PEAK OF FLIGHT NEWSLETTER

Issue 601 / June 6th 2023

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Different Methods for Protecting Your Parachute

By Tim Van Milligan

Rocket Recovery: Protecting Parachutes from Ejection Charge Heat

Imagine this scenario: you've meticulously designed and built your rocket, carefully packed your parachute for a safe descent, and then you eagerly launch it into the sky. However, during the critical moment of deployment, the intense heat of the ejection charge engulfs the parachute, leaving it singed and ineffective. The result? A disappointing recovery and potential damage to your beloved rocket.

Sometimes this is termed: "plastic wad recovery" instead of plastic parachute recovery. The wad of melted plastic doesn't inflate, and the rocket plummets out of the sky.

This unfortunate outcome highlights the paramount importance of protecting parachutes from the searing heat generated by ejection charges. Parachutes play a vital role in safely returning our rockets to the ground, ensuring we can relish in the thrill of repeated launches. Without adequate protection, the heat can compromise the integrity of the parachute, rendering it less effective or even causing it to fail entirely. That's where reliable heat protection methods come to the rescue.

In our quest to achieve successful recoveries, we'll explore a range of techniques that shield parachutes from the intense heat of the rocket motor's built-in ejection system. From traditional solutions to innovative mechanisms, each method offers its own set of advantages and considerations.

Remember, safeguarding your parachute not only ensures a successful recovery but also preserves the longevity of your rocket and enhances the joy of the rocketry experience.

So let's compare and contrast these approaches to help you make informed decisions for your rocketry ventures.

1. Recovery Wadding

One of the most commonly used methods to shield parachutes in rocketry is with recovery wadding. Made from lightweight, fire-resistant paper, this wadding is placed between the ejection charge and the parachute. The wadding absorbs the heat and provides a protective insulation for the parachute. Here are the pros and cons:

Pros:

- Widely available and easy to use. It may be the simplest system to protect the parachute.
- Can be applied to any rocket, and doesn't require any modification of the rocket itself.
- Relatively inexpensive.
- Lightweight
- Is completely ejected from the rocket, so it doesn't contribute to the descent mass.
- Biodegradable

Cons:

- Requires careful placement to ensure proper protection of the parachute.
- While inexpensive, its price can get expensive if you use a lot of it in your model rocket. For that reason, it isn't typically used in larger diameter models because they need a lot more volume of wadding to protect the parachute.
- Needs to be replaced after each launch, which can add to the long-term cost.
- Adds to the prep time required to get the rocket ready to launch.

Both Estes and Quest make paper flame-resistant wadding, which you can buy from us at Apogee Components. The Estes wadding is literally made from toilet paper that has been soaked in a flame retardant: **https://www.apogeerockets.com/Building-Supplies/Recovery-Equipment/Disposable-Wadding/Estes-Recovery-Wadding**

Don't ever use normal toilet paper, as it will burn quite easily and does not protect the parachute from the heat of the ejection charge.

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About this Newsletter

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Protecting Your Parachute Continued...

The Quest wadding is made from tissue paper, which has also been treated with a flame retardant chemical. Both are biodegradable, so once they come out of your rocket, they will eventually be broken down by the environment quite easily: **https://www.apogeerockets.com/Building_Supplies/Parachutes_Recovery_Equipment/Disposable_Wadding/Quest_Recovery_Wadding**

Which is better? It depends on how you want to use it. If you want something soft, then the Estes wadding would be preferred. But if you want something more stiff that doesn't compress as easily when stuffed into a tube, then the Quest wadding would be ideal. Other than that, they are pretty much interchangeable in your rocket.

To use paper wadding, you want to loosely crumple it up into a ball and place it into the rocket before you insert the parachute. Ideally, you want to have the amount of wadding so that it completely fills the diameter of the tube, and at a length that is approximately two diameters of the tube. So for a 1-inch diameter rocket, the length of tube you need to fill with wadding is approximately 2 inches. Its position in the tube (such as near the motor or near the top of the tube) doesn't really matter that much. It just needs to be between the top of the rocket motor and the parachute it needs to protect.

Figure 1: (Left to Right) Estes wadding, Quest wadding, dog barf wadding

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Just don't compress the wadding too much as you install it in the rocket. If it becomes too dense, it can act as a solid plug in the tube that doesn't move. This of course will prevent the parachute from being blown out of the rocket.

If you've ever seen a newbie's first rocket that comes down with only the nose cone off, but no parachute, this is probably what happened. The wadding was compressed too tightly in the tube, or the chute wasn't folded correctly.

You can also wrap a layer of paper wadding completely around the parachute for extra protection. But you should always use wadding below the parachute too. Just make sure the parachute slides easily within the tube so that it will be ejected by the rocket motor.

2. Dog Barf

It isn't actually real dog barf. It only looks like that. In reality, this is another paper wadding that has been treated with a flame retardant chemical. It is sold in home improvement stores in large bales as cellulose household insulation. It is meant to be blown into a fluffy layer in your house's attic to keep you warm in the winter.

Figure 2: Dog barf wadding leaves lint when you put it on cloth

The advantage of dog barf wadding is that it is cheap. You can get a big bale of the material for a very reasonable price.

The household cellulose insulation is actually recycled newspaper that has also been treated with a flame retardant chemical. Then it is shredded into tiny fluff so it can be flown into an attic.

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But to make shipping it more economical, it is compressed tightly and packaged in a plastic bag. When you open up the bale shaped bag, you need to re-fluff it by breaking it apart with your hands.

Once it is re-fluffed, it is a little messier to use than sheets of wadding. You can grab a handful, and getting it all into a rocket is tricky. It wants to go everywhere. But the bigger the diameter of the rocket, the easier it is to work with.

Like paper sheet wadding, fill the rocket tube with dog barf to a depth of about two diameters. Then lightly jostle the rocket to settle it down so it completely fills the entire diameter of the tube.

Pros:

- Offers reliable heat protection for the parachute.
- Cost-effective for larger diameter rockets.
- Suitable for both smaller and larger rocket models.
- Bio-degradable
- Lightweight and completely ejects from the rocket so it doesn't contribute to the descent mass
- Sometimes makes a big cloud in the sky that can help you find your rocket in the air

Cons:

- Storage: you always end up with a life-time supply when you get a bundle. You'll have to transfer a small amount to a plastic zipper bag so you can take it with you to the launch site.
- Messy. It is dusty and clingy to fabrics like the upholstery in your car.

3. Fireproof Cloth Heat Protectors:

Another popular option is the use of fire-resistant cloth heat protectors: **https://www.apogeerockets.com/Building-Supplies/Parachute-Protection/Cloth/Apogee-12in-Parachute-Protector**. These protective covers are made from specialized materials that can withstand high temperatures. The most common is a welding cloth (cotton cloth treated with a flame retardant). People also use Nomex®, which is a more expensive cloth where the fiber is actually a material that is fire resistant without any additional flame retardant chemicals added.

Both cloth materials work quite well. And they are reusable! So they typically stay with the rocket from one flight to the next.

Figure 3: Welding cloth heat shield

But it should be known that they are fire-resistant, not fireproof. In other words, you can still get burn holes in either the welding cloth or the Nomex. To prevent this, you should make sure that the cloth is not positioned too closely to the top of the rocket motor. The larger the distance between the motor and the cloth protector, the better. The minimum is probably 2 or 3 tube diameters in front of the rocket motor.

They will also get sooty because they capture the smoke and gunk from the burning ejection charge. But they can be washed without affecting the fire resistant properties.

They are designed to wrap around the parachute, shielding it from the ejection charge heat. A lot of people

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use the term "burrito," describing the process of rolling up the parachute into the cloth heat shield. That's what they look like when you have rolled up a parachute properly. We did a video on how to use a cloth parachute protector at: **https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_295**

Sizing is an issue with chute protectors. The size you need depends on the size of the tube it will go into. Here is a chart from the Apogee website for the most common sizes:

3" (7.6 cm) square size = Great for small rockets up to a diameter of 1.5 inches (38.1 mm). For example, this size will fit fine in a BT-50 to a BT-55 size tube.

6" (15.2 cm) square size = Rockets with a diameter greater than 1.5 inches (38.1 mm), but less than 2 inches (50 mm) in diameter. For example, this size will fit fine in a BT-60 size tube.

9" (22.8 cm) square size = Rockets with a diameter greater than 2 inches (50 mm), but less than 3 inches (76 mm) in diameter. For example, this size will fit fine in a BT-70 and BT-80 size tube.

12" (30.5 cm) square size = Rockets with a diameter greater than 3 inches (76 mm), but less than 4 inches (101 mm) in diameter.

18" (45.7 cm) square size = Rockets with a diameter greater than 4 inches (101 mm), but less than 6.5 inches (159 mm) in diameter.

24" (45.7 cm) square size = Rockets with a diameter greater than 6.5 inches (101 mm), but less than 8.0 inches (203 mm) in diameter.

Let's examine the pros and cons of the cloth heat protector:

Pros:
- Offers reliable heat protection for the parachute.
- Can be reused multiple times, making it cost-effective in the long run.
- Suitable for both smaller and larger rocket models.
- Can be swapped from one rocket to another

Cons:
- Requires careful wrapping and secure attachment to ensure proper protection.
- Initial cost is more expensive than paper recovery wadding.
- The heat shield size depends on the diameter of the rocket's tube
- Not typically available in hobby stores.
- Heavier than paper wadding.
- Stays attached to the rocket during descent, so it does contribute to the descent mass.
- Traps soot, so they have to be washed if you want them to look pretty.

Figure 4: Petal Protector heat shield - combines a cloth heat shield with the forceful ejection of a piston.

4. Deployment Bags

Technically, Deployment Bags would be a sub-set of cloth parachute protectors. They are typically made of the same material. If you saw them lying side by side, it would be hard to tell them apart.

The practical difference between a deployment bag and a heat shield is that the deployment bag is stitched together to actually form an open ended bag, whereas the heat shield is usually just a flat sheet of cloth.

Not only does the deployment bag protect the parachute from the heat of the ejection charge, but it also serves another function. Its pri-

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mary function is to aid in the deployment of the parachute by making sure events happen in a specific sequence. This is important for larger parachutes because an inflation failure can be far more dangerous since the rocket weighs a lot more.

Figure 5: Deployment bags of different sizes made from fireproof cloth

Ideally, we want the suspension lines to completely stretch out before the canopy starts to inflate. And that is the purpose of the deployment bag. There are loops of ribbon on the outside of the bag where the suspension lines are zig-zagged through to make sure the lines come out first before the canopy is yanked out of the bag.

Pros:

- Excellent protection for the parachute.
- Fully reusable.
- Suitable for larger rocket models with more powerful ejection charges.
- Can be swapped from one rocket to another

Cons:

- More expensive than a regular cloth chute protector
- Set-up for flight is more complex because the suspension lines have to be properly stowed
- The size of the bag has to be matched to the size of the parachute
- Harder to find, even on the internet.
- Heavier than a cloth chute protector because it has more material.
- Stays attached to the rocket during descent, so it does contribute to the descent mass.

Figure 6: A parachute wrapped up in a deployment bag. The lines are wound through loops to make sure they stretch out before the chute is pulled from the bag.

5. Ejection Baffles

Ejection baffles are permanent mechanical devices installed inside the rocket's body tube, between the rocket motor and the parachute. Essentially, they create a labyrinth of chambers that the ejection charge gasses must pass through as they flow out the tube. They capture the large chunks of flaming debris that are blasted forward, and also slow down the gasses so that they can cool slightly.

A lot of manufacturers make baffles from laser-cut plywood, but in actuality, they can be made from cardboard, metal screens, or shaved metal (like a pot-scrubber). You can find a variety of different size ejection baffles at:
https://www.apogeerockets.com/Building_Supplies/Parachutes_Recovery_Equipment/Ejection_Baffles

One issue with baffles is they can trap the little plastic cap that holds the ejection charge in Aerotech motors. Depending on how the ejection baffle is made, this could be an issue on subsequent flights because they could clog up the baffle preventing sufficient gas available to push out the parachute. Baffles should be inspected carefully between flights to verify that they aren't clogged and that they are fully operational.

Depending on the construction materials used to make the baffle, you may need to have a

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bit of space between the back of the baffle and the front of the motor. I personally like to have the back end of the baffle at least one body tube diameter away from the front of the motor so it doesn't get blasted so hard by the ejection charge. For example, you don't want a cardstock baffle so close to the motor because eventually the cardstock is going to char and fail.

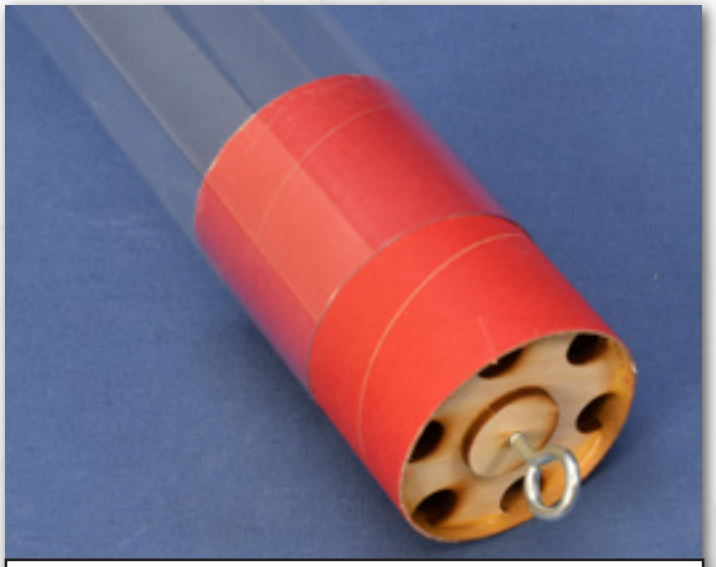

Figure 7: A typical ejection baffle with plywood disks mounted in a tube coupler.

On the Apogee website, you'll find these ejection baffle videos:

Removing Ejection Charge Caps from Inside a Baffle: https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_359

Making and installing an ejection baffle for a small diameter rocket: https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_155

Let's consider the pros and cons of ejection baffles:

Pros:

- Provides good protection for the parachute.
- Simplifies launch preparations - you only need to pack the chute.
- Permanently installed in the rocket.
- Suitable for all sizes of rockets.

Cons:

- Heavier than other devices that protect the parachute.
- Installation has to be done when the model rocket is constructed
- Not swappable between rockets
- Has to be inspected between flights for damage.
- Can also trap the ejection cap on composite motors, making them difficult to remove. Your rocket may rattle when you shake it because of the trapped particles inside.
- May occupy space that could otherwise be used for payload or other equipment.
- There needs to be some space between the back of the baffle and the front of the motor. This may force the rocket to be longer than you want.

Here are some other articles from the Peak-of-Flight Newsletter on the topic of ejection baffles:

Using Ejection Charge Baffles - https://www.apogeerockets.com/education/downloads/Newsletter129.pdf

Compact Baffle for a short rocket- https://www.apogeerockets.com/Peak-of-Flight/Newsletter463

Where should the ejection baffle go? - https://www.apogeerockets.com/education/downloads/Newsletter369.pdf

Building a Better Baffle - https://www.apogeerockets.com/education/downloads/Newsletter366.pdf

Two new Baffle Designs - https://www.apogeerockets.com/education/downloads/Newsletter188.pdf

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Protecting Your Parachute Continued...

6. Piston Ejection Systems:

A piston ejection system is essentially a sliding plug inside the tube of the rocket. It serves two purposes. First, since it is a solid bulkhead, it protects the parachute 100% from the heat of the ejection charge. Where wadding is loose and fluffy and allow gasses to reach the parachute, a solid bulkhead that fills the tube makes it impossible for any hot gas to get to the parachute.

And second, since it slides in the tube, it actually pushes everything in front of it out of the rocket's tube. It is probably the most forceful method to get the parachute out of the rocket.

Pistons can be made of a variety of materials. Essentially they are cylinders that slide in the tube. So a coupler with a bulkhead of cardboard or plywood works very well. For small rockets, we currently sell styrofoam piston plugs which are a little lighter in weight.

Figure 8: The Aerotech Sumo kit uses a piston ejection system to forcefully expel the chute from the rocket.

Since they slide out of the tube with the parachute, to keep them from descending by themselves, they are often tethered to the rocket by a shock cord.

The one thing you do have to worry about with pistons is that the ejection charge residue (soot) can accumulate on the inside walls of the tube. This can make them feel gritty. Unfortunately this grit can inhibit the sliding ability of the piston inside the tube. So you do have to clean out the tube after the flight and then verify that the piston will slide easily in the tube. If it doesn't, then it won't push the parachute out on the next flight, and that is probably worse than a singed chute.

Here is where you can find small pistons that we sell at Apogee: **https://www.apogeerockets.com/Building_Supplies/Parachutes_Recovery_Equipment/Disposable_Wadding**

Figure 9: Foam pistons used on smaller diameter rockets. You can cut a notch down one side to allow the shock cord to pass by the plug.

Let's explore the pros and cons:

Pros:

- Provides maximum protection for the parachute.
- Offers the highest protection of the parachute from the heat of the ejection charge.
- Installation can be done retroactively to older rockets that are already built.
- It may be possible to swap pistons from one rocket to another if they are the same diameter.
- Can be used on any size rocket.

Cons:

- A bit more complex because it is a moving part inside the rocket
- Adds weight and complexity to the rocket design.
- The piston can become stuck in the tube because of residue build-

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up along the inside walls of the tube.

- Adding a shock cord to keep the piston attached to the rocket is more difficult
- The length of the piston has to be considered. Short rockets may not have sufficient length for the piston between the parachute and the rocket motor.
- More information on using a piston ejection system can be found at: **https://www.apogeerockets.com/education/downloads/Newsletter315.pdf**

7. Parachute Buckets:

A parachute bucket is not very common because it can only be used in rockets that have a large diameter. Essentially, it is a solid bucket inside the rocket tube that the parachute is stored in. There is a gap surrounding the bucket that allows the hot gasses to pass around. The base and sides of the bucket protect the parachute until all the gasses pass by.

It is different from an ejection baffle, in that the gasses don't push the parachute out of the tube. The gasses push the nose cone off the rocket, and then the nose cone and the shock cord pull the parachute out of the bucket. In other words, it requires a pull force from the nose cone, rather than a push force to get the parachute out of the bucket. With a long enough shock cord, the parachute doesn't immediately come out of the tube, so the hot gasses from the ejection charge have enough time to pass by the bucket and exit out of the tube. But the bucket is the primary protection for the delicate parachute canopy.

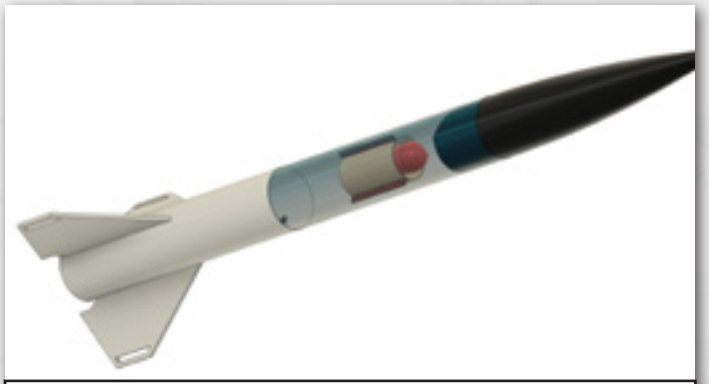

Figure 10: parachute bucket inside a large diameter rocket.

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Here are the pros and cons of the parachute bucket:

Pros:

- Cuts down on the prep time for the flight. You don't need to add anything to the rocket, and inspection between flights is quick and easy
- Parachute is protected by a solid structure.

Cons:

- Can only be used on larger diameter rockets where there is room to place the bucket and still allow a gap around the perimeter for the ejection gasses to pass by.
- Permanently installed in the rocket, and can't be swapped to another rocket.
- Adds weight to the rocket both for ascent and descent
- Takes up space in the rocket.
- Parachute needs to be loose in the bucket, so that the nose cone can pull it out easily.
- Installation in the rocket is more complicated than other systems

8. Flameproof Parachutes

What if you made your parachutes from materials that already had a lot of heat resistance? Then you wouldn't need to protect them from the ejection charge.

A lot of people have had similar thoughts, and have tried things like Nomex® cloth for the parachute. While this can work, the current downside is that Nomex cloth is not lightweight or soft where it can be folded into the rocket easily.

But that doesn't mean there aren't other materials that couldn't be used. Bruce Levison used to weave his own sheet parachutes out of teflon ribbon (like plumber's pipe thread tape, and dental floss). Bruce got the nickname of the "Teflon Rocketeer" because of these parachutes. This is totally possible, and very innovative. Who knows what other flameproof materials that are out there or have yet to be invented that might be used for rocketry.

Here are the pros and cons of flameproof parachutes:

Pros:

- Could possibly be the ultimate solution to the problem of protecting the chute from the ejection

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charge heat.
- Easy installation
- Can be swapped out easily between rockets
- Doesn't require any additional weight be added to the rocket, so you can get higher flights

Cons:
- Currently there are very few materials that meet the criteria for a good flameproof parachute. Such as: lightweight, soft, thin and foldable, strong, durable and cheap.

9. Cold Gas Ejection

What if the ejection gasses were cold instead of being hot? At that point, you wouldn't need any additional protection for the cloth parachute, because the heat problem disappears. And this has led to a number of CO2 systems to eject the parachute instead of relying on the hot ejection charge built into the front end of the rocket motor such as this product from Apogee: **https://www.apogeerockets.com/Ejection_Systems/CO2_Ejection_Systems/Peregrine_CO2_Ejection_Device_8g_12g**

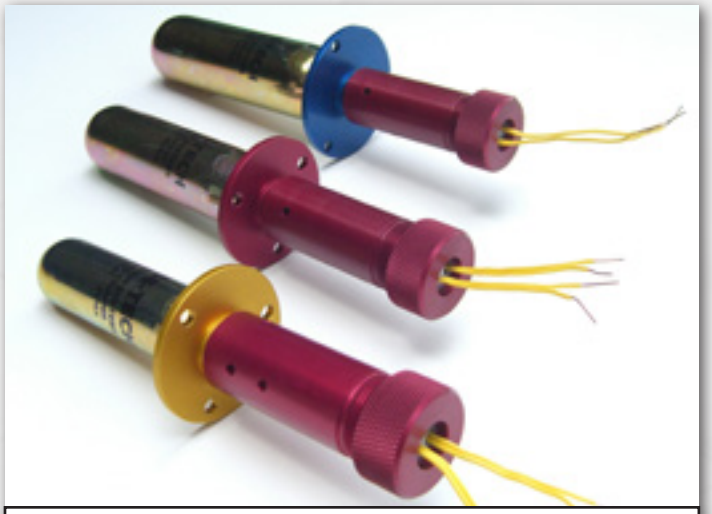

Figure 11: Several sizes of CO2 ejection systems. They contain a pressurized cylinder of CO2, and a mechanism to puncture the cylinder to release the gas

Pros:
- The problem of protecting the parachute goes away!

Cons:
- Adds additional complexity to the rocket design.
- It is typically heavier, because you have to carry up into the sky a cylinder filled with CO2.
- Expensive
- Cannot be easily swapped out between rockets.
- Not readily available to the average rocketeer

10. Mechanical Ejection Systems

At this point, we're getting away from the original topic of protecting the parachute from the heat of the ejection charge. Instead, we're looking for alternate solutions to get the parachute out of the rocket without using a pyrotechnic charge built into the rocket motor.

This may be the future of rocketry, and a lot of people are thinking of ways to accomplish this using some type of mechanical ejection system. However, it is beyond the scope of this article, but if you are interested in this, I suggest that you research what is going on in the water rocket hobby. This has been a common problem for them, as they face the issue of not even having a pyrotechnic charge to help push the parachute out.

But I will list the pros and cons of these systems so you are aware of them:

Pros:
- Eliminates the heat damage from the ejection charge
- Safer for younger modelers because it doesn't have any pyrotechnic charges

Cons:
- Adds significant complexity
- Needs another form of stored energy in the rocket to activate the system (which could be: electrical, springs or rubber bands)
- Expensive
- Has to be designed into each rocket
- Allows other forms of failure that we may not be aware of

Conclusion:

In this article, we have gone through a diverse array of methods to protect parachutes from the scorching heat of ejection charges, as well as alternative approaches to remove the ejection charge altogether. From traditional solutions like recovery wadding and fireproof cloth heat protectors to advanced mechanisms such as ejection baffles and piston ejection systems, we have explored a wide spectrum of options to ensure the safe descent of our rockets. Each

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method offers its own unique advantages and considerations, catering to various rocket sizes, complexities, swapability between rockets in your fleet, budgets, and personal preferences.

As model rocketry enthusiasts, it is our responsibility to prioritize safety and choose the method that best suits our specific needs and aspirations. By employing these protective measures and innovative solutions, we can embark on thrilling rocketry adventures with confidence, knowing that our parachutes are shielded from heat and our recoveries will be triumphant. So, fellow rocketeers, may your launches soar to new heights and your parachutes descend gracefully, fueling your passion for this captivating hobby.

Happy rocketeering, and until our next exploration, keep reaching for the stars!

Tim Van Milligan

About the Author:

Tim Van Milligan (a.k.a. “Mr. Rocket”) is a real rocket scientist who likes helping out other rocketeers. He is an avid rocketry competitor and is Level 3 high power cer- tified. He is often asked what is the biggest rocket he’s ever launched. His answer is that 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 to- ward an 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 also the author of the books: Model Rocket De- sign and Construction, 69 Simple Science Fair Projects with Model Rockets: Aeronautics and publisher of the “Peak-of- Flight” newsletter, a FREE e-zine newsletter about model rockets. You can email him by using the contact form at **https://www.apogeerockets.com/Contact**.

Tim's Messy Desk - June 2023

Time for an update on what is going on here behind my messy desk. I do these articles just to document things, so that I can jog my own memory of what has been going on here.

Over the Memorial Day weekend, I attended the National Sport Launch (NSL) sponsored by the NAR and the rocketry club in Alamosa, Colorado. I have to say that I was so happy to be there and to enjoy the company of so many of my rocketry friends. Many people that I haven't met before came up and introduced themselves, and I had a lot of great conversations about rockets. We also got to fly a whole bunch of rockets, including some of our new prototypes that we're working on. One of them is a rocket specifically designed to economically test out staging timers without using high power motors, and the other is a new swing-wing glider that turned a lot of heads on the range. We also launched the Eiffel Tower rocket plan from **Peak-of-Flight newsletter #599** twice. Each time it performed flawlessly and got lots of laughs and brought cheer to everyone.

Figure 1: Our prototype swing-wing glider on the launch pad at NSL

But my life these last few months has been revolving around my daughters, Allison and Ashley.

Allison graduated college last year, and then got married last summer, and she moved to Florida. Her goal is to become a physician's assistant (PA), but in order to get into graduate school, she needs medical hours. So right now she's working as an ER technician at a hospital.

Figure 2: Martin Jay McKee coming back from flying a rocket at NSL

But she was here in Colorado for about a week and a half because her younger sister Ashley just graduated from high school. So while Allison was around for that, she put in many hours helping out in our production department here

Figure 3: Ashley, Allison, and Tim take a break from flying rockets to visit the Royal Gorge Bridge near Cañon City, Colorado.

at Apogee. She poured a lot of resin for nose cones and other pieces that go into our kits.

Allison is in the stage

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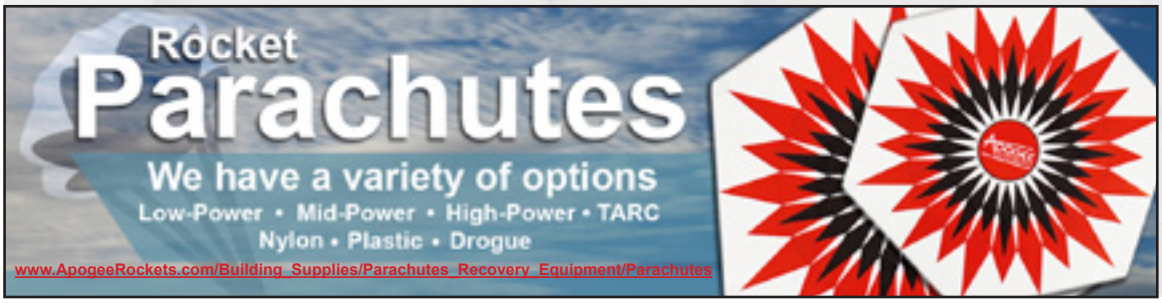

Tim's Messy Desk Continued...

By Tim Van Milligan

in her life where her "old dad" is no longer an embarrassment that he was when she was a teenager. Now she actually comes to me seeking advice with her "life questions." It has been an honor to see her mature in a way that I know she will be a huge contributor to society. She's elevated herself to the status of being a taxpayer instead of being a tax receiver.

Ashley finished her senior year of high school on a high note. She won the state championship title for Colorado as a diver on the swim team. Academically, she also finished in the top 10 of her class while taking all the hard classes. I'm so proud of her, as she did it all herself. I can't recall even spending 10 minutes with her doing homework during her high school years.

Last summer, Ashley tried out for a spot on the US National Team for rocketry. And she qualified for two events in the senior division. At the beginning of July, she'll be representing us in the Streamer duration and Gyrocopter duration events.

When it comes to rocketry, I do help her out. This is a "team" event, so having help is not cheating. It is actually encouraged to share information and techniques with others. So this winter, while Ashley was busy with high school activities, I was doing research on making the past competition rockets she used better. Now that school is done for her, we've been doing a lot of test flying of the rockets. As a dad, this is the part I enjoy, because usually it is just her and I. As I'm typing this, we're driving home from a rocket test launch. I couldn't be more at peace with the time we just had. A few weeks ago, when Allison was home, we had the whole family out for a rocket launch. That was also just as fun.

Figure 4: Ashley comes back from flying a Gyrocopter rocket as she practices for the World Space Modeling Championships in July.

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Until the world championship contest in early July, my time will be filled with helping Ashley get ready. So while I'm doing that, the team at Apogee has stepped up and has really done a fantastic job at keeping everything running smoothly. If you've noticed, they have been putting out one new Apogee kit per month. The last was the Kestrel kit (https://www.apogeerockets.com/Model-Rocket-Kits/Skill-Level-3-Model-Rocket-Kits/Kestrel) released in May, and we'll be releasing the TTV (Timer Test Vehicle) in just a few weeks.

Our inventory is also at great levels, which means our production department has been able to keep up not only with the old kits we've made for years, but also with the new ones coming out. We're still keeping up with our guarantee of same-day shipping. If you place an order before 2 p.m. Mountain Time Zone, they ship it out that same day.

Our customer service team is also taking on more work. One of my goals this year was to shift to being more of an investor in Apogee, and less of a worker at the company. So we made a decision a few months ago to pull me out of the loop on responding to daily emails. The team is answering them all. For one or two emails a week do they ask for my input on how to respond. At first, letting go of the task of responding to emails was scary for me. But to be honest, I think that I was being more of an interference than a help to them for a long time. They were more than capable of answering everyday questions.

The one area that I'm still involved on a daily basis is with marketing of Apogee. I'm still the face of the company, the one doing the videos and doing a majority of writing for the newsletter. This is an area that I'd love to give up and let someone more productive take over. I've been looking for a person to work in our marketing department for a long time.

Maybe that is you? Don't brush this aside just yet. Things are rapidly changing that could mean that your experience with rocketry is all you need as a qualification to work in marketing. What changes?

I'm sure you've been following all the advancements in artificial intelligence. Since November 2022, when ChatGPT was first

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Tim's Messy Desk Continued...

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released, there has been a dramatic upheaval in marketing. The A.I. generated content is very impressive. It can take someone with no ability to put together a coherent sentence, and make them look like Einstein (example: even me). So maybe you do have the capability to do marketing if your rocketry skills are enhanced with A.I.

I still think a human has to be involved in the process though. While Large Language Models (LLMs) like ChatGPT are impressive, they still aren't perfect. Let me give you an example.

For this issue's feature article on protecting your parachute from the heat of the ejection charge, I did an experiment and let the A.I. make a first draft of the article. I just gave it the prompt of what are the ways to protect a parachute from the heat of the ejection charge, and what might be the pros and cons of each way.

The AI came up with just three methods: "Estes wadding," heat shields, and piston systems. Additionally most of the pros and cons of each method were junk. It is like the A.I. was just making stuff up. This is commonly called "A.I. hallucinating."

For example, the advantages of an ejection piston according to the A.I. are:

- Improved recovery device deployment. By directing the ejection gasses rearward, the baffle helps ensure the parachute or streamer exits the rocket body in a straight line. This reduces the chance of the recovery device tangling or failing to deploy.
- Increased altitude. By efficiently using the ejection charge gasses, more of the rocket's energy goes into achieving altitude rather than dispersing the gasses. This can result in a higher rocket flight.

If you can easily identify that these supposed advantages are entirely fabricated and utterly baseless, then you probably possess the qualities needed to write a newsletter article in the future. The actual writing can be handled by the A.I., but it takes an experienced rocketeer with real-world knowledge to distinguish truth from falsehood.

Despite the drawbacks, by having experimented with this, I can say I am excited about the potential of A.I. technology as a tool to enhance our work here at Apogee. While it may still generate unreliable information, currently its true strength lies in crafting the structure and framework of an article. The assistance it provided was highly professional

Figure 5: Flight of the Eiffel Tower at NSL.

and saved me an enormous amount of time. Can you tell the concluding paragraph was mostly written by the A.I.?

While I am still in search of a marketing professional, I can confidently state the following: I have expanded my criteria for the type of person I am willing to hire. Previously, I was seeking a mythical creature—a unicorn—which most of my mentors insisted didn't exist. However, now I believe that with the help of A.I., all I require is an individual with expertise in rocketry and a strong drive to succeed. It is no longer necessary for this person to possess exceptional writing skills, as the A.I. can handle that aspect of the job. If you're interested, please feel free to reach out.

What's next? I'm having a hard time thinking past the World Space Modeling Championships in early July. But I'll be returning back to Texas late in the summer to drop my daughter Ashley off at the University of North Texas. She will be studying Biomedical Engineering there. She told me she wants to eventually work in the space program designing space suits for astronauts. How cool is that? The first step into space really is a model rocket!

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