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**Using Streamer Recovery
Instead of Parachutes**

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COMPONENTS

1130 Elkton Drive, Suite A
Colorado Springs, Colorado 80907 USA
www.ApogeeRockets.com email: orders@ApogeeRockets.com
phone: 719-535-9335 fax: 719-534-9050

The Art Of Using Streamer Recovery

By Tim Van Milligan

Every once in a while, I get an email from someone new to rocketry, and they ask, "What is a streamer?" I keep forgetting that this isn't a common recovery method. When most people see rocketry for the first time, the starter set has a parachute for the recovery device—not a streamer. So they don't make the connection of what a streamer is supposed to do.

The recovery device in any model rocket is the "thing" that slows the rocket so it lands on the ground nice and soft. You want to be able to use the rocket over and over, don't you? That is the purpose of the recovery device.

Parachutes are the most common recovery devices. They operate by producing a drag force that counteracts the force of gravity. The more drag, the slower the rocket descends.

Streamers work in exactly the same way. They produce drag. However, they don't produce nearly as much drag as a parachute, so the rocket will come down at a much higher rate. That is why streamers aren't used as often as parachutes—

because they work best on lightweight rockets. Otherwise, they fall a bit too fast, and you wind up with busted fins as the rocket touches down.

The most common use for streamers in rocketry is in the competition realm. There are specific rocketry events where the object is to stay in the air the longest. These are the "duration" events. One type of duration event is the "streamer" category. You specifically have to use a streamer in this competition, as a parachute would easily beat a streamer.

To have a better chance of winning a streamer contest, you try to build the model as light as possible, and use a big streamer. Makes a lot of sense, doesn't it?

When to use a Streamer?

Your next question is probably "when should I use a streamer in my model, and when should I use a parachute?"

In general:

1. Streamers are for lightweight rockets: under 30 grams of weight. A parachute would be major overkill on this size rocket. Anything over 30 grams, and the rocket will probably descend so fast that something is going to break when the model touches down.

2. If the rocket is going to go higher than 2000 feet (609 m), then a streamer might be a good choice, as the rocket will probably drift too far if there is any wind. Many high power rockets use dual-deployment techniques, where a streamer is ejected at apogee so that the rocket falls quickly and doesn't drift far. But when the rocket nears the ground (usually around 200 feet up), a parachute is deployed so the rocket gently lands on the earth.

My own personal "The rule of thumb" when it comes to descent speed is to keep the rocket in the range of 11 to 15 ft/sec (3.5 to 4.5 m/s). You'll find this listed in the designer's guidebook: "*Model Rocket Design and Construction*." http://www.apogeerockets.com/design_book.asp

What Materials To Use?

Basically, streamers can be made out of any ribbon type material. Here are some common materials: paper, cloth, plastic. Therefore, you'd select the material based on other qualities. Such as: heat/fire resistance, stiffness, visibility, color, availability, and durability.

Examples:

Crepe Paper – lightweight flame retardant paper. Easy

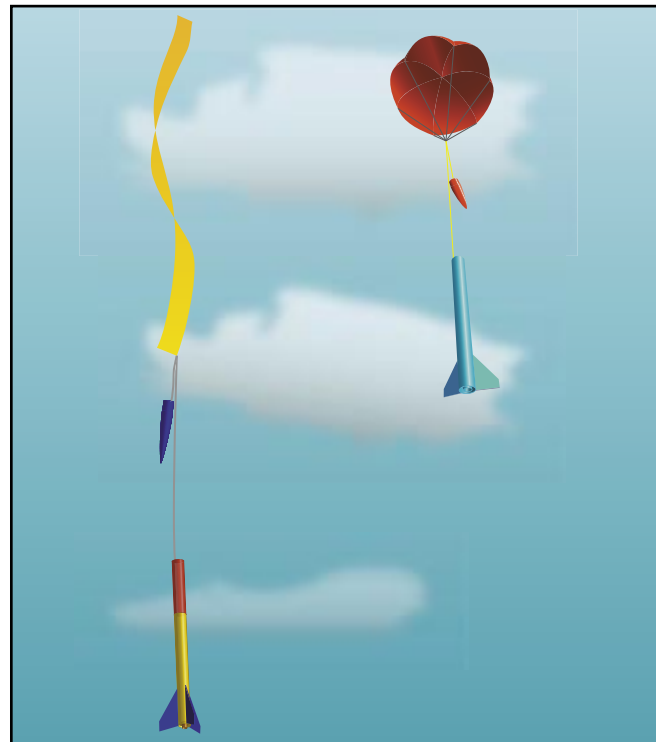


Figure 1: Streamers act like parachutes, creating drag to slow the model down for a soft landing.

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to find in stores. But tears easily.

Drafting paper – extremely lightweight and stiff. Not fire resistant. Slick surface finish.

Tyvek® Synthetic Paper – Great durability. But not fireproof and fairly heavy. Comes in white, but can be dyed or colored with markers to increase visibility.

Mylar® ribbon – Excellent visibility because it sparkles in the sunlight. It also holds creases in folds nicely.

Nylon cloth – Great durability, available in many colors. Not useful in competition, but great for high power rockets.

Nomex® Cloth – Best fireproof material. Very expensive, and very heavy.

There are always trade-offs to consider when selecting a material. I have not found a one-material fits all rockets, and I suggest some experimenting.

What Size Streamer To Use?

How do you calculate the descent speed of a rocket using

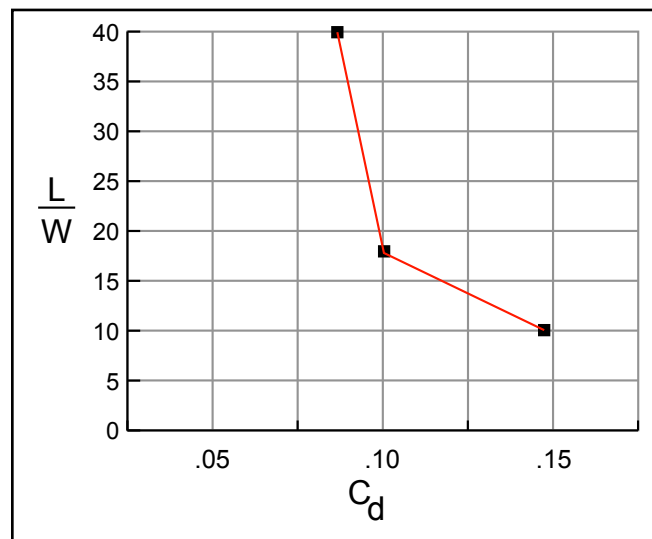


Figure 2: As the streamer gets shorter and fatter, the drag coefficient increases.

a streamer? That depends on the dimensions of the streamer, its material, the stiffness of the material, how slick/rough it is, and how it is attached to the rocket. That is a lot of different variables, isn't it?

Let's look at the size variable, as it is the one most often studied in science fair experiments. In other words, say you have two streamers of equal surface area. They differ in that one is long and narrow, while the other is short and wide.

Which would give you more drag, and thus which would fall slower?

A long while back, I did some digging into all the science fair reports that I could get my fingers on. The result is the graph shown in Figure 2.

As you can see, the shorter/wide streamers are better for slower descents, as they have higher drag coefficients. This is why NAR competitors usually go for the smallest aspect ratio (length divided by width) allowable under the contest rules.

Important note: There are many rules in competition that govern the size of the streamer. These rules do NOT apply to modelers flying just for fun. For example, your streamer does not have to have a length-to-width ratio of 5, nor does it have to be a rectangular shape. Those rules are only for competitors. Choose the size and shape that is most appealing

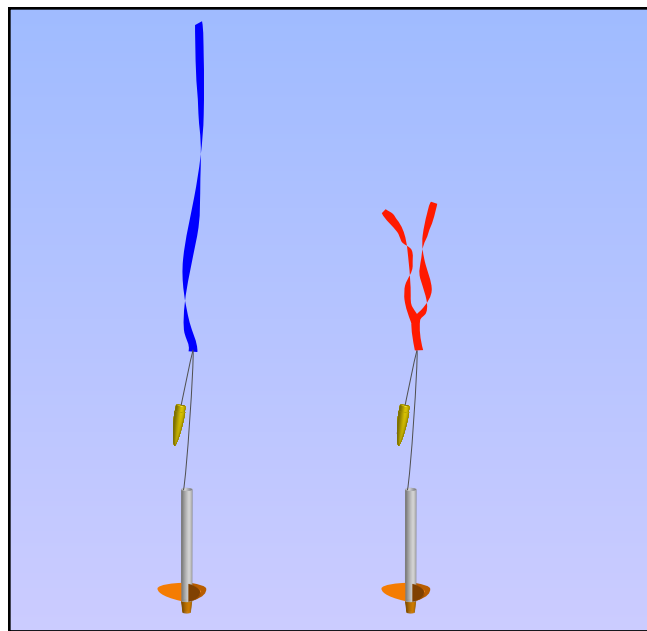


Figure 3: Which is configuration yields slower descents? Read on to find out.

to you.

But if you are not in competition, you might consider the advantage of a long streamer—visibility. Not so much the visibility of the rocket in the air, but when it lands on the ground, or in a tree. The longer streamer might be easier to see because it drapes better over the terrain.

Another question that often comes up is which is better, to attach the streamer by the end, or in the middle? See figure 3 shown above.

The evidence, from a grade-schooler's science fair

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project seems to indicate that by attaching at the middle of the streamer is a bad idea. The rocket will fall about 20% faster.

My own experience seems to show the same thing. The reason is that the two parts seems to get tangled, and don't act separately like you'd hope. Only the tips seem to perform independently of each other.

As mentioned previously, there are many other factors that determine the C_d of the streamer. The "stiffness" seems to be a major one. NAR competition modelers have shown us that a thicker streamer falls slower than a thinner one of the same material. For example, a 1 mil thick Mylar® streamer is significantly better than a 1/4 mil Mylar® streamer. However, if the material gets too thick, such as a 2 mil Mylar® streamer, the added weight negates any benefit gained from added stiffness.

Also, from a competitor's standpoint, the thicker 2-mil thick streamer is harder to stuff into a skinny body tube. They want to use a smaller tube, because they are trying to keep the weight of the model as low as possible.

The surface smoothness of the streamer is another obvious factor in how fast the streamer will fall. Competitors like aluminized (shiny) Mylar® streamers because they are stiffer-but the highly polished surface finish actually works against them. A crepe paper streamer, which has lots of bumps, has a skin friction drag that is about 25% higher than

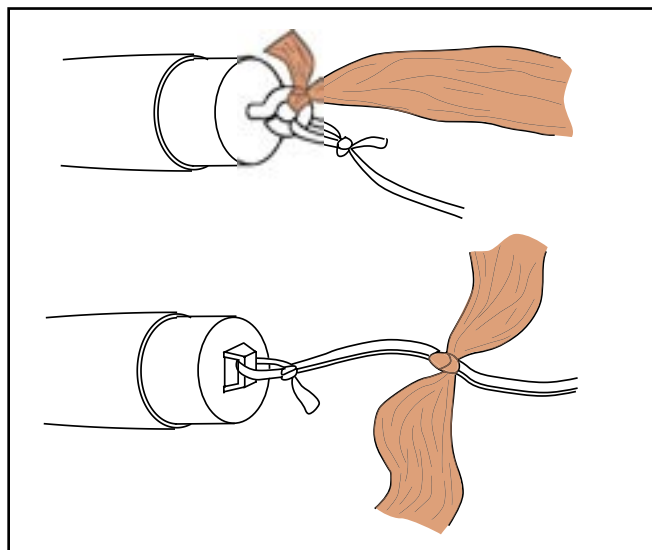


Figure 4: Tying the streamer to the rocket is the most simple attachment method.

the smooth Mylar® streamer. But you really have to weight the skin friction factor of the crepe paper against its lack of stiffness.

When considering the surface finish of streamers, a nylon cloth streamer is somewhere in middle. The "rip-stop" variety is coated with a thin layer of glaze that helps keep the fibers from fraying. It is what gives the cloth its shiny appearance. But the downside of this is that it reduces the skin friction drag.

How to attach the Streamer To The Rocket

Like everything else presented in this article, there are many options available to the builder when it comes to attaching the streamer to the model. I borrowed some figures from my design book to illustrate some of the most common methods.

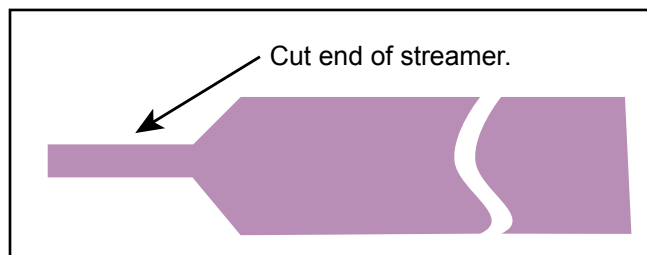


Figure 5: Cut end of the streamer to make it easier to thread into the nose cone loop.

In Figure 4, you can simply tie the streamer to the rocket. The advantage of this is simplicity and speed of construction. You can tie directly to the loop on the base of the nose cone as shown in the upper illustration, or you can tie to shock cord.

Personally, I prefer to tie directly to the loop on the base of the nose cone. The reason is because I think it easier to insert the streamer into the model for flight. The shock cord doesn't get tangled in the streamer as it is inserted into the tube.

The exception to this is when the loop is so small, that it becomes difficult to thread the streamer through it. However, there is a cure for that too. You can cut the streamer end with a scissors so it comes to a longer point, as shown in figure 5. Note that this will make the streamer a little weaker where it attaches to the rocket. So use only with tear resistant materials, like Tyvek® synthetic paper.

Most experienced modelers prefer to use some sort of bridle system to attach the streamer, such as the two shown in figure 6. The advantage of these is that you can swap out streamers in the rocket a bit easier. This is especially true if you use a fishing snap swivel on the free end of the bridle

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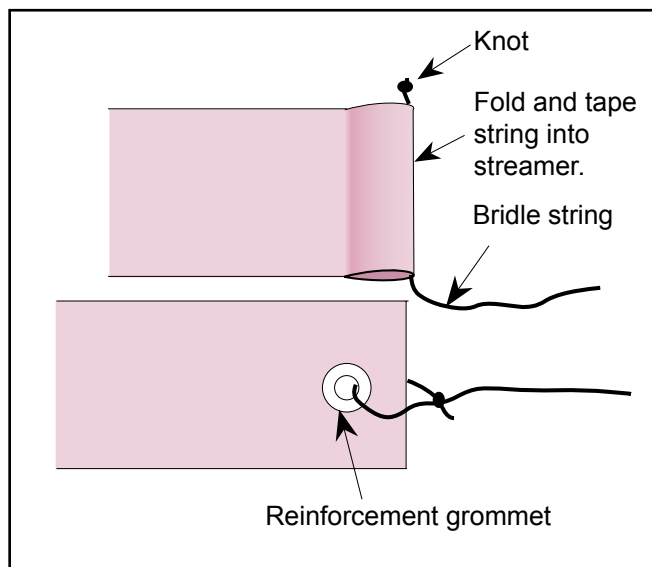


Figure 5: A bridle string attached to the streamer makes it slightly easier to prep for flight.

string.

The upper method, where the string is attached to a corner is the preferred method for competition modelers. This makes the streamer whip around more in the air, slowing the descent of the model significantly. You can either tape, or sew the string to the edge as shown.

The bottom method, of using a tape reinforcement ring, or a metal eye-grommet is probably the strongest method of attaching the streamer to the bridle cord.

Conclusion

While streamers are somewhat odd to most new modelers, they have been used successfully in rocketry since the hobby got started in the late 1950's. This article was intended to give you some ideas to think about, and the types of trade offs you can make when selecting the right streamer for your models.

Other Information Worth Reading:

"Model Rocket Design And Construction" http://www.ApogeeRockets.com/design_book.asp This book is the bible for all rocket designers. It gives you a depth of information about all the recovery techniques like Streamer and Parachute recovery. By the way, did you know that there are nine different types of recovery devices and techniques?

Technical Publication #3 – The Science & Beauty of Streamer Recovery. http://www.ApogeeRockets.com/technical_publications.asp Read this publication if you want to find techniques to make your streamers fall even slower. There is also an extensive bibliography that points you to R&D reports about streamers.

RockSim Design software – Takes all the guesswork out of sizing a streamer for your rockets. Download a free demo version at: www.ApogeeRockets.com/rocksim.asp

About the Author:

Tim Van Milligan 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 the FREE e-zine newsletter about model rockets. You can subscribe to the e-zine at the Apogee Components web site, or sending an email to: ezine@apogeerockets.com with "SUBSCRIBE" as the subject line of the message.

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