Chute!

One of the larger expenses involved in flying big rockets is related to the recovery systems. I've also learned (the hard way) that this is a terrible place to try to be a cheapskate. If you skimp and the recovery system fails, the resulting damage will cost you many times what you could ever save in cheaper components -- and there is also the additional safety risk incurred when rockets parts come dropping out of the sky.

That isn't to say that there aren't opportunities to reduce cost. I have found that it is possible to sew your own 'parabolic cupped' parachutes that are virtually identical to the leading brand names for a fraction of the retail price.

I'll also add that my first sewing project of any kind was a 12-foot version of this chute, and it turned out fine even though I managed to sew my fingers to the parachute. Twice. I wouldn't enter it in the county fair, but it's been used in a number of recoveries and worked beautifully each time.

Size Calculation

I've written a parachute calculator (requires Excel) that will compute the right size for your parachute after you input certain parameters. I won't explain it -- it's really simple, so if you can't figure it out you have no business trying to make your own parachute.

See **ChuteCalc.xls** for the Excel parachute calculator.

Enter the rocket weight and desired descent rate, and the calculator will also give you the dimensions you need to make the pattern below. (You can also enter the size of a chute you already have of this type, and it will calculate the descent rate.)

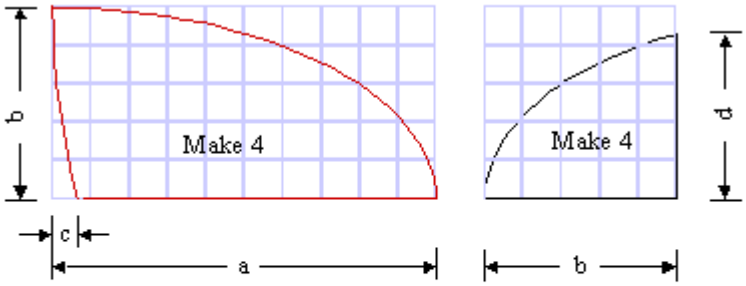
Pattern

Find a sheet of paper large enough to draw your pattern. This is larger than the dimensions indicated on the illustration.

The parachute calculator will indicate a 'grid size' -- this is the size of the squares on the pattern grid. For example, an 8' canopy will require a grid size of 4". You would draw the grid lines 4" apart. The grid is 5 squares by 10, so your pattern size will be 20" by 40".

The next part requires a careful hand and a keen eye, but it isn't difficult. Study Figure A, and mark each point where an arc crosses a grid line on your pattern grid - then connect the dots with a smoothed line.

Cut out your pattern and pin it to the parachute material.



Xf = Distance across the canopy in FEET
a = Xf × 5 (in INCHES)
b = a ÷ 2 (in INCHES)
c = Xf × 0.4 (in INCHES)
d = Xf × 2.25 (in INCHES)

Materials

Canopy

I use 1.9 oz. rip-stop nylon for the canopy. I usually buy it at Joann Fabrics, a national chain. Watch the newspapers you can often find coupon from this store for 50% to 60% off. Their coupons can also be found online at joanne.com. That really makes this a good deal. Remember when you purchase your fabric that you are making 4 of both pattern shapes. You may want to purchase contrasting colors to make the canopy more visible. (Avoid white and light blue for material colors!)

Reinforcement - Canopy Edges

The edges of the canopy need to be reinforced, both for strength and protection against unravelling. Fabric stores sell a woven nylon ribbon that works well for this purpose. (This is NOT the same as gift ribbon, by the way....) 1/2-inch ribbon is suitable for the edges of an 8-foot canopy; adjust to a narrower width for smaller chutes and wider for larger chutes. Use binding tape for the edges of really small canopies. Resist the temptation to fold over the edges to form an edge - it will deform the canopy and reduce performance.

Reinforcement - Seams

Seams can also be reinforced with woven nylon ribbon. It may not be necessary on smaller chutes, but I recommend it on bigger chutes with bigger loads. 3/4-inch to 1-inch ribbon works well because it makes it easier for those of us with questionable sewing skills to cover the seam.

Remember there is a trade-off when you add reinforcement. The more you sew onto your canopy, the heavier it gets and the larger the packed bundle becomes. If you decide not to use reinforcement, double or triple stitch each seam.

Shroud Lines.

The rope section at Home Depot stocks a product that is labelled 'Parachute Shroud Lines'. It is tough braided nylon cord, and the advertising was enough to convince me it would be suitable. I've used this on chutes up to 12-foot canopy size on a 20-pound rocket with no indication that it was overstressed. I also did some ballistic testing on this shroud line material, and I'm confident in its ability to exceed the advertised stress weight.

Camping stores sell a similar nylon cord that is slightly thinner and flatter - I like this for canopies less than 4-feet across.

There are also some varieties of 1/2-inch tubular nylon that would work well. If you really want to make your chute bulletproof, use this and sew the tubular nylon right over the top of the canopy - this would also eliminate the need to reinforce the main seams with woven nylon ribbon.

Assembly

Cut the panels out of your fabric. Leave an extra 1/2" around the pattern for all the seamed edges, but not for the external edges.

Sew the panels together as shown in Figure B. Attach the edge reinforcing nylon ribbon on seams and edges.
Cut two pieces of shroud line material per the formula in the Excel spreadsheet.

(Each length equal or greater than twice the length of the canopy width, plus one inch for each foot of canopy width. Attach each end of the 2x shroud lines to a canopy point. The length of the anchored section of shroud material should be 1/2-inch for each foot of canopy.)

Reinforce with nylon ribbon; sew around the edges of the ribbon and then over the top with a cross-stitch.
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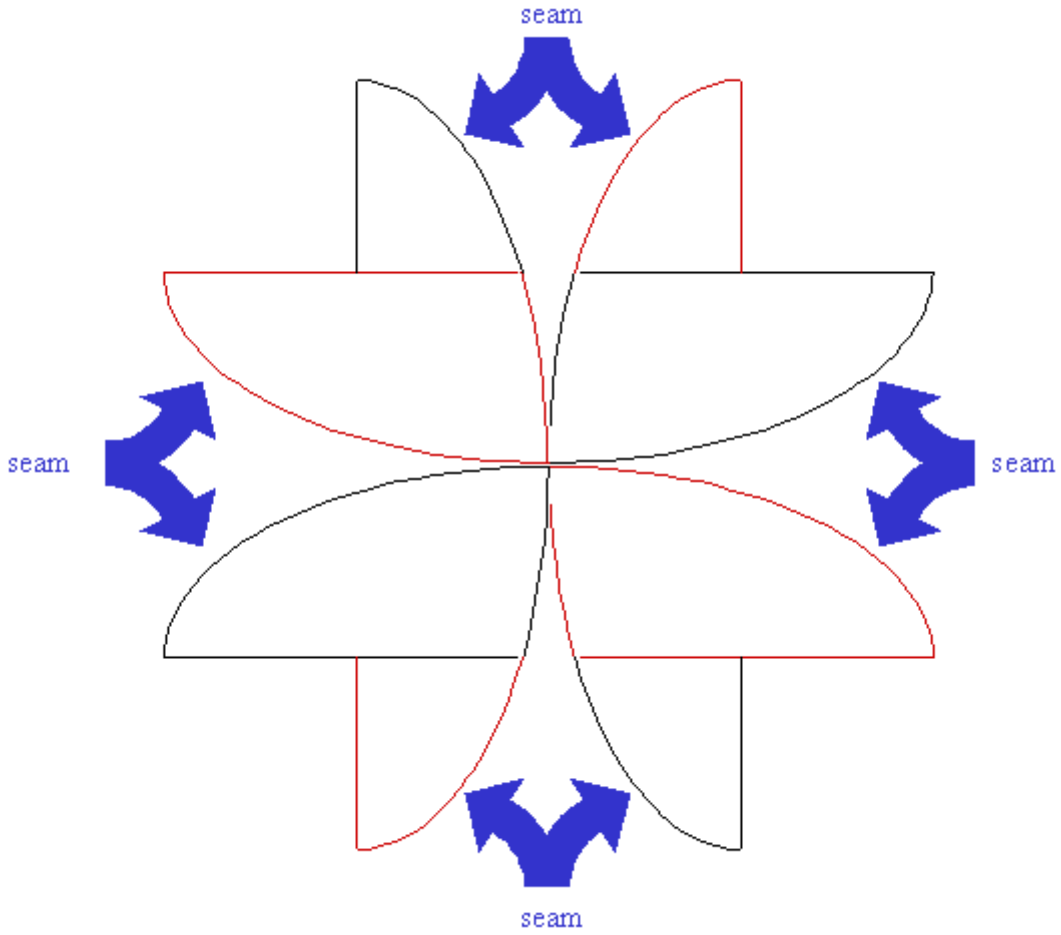

Adjusting Descent Rate

You can increase descent rate and decrease drift by shortening the shroud lines. A quick temporary method is to use a cable tie at the desired point.