damage during deployment.

Since a pyrotechnic charge is used to deploy the parachute, some means must be used to protect it from being damaged by the hot ejection gases. Two of the more common methods are the use of wadding (either flame-retardant sheets or shredded cellulose) or reusable heat resistant cloth sheets. You may also choose to use a piston system, which provides a more solid boundary between the hot gases and the parachute. Whichever method you choose, you must employ it properly. If you use too little wadding, you could melt your parachute. If you use too much, you could cause a blockage that prevents it from deploying. If your piston isn't properly sized or cleaned, it could bind. Needless to say, any of these situations could easily ruin your rocket's day.

So, there are many considerations when preparing your rocket's recovery system. Your job is to find the happy medium between all of them that will result in a successful deployment and gentle landing. After all, it is rocket science!

How Small is Big Enough?

So how do you determine the correct parachute size for your rocket? RockSim, of course! But first, you must decide on an acceptable descent rate for your rocket. If it's built out of surplus Sherman Tank parts, it can probably withstand a landing speed of 30 feet per second or more. But since we typically don't overbuild to that

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About this Newsletter
You can subscribe to receive this e-zine FREE at the Apogee Components web site (www.ApogeeRockets.com), or by sending an e-mail to: ezine@apogeerockets.com with "SUBSCRIBE" as the subject line of the message.

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extreme, we need a more reasonable number. A quick way to estimate a good descent rate is to envision dropping your rocket from a pre-determined height. Would you expect your rocket to survive a drop from say, two feet? How about three feet? Four or more feet? Here's a table of descent rates for given drop heights:

Drop Height (Feet)	Descent Rate (Ft/Sec)
2	11.3
3	14
4	16
5	18
6	19.6

Now, we can go to RockSim. Shown in Figure 1 is the RockSim Parachute Editor, with data for the DynaStar Rising Star and the supplied 32-inch plastic parachute.

We see that this combination produces a descent

Figure 1

rate of 9.8 Ft/Sec – quite gentle. Let's say that we want to increase the descent rate to that of a three foot drop – 14 Ft/Sec. To do so, select the Outer diameter slider control, and adjust it until the Descent rate value comes close to the desired value. You'll find that the Rising Star achieves a 14 Ft/Sec descent rate with a 22.75-inch parachute.

The Best of Both Worlds

So now you know how large of a parachute you need to ensure your rocket's safe return. Due to motor size and storage space constraints, you also know that you can't simply grab that super-duty bullet-proof heavy nylon parachute. You need one that is strong but lightweight. So you find one that will do the trick, such as one of Apogee's nylon parachutes (www.ApogeeRockets.com/parachutes.asp). What's the best way to pack the parachute to ensure a successful deployment, especially if available space is at a premium? The answer is with efficient folding. Follow along as I fold the Apogee 58-inch nylon parachute so that it will fit comfortably into an 8 inch length of BT70 body tube. You probably will never need to pack this large of a chute in this small of a rocket, but I'll show you that it can be done.

You Gotta Know How To Fold 'Em...

First, carefully fold the parachute in half so that you have four pairs of shroud lines. For this fold, as well as each subsequent one, be as careful and exact as you can.

Figure 2

Fold in half a second time, creating two quads of shroud lines, and then a third time, creating a single group of eight lines and a triangle shape. Lay the shroud lines out on the middle third of the parachute, with the attachment point extending out about two inches.

Continued on page 4

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Figure 3

Fold one of the outside thirds over onto the middle third, and then the other, creating a narrow spike. Then use a triple fan fold to reduce the parachute to one quarter of its radius.

Figure 4

Finally, roll the parachute into a cylinder shape and insert it into the rocket. There you have it!

The main rule here is neatness. You will never get an efficient fit or a reliable deployment if you simply wad the parachute and try to stuff it in. In summary, here are the general steps for folding any parachute:

- Work slowly, carefully and neatly
- Fold the parachute until you have one bunch of shroud lines
- Lay out the shroud lines and fold the sides in to encase them

Figure 5

- Fan fold the parachute to reduce it to the desired length
- Tightly roll the parachute, and make sure it fits loosely in its compartment.

Be sure to check out the other features in this issue for more parachute related info!

About The Author

Dave Virga holds a Bachelor's degree in Computer Science, and is an Information Technology Specialist for the Department of Defense. A typical Born Again Rocketeer, he enjoyed building and flying rockets through high school, then set the hobby aside for college, career and family. He re-discovered rocketry in the late '90s, and has become a voracious student, teacher and practitioner of rocket science. In past lives, he has been a naval submarine officer, computer systems engineer, ski instructor and Scout leader. A trombonist since elementary school, he will also on occasion sit in with his wife's early music ensemble when a bit of sackbut is needed. He lives in Black Forest, Colorado with his wife, son, dogs and parakeets.

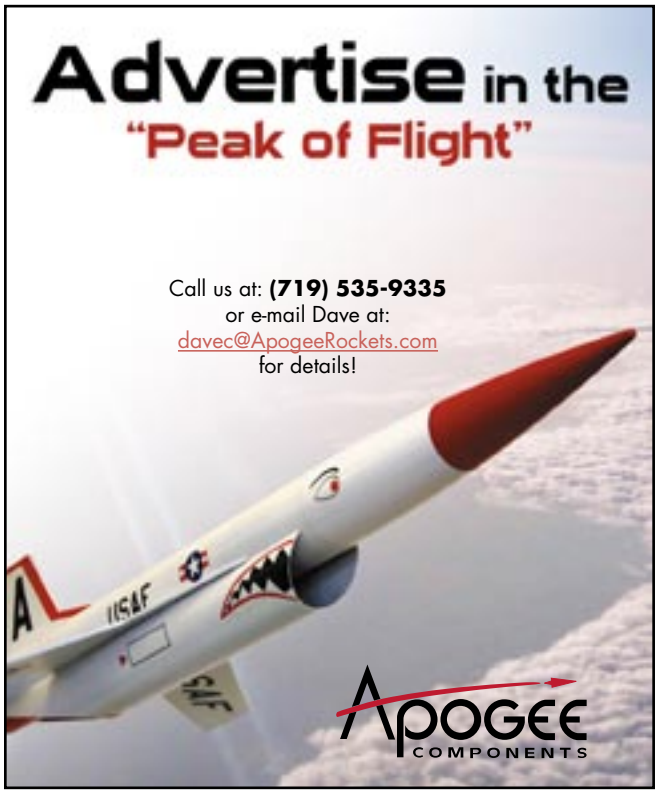
QUESTION & ANSWER

Keegan recently wrote and asked, *"What do I use for parachute reinforcement rings, how long do I make the parachute lines, and what do I make them out of (is string ok?), and finally is there any special way of packing the chute?"*

A very well-timed set of questions, Keegan! See this issue's feature article for a discussion on recovery system considerations and chute packing steps.

To reinforce the shroud line attachment point, visit your local office supply store and grab a box of binder hole reinforcement labels (see photo); they typically come in a box of 200. Apply one at each attachment point, poke a small hole in the middle, and tie the shroud line through it. They're super-strong, yet lightweight; I've never had one fail.

For shroud lines, you can use most any strong thread or light string, such as carpet thread. Try to stick with cotton or Kevlar® threads; polyester threads can be melted by hot ejection charge gases. See the Apogee shock cord selections at http://www.apogeerockets.com/construction_supplies.asp#shock_cord for a couple of excellent options. Each line should be as long as the parachute's diameter, so if you make shroud line loops, each loop should be twice the chute's diameter in length, plus an inch or two for the attachment knots.



Apogee Components, Inc. is pleased to announce the second annual grant program geared toward model rocketry education organizations!

Apogee Grant Program

The rules are simple:

1. Entrants must submit an essay to Apogee. There is no length requirement for the essay.
2. Any club, organization, or school program, is eligible for entry. This would include rocketry clubs or prefectures, 4H, scouts, etc.
3. The content and purpose of the essay is as follows:
   - If we gave you $300.00, How would you use it to impact the rocketry community?
   - How many people do you think it will reach?
   - How many people will be involved in the organizing and running of the event?
   - How big of an effect will it have on the rocketry community?
4. One of the biggest things to keep in mind when composing your essay is **"How is what I am planning unique?"**

There will be only one winner of the grant, which is $300.00 towards any order with Apogee Components.

The deadline for entry is November 30, 2007.

Make sure it is post-marked by November 30th!

The grant winner will be announced on January 1, 2008.

What a great way to start off the new year!

Send to:

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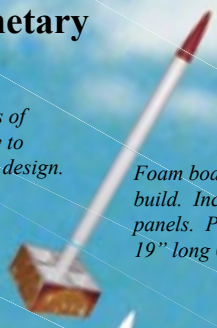
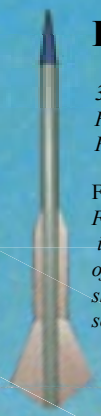


Box Racer

Foam board fins for a different build. Includes pre-printed side panels. Plastic nose cone. 19" long 0.976 dia.

Space Speedster

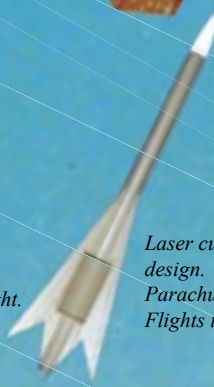
Printed body with foam board fins. Preprinted fins. Laser cut foam mounting rings.



Flechette

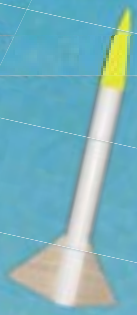
3 fins 6 piece laser cut balsa. Flights to 1000'/ 300m. Parachute recovery.

Flechette: *The word flechette is French for "dart." In military use, it is a projectile having the form of a small metal dart: a sharp-pointed tip and a tail with several vanes to stabilize it during flight.*



Explorer

Laser cut 4 fin with distinctive design. 21" long 0.976" dia Parachute recovery. Flights to 750'/ 250m

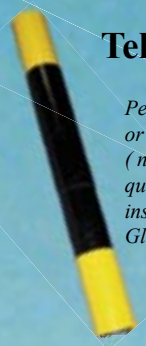


Bug Me Not!

Great beginner's rocket. Laser cut fins. Streamer recovery. 0.976" dia 11" long.

Lightning Fury

Simple to build. Laser cut fins. Streamer recovery. 0.796" dia, 21" long



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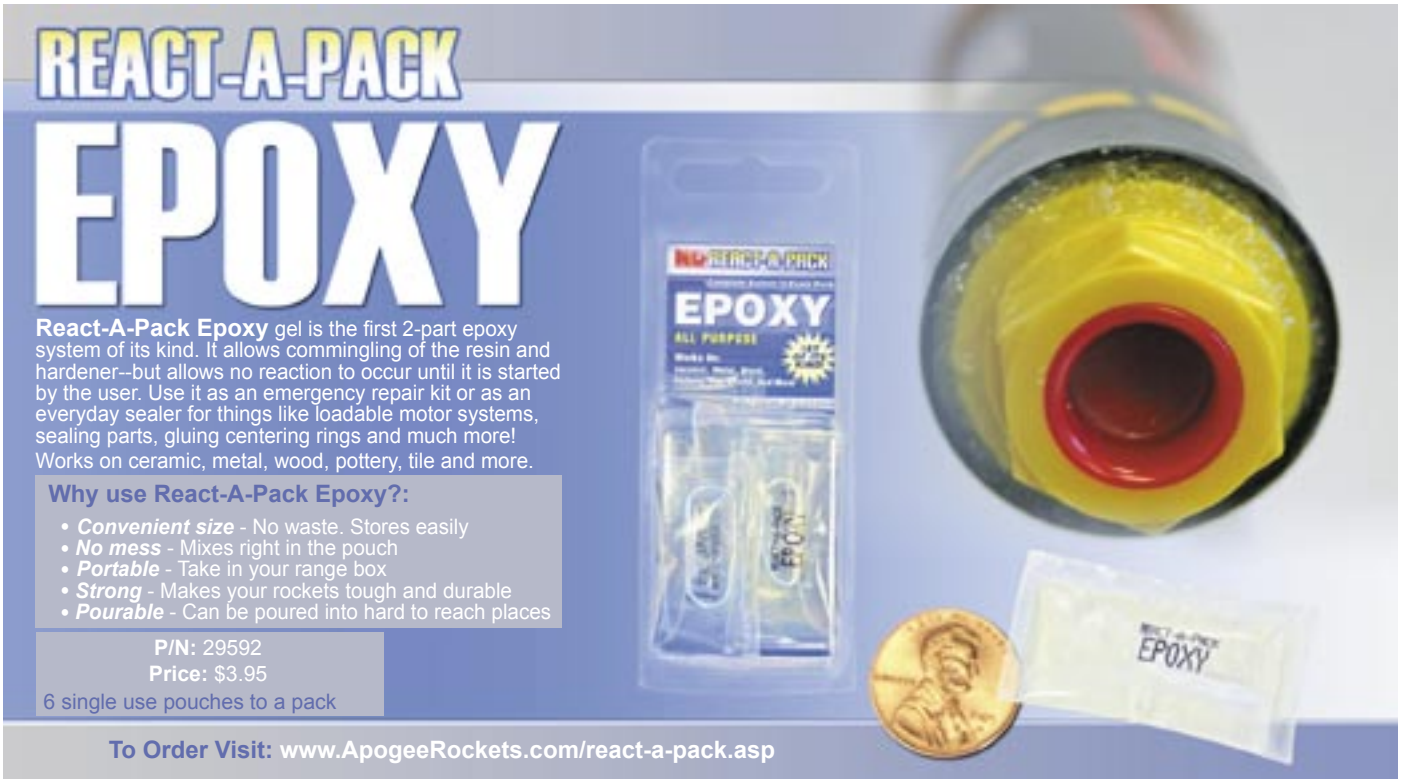
TIP OF THE FIN

Take a close look at the parachute pictures in this issue's feature article. Did you notice the gizmo that's on the end of the shroud lines? This is a snap swivel (used on fishing lines). Every parachute needs one of these! Simply attach the shroud lines to the closed loop of the swivel, and use the snap end to attach and detach the chute.

The most obvious advantage to using snap swivels is that you can quickly and easily move a chute from one rocket to another. But that's just the beginning of their usefulness. The best way to store parachutes is outside of the rocket, hanging open; snap swivels allow you to easily remove them for this purpose. Have you ever noticed a rocket descending under a half-open chute because the shroud lines are badly twisted? Snap swivels help to solve this problem too. And how many times have you had to cut the lines on a tangled chute because you couldn't straighten them out? Snap swivels are the answer again.

So the next time you're perusing fishing supplies, grab a few packs in various sizes, as shown in this picture. Size 14 are good for small (12-inches or less) chutes. Size 10 swivels are good for medium sized chutes (18-24 inches) with thread shroud lines. Use size 5 swivels for medium and large chutes with light string or cord shrouds. Also, look for the interlock style that have the hook on the end of the snap; they won't pull through under heavy load.



Wanted: Rocket Plans & Articles!

$100 if we print them in this newsletter.

Email us for details at: davec@ApogeeRockets.com

Web Site Worth Visiting

Rocketry and astronomy seem to share a fairly common enthusiast base; many rocketeers enjoy a bit of star gazing on occasion. And it makes sense; rockets provide the only means to get things off of our planet and into space, so it's natural that rocketeers would have an interest in the many wonders of our universe.

The Astronomy Picture of the Day (APOD) is my favorite place to go for fantastic imagery of celestial objects. Its archive dates back to 1995, when the site was first established. Each day's article is well-written, and loaded with links to related information. The topics frequently highlight current events, such as comets, supernovae, etc. And the pictures are, well, out of this world! Check it out for yourself at http://antwrp.gsfc.nasa.gov/apod/astropix.html.

DEFINING MOMENTS

A Spill Hole is an opening in a parachute canopy that allows air to escape. Typically, spill holes are located at the apex, and are between 10% and 30% of the parachute's diameter.

The purpose of the spill hole is to provide a controlled release of the air trapped in the parachute's canopy. Many times you will see a parachute and its rocket spinning or oscillating back and forth. These motions are caused by imbalances in the canopy – usually unequal shroud line lengths – that allow air to spill out unevenly around the edges. Any such undesired motion of the parachute could cause damage to the attached rocket, either through a faster descent rate or non-vertical motion (swinging) at touchdown. By allowing air to exit the canopy from the top, the undesired forces are not generated around the edges.

A spill hole will reduce the efficiency of a well-balanced parachute, so you need to compensate by increasing the size of the parachute for a given rocket if you choose to use one. In most cases though, you will see an improved descent rate because the loss of efficiency due to the spill hole is less than the inefficiencies of the chute's imbalances. RockSim's Parachute Editor even knows how to accommodate spill holes, so you can experiment with different parachute sizes and spill hole sizes to achieve the desired descent rate.