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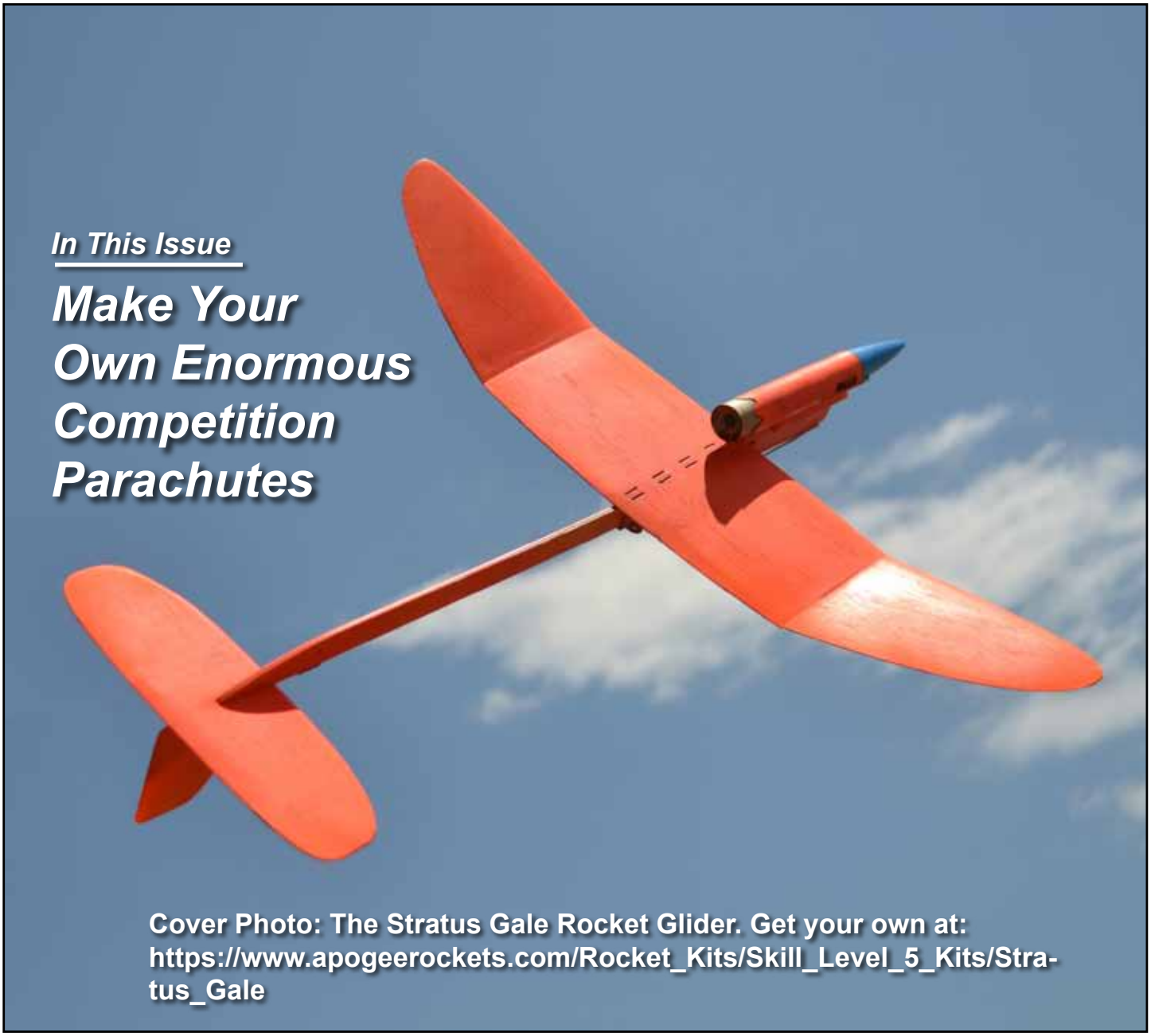
PEAK OF FLIGHT

NEWSLETTER



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Cover Photo: The Stratus Gale Rocket Glider. Get your own at: https://www.apogeerockets.com/Rocket_Kits/Skill_Level_5_Kits/Stratus_Gale

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Make Your Own Enormous Competition Parachutes

By Tim Van Milligan

Nearly every rocketry competition has as one of its events a parachute duration challenge. The object of the parachute duration event is simple: keep your rocket in the air as long as possible using a parachute as the recovery device.

There are two basic strategies in this event. The first is to use a small and lightweight rocket that is designed to kick the rocket as high into the sky as possible. The higher the rocket flies, the longer distance it has to travel to get back to the ground. The rocket in this case is minimum diameter, meaning that the main tube is also the engine mount tube. So if you were flying 1/4A engines, the diameter of the rocket would be 13mm (an Estes BT-5 type tube).

The disadvantage of this first strategy is that your rocket is limited in space and therefore can't contain a big parachute.

The second strategy is to use a larger parachute, which necessitates a larger diameter body tube. The intent of this strategy is to reduce the decent rate of the rocket by having a larger parachute canopy.

Canopy Material

Regardless of which strategy you choose, you still want to use a parachute that is large and lightweight. That is the common variable in parachute duration.

Essentially, you desire a parachute that has a thin canopy material, because it will be smaller when folded up and stowed in the rocket. This typically rules out cloth parachutes, because the thinnest cloth is thicker than a plastic parachute.

But not all plastic is desirable. Typically, the standard model rocket parachute is 1-mil (0.001 inches) thick. As you know from experience, they can be stiff to fold, especially in colder weather.

The holy grail of material is 1/4-mil (0.00025 inch) thick aluminized mylar. Besides being thin and very flexible, its silver coating is highly visible and can be seen a long distance away becuase light is reflected off of it.

However, it is difficult to find, and can be as expensive as a cloth parachute.

I've pretty much used every type of plastic that I could find, including high-strength garbage bags and dry-cleaners bags.

Among the best free material that I've found is the produce bags you get from the grocery store. These are very thin and easy to come by. The limiting factor on these bags is their size. They aren't typically large enough to make a big parachute. The largest ones I've found are from Walmart. I've used them to make parachutes as large as 18 inches in diameter. They also make great sheeting material for Rogallo wing gliders (see: https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_59).

To make larger parachutes, you need larger bags, or assemble one from several smaller bags.

A couple of years ago, I was browsing through one of those Dollar Tree stores and came across some of the thinnest and cheapest garbage bags I've ever seen (http://www.dollartree.com/Food-Snacks-Drinks/paper-plastic/trash-bags/30-ct-Fresh-Scented-Tall-Kitchen-Bags/). For a single dollar, you get 28 tall kitchen trash bags. I don't know

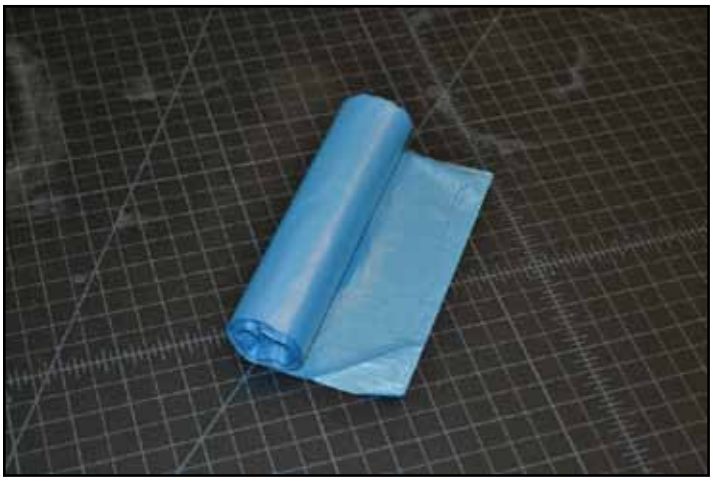

Photo 1: A roll of 28 ultra-thin trash bag liners can be purchased for a dollar.

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if I'd ever use them in my kitchen, because they are so thin that they don't have much puncture resistance. But they make GREAT competition parachutes. The price is right, especially if you consider that the objective is to thermal away the rocket and lose them on every launch.

The only downside these bags have is that they don't have the metallic silver color that gives them extra visibilty. So you'll have to color them with some permanent markers.

The bags, when cut open and laid flat, have a size of 29 inches by 47-7/8 inches. So the largest chute you can get out of a single bag is 29 inches in diameter.

What I want to show you in this article is how to make an even bigger parachute out of them by splicing two sheets together. Where would you need such a big chute? One place is for F.A.I. competition (international events). In the S6 event, you'd probably need a chute at least 36 inches in diameter.

The strategy is to splice the sheets together by fusing the plastic with a hot iron. The combined width of two sheets means you can make a chute that is almost 48 inches in diameter! This is far bigger than you'll probably ever need.

Photo 2: The bags are so lightweight, that it is easiest to get them to lay flat by gently blowing air over them to work out the folds.

Step 1: Laying the bag flat

Laying the bags flat is trickier than it sounds. They are so thin that they shift around very easy. When you pull on one corner, the whole bag moves.

What I've found is that if you hold down two corners, you can gently blow air across the plastic to work out the fold and any air bubbles trapped under the surface (see Photo 2).

Photo 3: Align the edge of the second sheet of plastic.

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Step 2: Align the edges of the second sheet

Laying the second sheet of plastic down isn't too difficult if you remember that the objective at this point is only to get the one edge perfectly flat. There can be air bubbles and folds on 90% of the surface, as long as the one side where the plastic will be fused together is perfectly flat and smooth (See Photo 3).

Step 3: Seal the plastic together with an iron

This is the hardest step, and you may want to practice many times on scrap plastic before you commit to sealing large sheets. It can be frustrating if you put a lot of work into sealing, and end up with melted plastic, or plastic that doesn't fuse together.

As you can see in Photo 4, I use a monocote iron, which you can find at a hobby store or web site that sells RC airplane supplies. You will have to play with the heat settings to get the right seal. Generally, I start with the lowest heat setting because the plastic is so thin that it hardly takes any heat to cause it to melt.

Photo 4: Sealing the plastic together using the iron.

The process that I use is to lay a straight edge about 1/2 inch from the edge of the sheets. The sheets are never perfectly straight, so you have a little bit of scrap that you'll cut off later.

I don't slide the iron along the plastic. I pick it up and press it down in short sections, using the straight edge as a guide. The plastic is so thin that sliding it along can easily get it to catch on the plastic and shift it around.

If you look closely in Photo 4, the iron is tilted, and only its edge is in contact with the plastic. I just want a thin amount of plastic sealed. Ideally, it would be about a 1/16 inch wide strip of sealed plastic along the length of the plastic.

Step 5: Trim off the excess plastic

At this point, the straight edge has to be carefully lifted and shifted over about 1/32 inch so that the excess plastic can be trimmed off. Because the plastic moves around so easily, this is a little harder than it sounds. Do it slowly to avoid moving the plastic. The object is to keep the sealed

Photo 5: Cutting the plastic. Hold down the corner to prevent the plastic from shifting.

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edge in a perfectly straight line so you can cut it easily. Cutting should be done with a fresh (brand new) hobby knife. A dull knife will grab the plastic because it is so wispy.

When you cut, don't try to get right to the edge of the sealed line. Leave a little bit of the sealed plastic along the edge. While this will leave a seam that hangs off the parachute's canopy, it will add to the strength of the sealed line. And you don't want your chute to split wide open when it pops open during the flight.

Photo 6: Carefully remove the excess plastic.

Step 6: Remove the excess plastic

Work slowly when pulling away the excess plastic. The material is so thin that it can be hard to cut. I seal using a woodend table instead of a plastic cutting mat. I don't want to accidently fuse the plastic to the cutting mat. But the canopy is hard to lay straight, so I don't move it onto a cutting mat to trim off the excess. So I'm cutting directly against the wood table. Because of this, there are little sections of the plastic that don't cut all the way through. So as you're lifting away the excess plastic, you'll find yourself coming back with a knife to snip through those little points in the plastic that weren't cut through easily.

Step 7: Cut out the canopy shape

In Photo 7, you'll see that I use a large cardboard template as a guide for cutting out the canopy. My template is made from a scrap cardboard, and I draw the circle using a pen connected to a string. While the circle created this way isn't perfect, it is good enough for this application.

And actually, you only need one half of the circle. If the plastic is still folded in half, you can lay the circle template along the sealed edge, and cut through two layers of plastic at the same time. If you notice in Photo 7, only half of the circle template is on the canopy, because it is still folded in

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Photo 7: Cutting out the circular canopy.

half.

Before cutting out the circular canopy, I do reposition the material on top of a cutting board. The ease of cutting on a real cutting board makes it worth the effort of sliding it off the wooden table top, and onto the cutting board. You can press a lot harder with the knife and you don't get nearly as many tick marks where the material isn't cut all the way through.

Step 8: Remove the excess canopy material

As before, carefully and slowly pull away the excess material after cutting out the circular canopy. Notice in Photo 8 that I've left the template on top of the plastic material, and I'm actually pressing down on it to keep it from shifting. If there are any second cuts to be made while peeling

Photo 8: Peel away the excess plastic material.

up the material, having the template in the correct position makes it easier to cut the plastic material.

Step 9: Inspect the seam for unsealed gaps

After the canopy is cut out from the folded plastic, the cutting template is removed and the plastic can be unfolded. This is the first time that I typically see how good of a job I've done sealing the edge.

The plastic is so wispy that it has to be handled gently. I typically start by separating the plastic by sliding it through two fingers, and then gently blowing air in between the sheets so fully seperate them (see Photo 9).

Once the canopy is open, I look along the seam and inspect for gaps.

Step 10: Mark any gaps with a marker

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Photo 9: Open the canopy and inspect for gaps in the seam.

Since it is difficult to seal the plastic, I invariably find small gaps in the plastic along the seam that weren't completely sealed. The most likely cause is that it was sealed properly, but that the excess was trimmed too much, and the cut line went over the edge of the sealed line.

I use a marker to indicate the extent of the line that needs to be resealed (see Photo 10). The reason is that once the plastic is folded in half to reseal the edge, it is difficult to tell where the gaps were. The marker lines make it easy to tell where the holes are in the plastic.

Step 11: Reseal any gaps in the plastic

I'll be honest. Resealing is always harder than sealing

Photo 10: Use a marker to indicate where the plastic needs to be resealed.

the first time. First of all, you have to fold the plastic back in half and try to get the sealed edge to be perfectly straight again.

As shown in Photo 11, the technique for sealing any holes is nearly identical to the approch used for making the original seam line. I warm up the iron, and use its edge to fuse the layers of plastic together.

The downside of having to reseal any holes is that it slightly deforms the canopy. It sort of gathers up a little extra material and bunches it up slightly. There is nothing you can do about that. It is more important that the hole be sealed up than the canopy being perfectly straight along

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Photo 11: Reseal the edge in the location where the holes in the canopy are located.

the seam line. This is such a huge parachute that the slight deformity isn't going to make much difference.

Step 12: Add strings to the chute

Once the canopy is completed, the remainder of the chute assembly can be done. I personally use thin thread for the suspension lines, and attach them using those hole reinforcement rings for notebook paper. I find tying them on is stronger than just using the old-fashioned tape dots.

To mark the string location on the canopy, I simply lay it back down on the cardboard parachute cutting template. If you look closely in Photos 7 and 8, you can see I had already drawn lines on it to indicate where the strings should go.

For this size parachute, I use 12 suspension lines. The more lines you use, the more efficient the canopy will be at trapping air. But too many will add more weight because of the extra string.

The last question that may be going through your mind is, how strong is the seam on the canopy? My experience is that it is strong enough. Ideally, you don't want any seams, as we know they will always be weaker than a uninterupted canopy. I've had a few canopies that did start to splay open during deployment. It wasn't catastrophic, and was more like a spill hole in how it affected the flight. These canopies are so huge that it doesn't take much of a thermal to lift them high into the sky and drift them away.

It should also be pointed out that this is the same technique you can use to make a hemispherical parachute. The book Model Rocet Design and Constuction (https://www.apogeerockets.com/Rocket_Books_Videos/Books/Model_Rocket_Design_And_Construction) has plans for making these types of chutes using sealed edges.

About the Author

Tim Van Milligan (a.k.a. "Mr. Rocket") is a real rocket scientist who likes helping out other rocketeers. Before he started writing articles and books about rocketry, he worked on the Delta II rocket that launched satellites into orbit. He has a B.S. in Aeronautical Engineering from Embry-Riddle Aeronautical University in Daytona Beach, Florida, and has worked toward a M.S. in Space Technology from the Florida Institute of Technology in Melbourne, Florida. Currently, he is the owner of Apogee Components (http://www.apogeerockets.com) and the curator of the rocketry education web site: http://www.apogeerockets.com/education/. He is also the author of the books: *"Model Rocket Design and Construction," "69 Simple Science Fair Projects with Model Rockets: Aeronautics"* and publisher of a FREE e-zine newsletter about model rockets.