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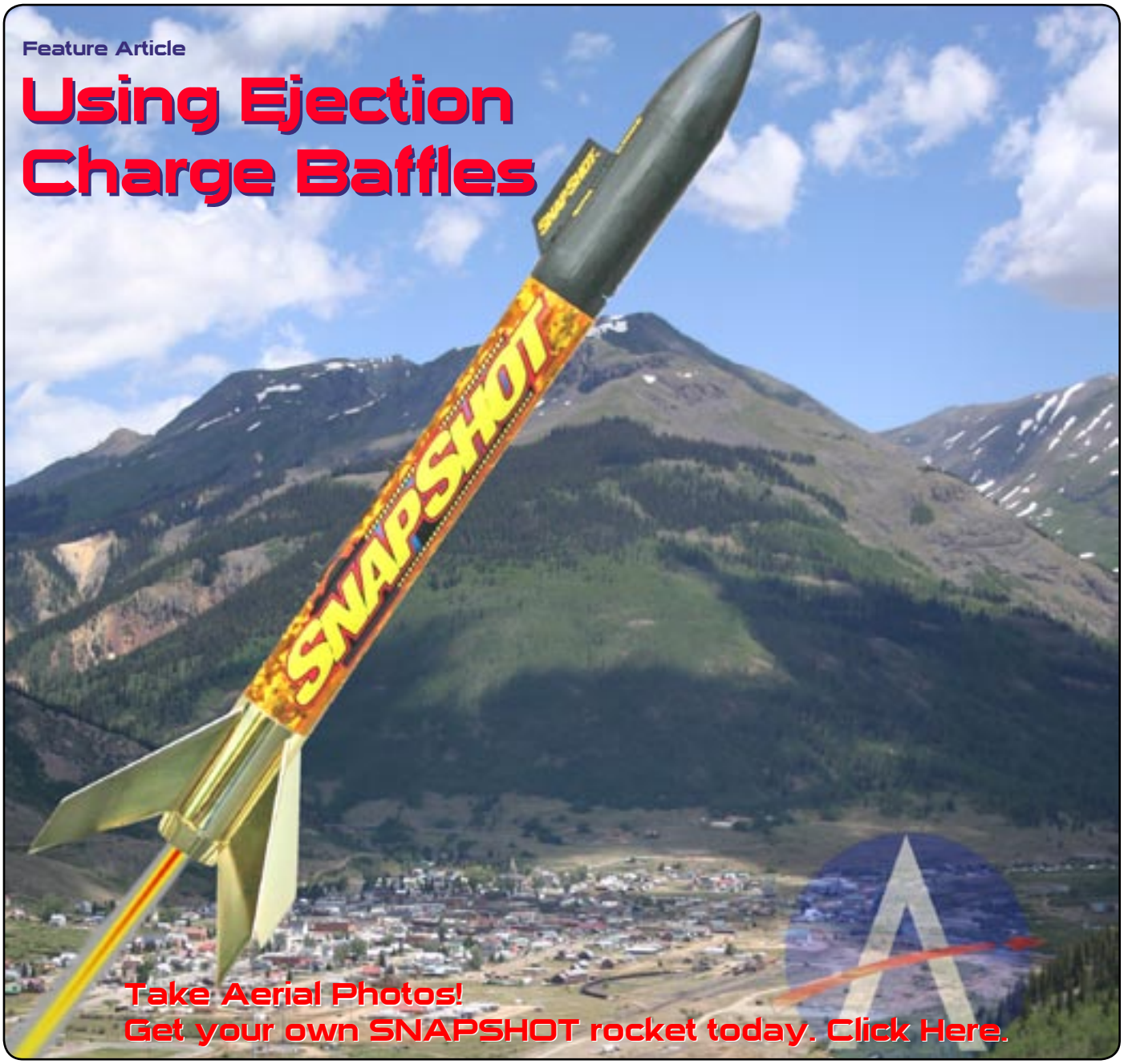
Feature Article

Using Ejection Charge Baffles



APOGEE 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

Using Ejection Charge Baffles

By Tim Van Milligan

As you know, recovery wadding protects the recovery device (i.e., a parachute or streamer) from the heat of the ejection charge of the rocket motor. Without wadding, the parachute would be melted into a plastic wad, and the rocket would come down fast and land with a thud.

Wadding is made from flame-proof paper, such as toilet paper or thin tissue paper. You can also use cellulose house insulation (shredded paper treated to be flameproof), which can be bought cheap at hardware stores.

It is recommended that you fill the tube with wadding to a length of two or three times the tube-diameter in length. This is to ensure that the hot gases and burning particles are complete blocked from reaching the parachute.

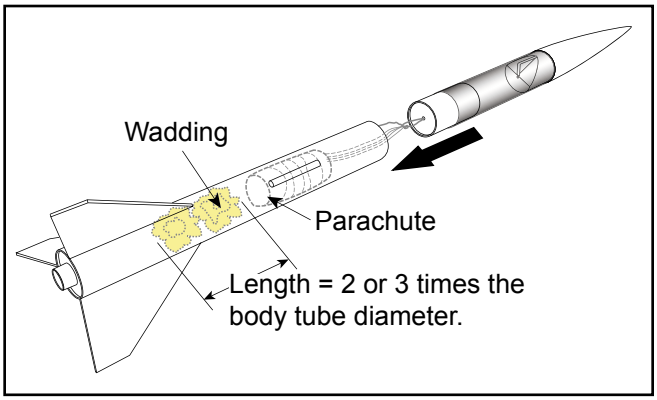


Figure 1: Wadding is inserted into the tube below the parachute to protect it from the heat of the ejection charge.

In small rockets where the diameter is skinny, you only need a little bit of wadding to protect the chute. But as the diameter gets larger, it takes more and more wadding. This can get burdensome to install prior to each flight. And if you haven't discovered cellulose home insulation, it can get very expensive.

In larger diameter rockets, the alternative to wadding is to use a ejection charge baffle.

An ejection charge baffle is a mechanical device used as a substitute for recovery wadding. In other words, when you use a baffle, you eliminate the need to use wadding.

They work by trapping the burning particles of the ejection charge. They also slow down the velocity of the gases, giving them a little bit of time to cool.

The important part is trapping the burning particles. They are the thing that do the most damage to the recovery device.

Where do these burning particles come from? They are particles of black powder from the ejection charge. All the particles don't burn at the same time. Some take a bit longer to consume themselves. But they are flung forward into the body tube of the rocket. Therefore it is important to trap them before they reach the parachute to burn holes in the canopy. Both recovery wadding and baffles do this.

In this article, I want to show you the variety of baffles that I have come across.

Baffles have been around a long-long time. In fact, they were first patented in 1973 by Leroy Piester (US Patent 3,719,145). See Figure 2.

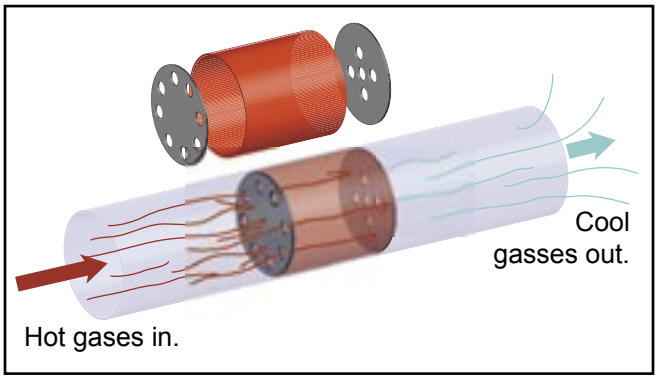


Figure 2: The first baffle was invented by Leroy Piester in 1973.

Another popular baffle design was patented in 1991 by Gary Rosenfield (US Patent 5,054,397). It uses a wire mesh to trap the particles, like the one shown in Figure 3.

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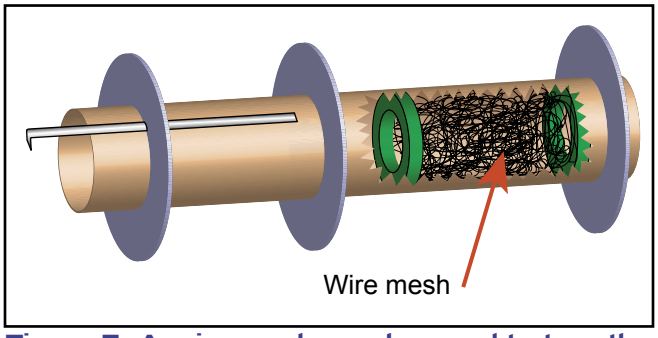

Figure 3: A wire mesh can be used to trap the particles of the ejection charge.

Ejection Charge Baffles

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One of the nice features of the wire mesh is that all that surface area of the wire means a lot of heat can be removed from the gases as they flow through the baffle.

For wire mesh, most modelers use scrubbing pads, like CHOREBOY pot scrubbers. They are very coarse, and allow air to pass through easily.

There are two disadvantages to the mesh baffle though. The first is that there is a lot of soot created by the ejection charge, and this get retained in the mesh. After a few flights, it has to be removed and cleaned out. Otherwise, it will clog up.

Clogging is a big problem. If it clogs up, the tube will overpressurize. What happens next will always be catostrophic. The paper tube could burst inside the rocket, and/or the baffle could be shifted forward and out of the rocket. What is equally possible is that the restraining device holding the motor in will fail. Then the motor will be ejected out the back of the rocket, and the rocket will come down ballistically. That is very bad!

There is another way for the mesh to get clogged. It happens when composite propellant rocket motors are used in the model. These motors have a paper or plastic cap on the top that holds the ejection charge in the motor. This cap is blown forward at ejection, and it does not get burned up.

It is important to inspect the baffle prior to each flight to make sure that air can still pass easily through.

One design I came across from Gary Bolles of Colorado is a simple plugged tube with holes near the base (See Figure 4).

One thing about this design is that it is easy to clean after each flight. The cap on the composite motor should simply fall out of the rocket when the motor is removed, and there isn't a mesh to trap the soot from the ejection charge.

One thing that you do have to watch out for though, is that the paper tube around the holes is going to take a lot of heat. You'll need to put a thing coat of epoxy on the inside of the tube near the holes to prevent the tube from being burned from the intense heat of the ejection charge.

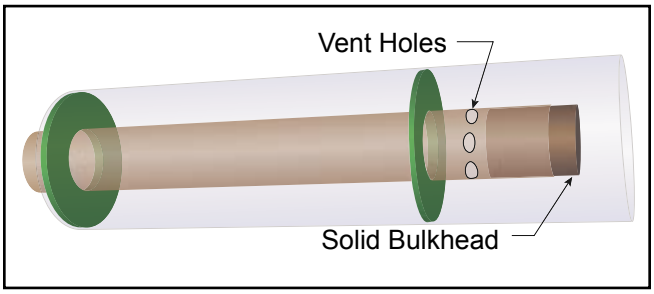

Figure 4: Simple plugged tube baffle design by Gary Bolles.

During my search for designs, I did come across two on the web site of Tulsa Rocketry, the local Tripoli prefect in the Tulsa, Oklahoma metropolitan area. The first design they call the *Type A Baffle System* (See Figure 5).

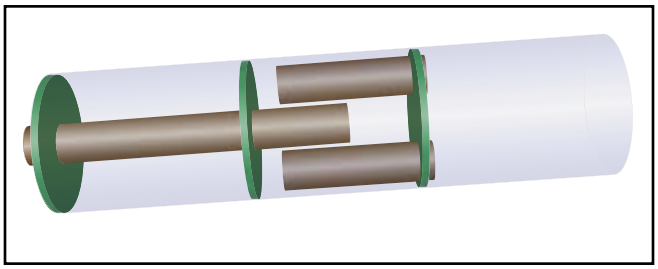

Figure 5: "Type A Baffle System" from the guys in the Tulsa, Oklahoma.

This design certainly will trap the burning particles that come out of the motor. The downside is that it is going to trap the soot in the works too. Not so bad, but the rocket is going to rattle when you pick it up.

The paper/plastic cap on the engine might be a problem though. But I piece or two of music wire in a cross-hair pattern at the end of the tube should prevent it from entering the baffle portion.

The other design on the Tulsa Rocketry web site is named the *Type B Baffle System* (see Figure 6).

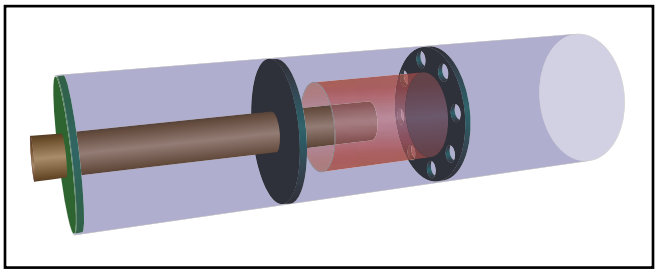

Figure 6: "Type B Baffle System."

This second design looks like it would be easier to shake out the soot and crud after the launch.

Not shown in either figure 5 or figure 6 is an eye bolt on the forward most disk. The middle of both disks are solid, and you can easily add an eyebolt to allow for parachute attachement. In other words, it is s strong anchor point!

In big rockets, where the shock cord or parachute is attached is always important. So I would recommend making this disk the attachement point.

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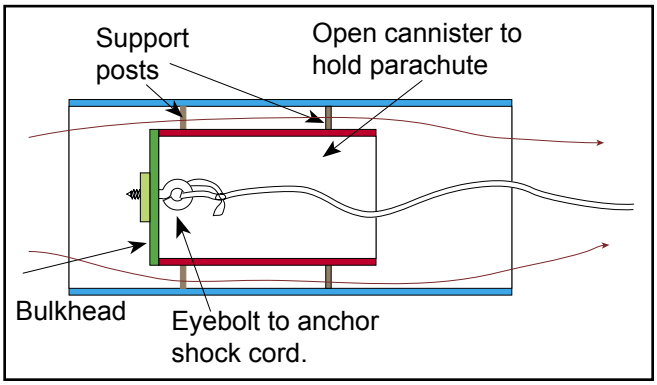

Figure 7: Parachute "bucket" design from the book *Model Rocket Design and Construction*.

In figure 7 we see a design called the parachute bucket, which comes from my book *Model Rocket Design and Construction*. In figure 8, we see a slight modification on this design, showing rails between the bucket and the sides of the tube. These rails would replace the posts holding the bucket in the tube.

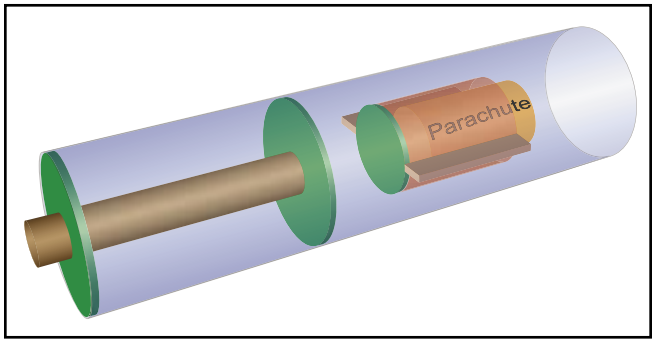

Figure 8: Modified parachute bucket showing rails holding the bucket in place.

The intent of this design is to allow the hot gases to pass around the bucket that holds the parachute. It doesn't attempt to slow the gases down at all, just to get them past the bucket and eject the nose cone. As the nose cone moves forward, it would pull the parachute out of the bucket so that it could inflate.

The drawback of this design is that the rocket must be really fat so that it can have a separate tube in the middle of the rocket. This doesn't occur that often in real life.

Additionally, the parachute must fit loosely in the cannister. If it is a tight fit, it might get stuck when the nose cone blows off. You've probably seen a lot of rockets come down with the nose off, but the parachute stuck in the tube.

The last baffle design I came across was from Bob Fortune. The baffle is made by cutting a solid disk down the middle, and gluing the two halves in opposition to each other inside a tube coupler (see Figure 9.)

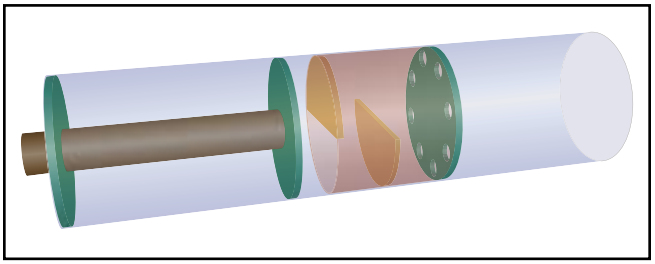

Figure 9: Bob Fortune's *S-Turn* baffle system.

This forces the ejection charge gases to make a S-turn inside the baffle, thereby trapping any burning particles.

Like the baffles shown in figure 5 and 6, the forward disk can accept a eyebolt in the middle to allow the shock cord to be attached directly the baffle system.

This design should also be easy to clean by shaking the rocket back and forth to remove the residue and the grit.

One word of caution about any baffle system you might use. Any part or disk that takes direct fire coming out of the engine mount tube should be coated with a thin layer of

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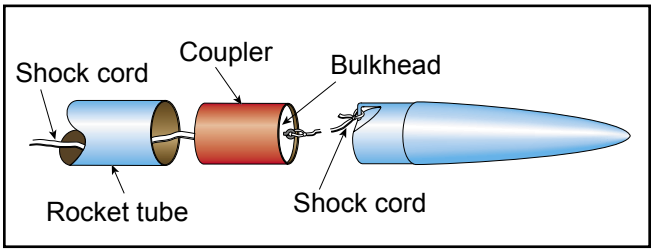

Figure 10: Piston ejection system.

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epoxy. It will take a lot of heat and be sand blasted by the gases, so it will need a bit of protection.

Piston Ejection

A more popular system to protect the parachute is the piston ejection system as shown in Figure 10.

The piston is made from a tube coupler with a bulkhead near the front end. A shock cord is attached to both ends of the piston, so that it is allowed to slide completely out of the rocket tube at ejection. Obviously, this means that the shock cord at the base of the piston must be heat resistant, like Kevlar® or a twisted steel rope.

Other Parachute Protection Systems

Baffles are not the only means to protect the parachute. A lot of modelers are also using *Parachute Deployment Bags* made from fire-resistant Nomex® cloth.

In essence, the Nomex® acts just like wadding — keeping the burning particles from reaching the parachute.

There is a very good article on Rocketry Online's Info Central by Dean Roth that describes parachute deployment bags and how they are used. See: http://www.info-central.org/recovery_deploybag.shtml.

There are other advantages of the bags besides heat protection that Dean mentions. He says:

> "It allows the bridle and suspension lines to be pulled tight before the parachute opens, preventing a large 'jerk' on the system when the parachute inflates" and, it "allows the parachute to move away from the rocket before it opens, helping prevent it from becoming tangled with the bridle, nose cone, fins, etc."

Conclusion

As you can see from this article, there are a number of baffle systems you can use to protect the recovery device from the heat and burning particles of the ejection charge. For the most part, they are used mainly on larger diameter rockets, because filling them up with wadding is cumbersome.

For Further 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 types of rockets, from simple beginner rockets to big high-power models.

"Building Skill Level 1 Model Rocket Kits" -- To build a great model, you need to know the basic construction techniques. You don't learn techniques by reading, you learn by watching an expert do it. You didn't learn to tie you shoestrings by reading about it, did you?

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.