Issue 627 / June 4th, 2024

PEAK OF FLIGHT NEWSLETTER

Apogee Components, Inc. / ApogeeRockets.com / Colorado Springs, CO

Checklist for Dual Deployment in High Power Rocketry (Part 2)

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COVER PHOTO

Katana

The Katana is a large 4-inch diameter rocket that is powered by 54mm diameter rocket motors. It is dual-deployment capable with the e-bay compartment included in the kit. Also includes 2 sheets of colorful vinyl decals.

FEATURED ARTICLE

Checklist for Dual Deployment in High Power Rocketry? (Part 2)

by Tim Van Milligan

This article discusses optional components for dual deployment rockets, emphasizing that beginners should master basic dual deployment before adding these extras. Key optional items include shear pins for securing parts, fasteners for assembling long rockets, deployment bags to ensure orderly parachute deployment, recovery harnesses for improved stability during descent, swivels to prevent parachute line twisting, and quick links for easier assembly and disassembly.

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About this Newsletter

You can subscribe to recieve this e-zine FREE at the Apogee Components website: www.ApogeeComponents.com, or by clicking the link here **Newsletter Sign-Up**

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Yukon Gold flying at the SCORE launch in Pueblo, Colorado 05/18/2024

Would you like to see your launch photo featured in the *Peak-of-Flight* newsletter? Submit your photo at apogeerockets.com.

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Checklist for Dual Deployment in High Power Rocketry (Part 2)

by Tim Van Milligan

In the previous Peak-of-Flight Newsletter, we presented a checklist of the mandatory items you'll need when you're doing your first dual deployment rocket. This included things like:

- A Dual Deployment rocket kit
- Dual Deployment Altimeter
- Low Voltage Igniters
- Ejection Charges
- Drogue Chute
- Main Parachute
- Rocket Motor
- Battery
- Electronics Mounting Hardware

Figure 1: *Peak-of-Flight* Newsletter #626

We discussed each of the items, giving you several options that allow you to personalize the process, because every modeler's situation is different. We discussed the pros and cons of the important choices that you'll have to make so that it doesn't seem so daunting or complex.

The optional items for dual deployment

This article goes over the optional items that you might add to your dual deployment rocket. Normally they are added in order to increase ease of use, or provide additional redundancy and safey to the process.

When it comes to these optional components, I always caution people that "less is more" when you are just getting started with a new skill like dual-deployment. You could add these additional items, but it will also add expense and increase complexity in either the construction or the preparation of the rocket prior to launch. You need to get the "basics" of the process down first, before you try to enhance everything.

If you do decide to use these optional components, I recommend reaching out and finding a mentor in your local club that can look things over for you and verify that everything is set up correctly before you launch. Again, it is this additional complexity that prompts me to say to do dual-deployment separate from a high power certification launch.

Shear Pins

Shear pins securely fasten parts together — which are otherwise meant to separate during ejection of the rocket. For example, the nose cone is meant to come off at ejection of the parachute. But anyone that has launched small rockets know that sometimes the nose doesn't come off, or sometimes it is so loose that it comes off early.

Figure 2: Shear Pins are used to temporarily hold sections of the rocket together until deployment.

Shear pins are used specifically to make sure things don't separate early. The nose is put onto the top of the tube, and then to securely hold it on, small plastic pins are placed around the tube into the shoulder of the nose cone to lock it in place.

But the pins are so small, that the ejection charge, when it pushes on the base of the nose cone, will snap these pins in half, releasing the nose cone to come off the rocket. Literally, they are sheared in half by the movement of the nose sliding out of the tube.

Do you really need shear pins when a layer or two of masking tape on the shoulder of the nose cone will also hold it in place? That is a question you have to ask yourself. Obviously, tape is a cheap solution to the same problem.

But there are a couple of disadvantages of tape. First, it it hard to know how much to use. If you make it too tight, then the nose may not come off at all. And second, with too much tape, just putting the nose cone onto the rocket is a chore.

If not enough tape is put onto the shoulder, then there is the possibility that the nose may come off prematurely. Why would it come off early? It has to do with the internal pressure inside the tube of the rocket.

There is obviously some air inside the rocket. This air pressure is equalized while the rocket is on the ground, which means it is the same on the inside as it is on the outside. But as the rocket ascends into the sky, the external air pressure decreases (remember that air pressure decreases until you get into space where there is none). But the air inside the rocket is still higher. This

difference in pressure could cause the nose cone the nose to pop off prematurely as the rocket ascends.

It is for this reason, you can put a pressure relief hole in the side of your rocket. It would help to vent off some of the pressure. See also (**https://www.apogeerockets.com/education/downloads/Newsletter68.pdf**).

It is not always required to have a pressure relief hole. I rarely use them on my rockets.

But in a couple of situations, you will want to use shear pins. The worst case situation is for larger diameter rockets, and those that use high-thrust motors where the rocket is meant to exceed Mach 1.

In the case of large diameter rockets (greater than 4-inches in diameter), there is a lot of volume of air in the tube, so a lot of air has to be vented during the ascent.

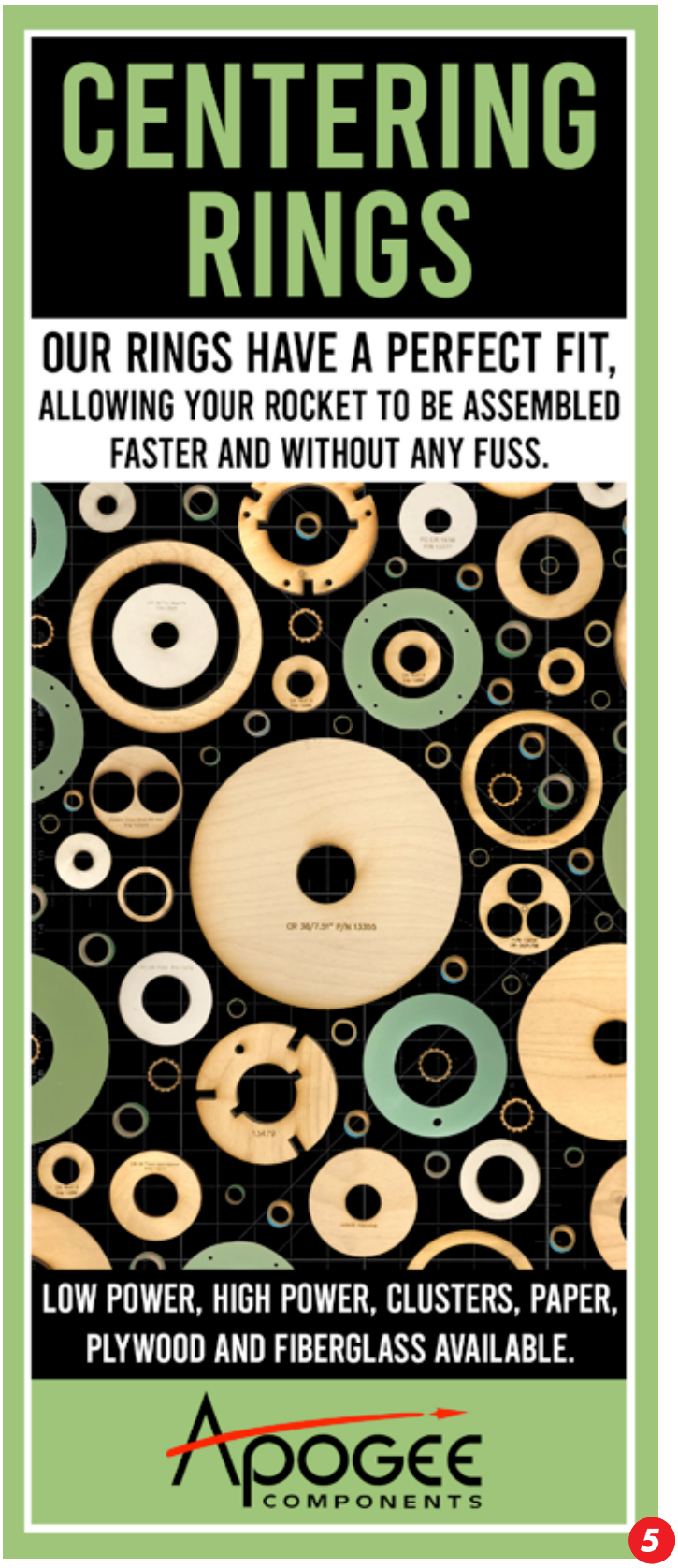
In high speed rockets, you just can't dump the excess pressure fast enough, because the outside air pressure is decreasing faster than air can flow out of the rocket.

In both of these cases, you shouldn't take chances, and this is where shear pins would be required.

I also tend to use shear pins in rockets made from composite tubes (like fiberglass or carbon fiber). The fit of these types of parts is tighter and stiffer, so they hold air inside them better. Whereas, paper tube rockets are more flexible around the joints where the nose cone slides in, so you get more air leakage to help relieve the excess pressure.

Most people use three shear pins in each section of the rocket that they want to stay together during the flight (both apogee and main chute compartments) There are different sizes of shear pins if you think you need more holding force.

Once you decide to use shear pins, this will definitely change the amount of black powder you'll need to separate the parts during the flight. Again, use RockSim



v11 to calculate the amount of BP needed. It does automatically calculate the amount of extra needed to actually shear the pins.

More information about shear pins can be found on our website at: **https://www.apogeerockets.com/Building-Supplies/Misc-Hardware/Nylon-Shear-Pins-20-pack**

Fixing paper tubes from shear pin damage - **https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_334**

Fasteners

Fasteners are also used to hold parts of the rocket together. Such as joining long tubes together, that are too long to fit in your car and transport easily to the launch site. You'll bring the rocket out to the field, and do final assembly there.

The difference between shear pins and fasteners, is that the sections that are assembled using fasteners are NOT intended to separate during the flight. So in this case, instead of skinny little plastic pins, we'll use either thicker plastic rivets (which are removable), or actual metal screws and nuts.

We like the plastic rivets for rockets made of paper tubes, and we generally use as many in the rocket as there are shear pins. Since they are beefier than the pins, the

Figure 3: Plastic Rivets are stronger than shear pins, and keep the sections of the rocket together throughout the flight.

weaker pins will split long before the plastic rivets will.

For fiberglass tube rockets, or larger diameter models, we at Apogee Components have special aluminum fasteners (**https://www.apogeerockets.com/Building-Supplies/Misc-Hardware/Aluminum-2-56-Tube-Fasteners-3-pk**) that use regular steel screws to hold the sections together. The aluminum is coated with a chemical that bonds to epoxy which makes them stick in the rocket permanently.

Many modelers like these fasteners because of their exceptional strength and how they have a low profile on the rocket to minimize drag.

If you're building long rockets that need to be assembled on the range because the size of the rocket makes transport difficult, then you'll definitely need some sort of fasteners.

Deployment Bags

The purpose of the deployment bag is to insure a orderly deployment of the parachute of the rocket. As your project gets bigger and more expensive, then using a deployment bag (also called with the slang term: D-bag) is probably something worth considering.

The most common reason that rockets fail in a flight is a deployment issue. There are many types of deployment failure:

- The parachute isn't ejected
- The parachute is melted or damaged by the ejection charge
- The parachute is ejected when the rocket is at too high a speed, and it is torn apart (shredded)
- The parachute wasn't attached properly and becomes separated
- The parachute is fouled (tangled) in other parts of the rocket

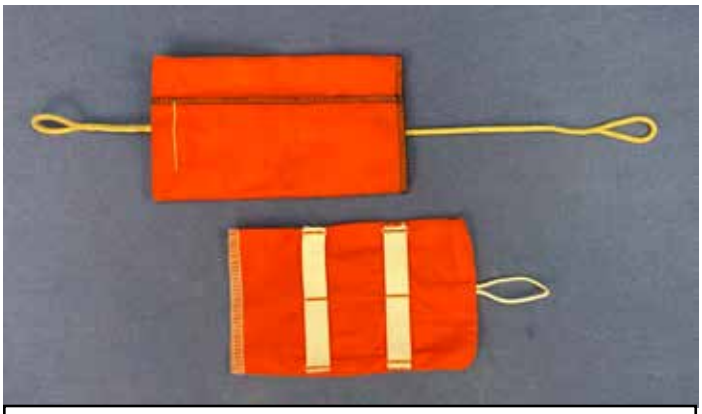


Figure 4: Deployment bags protect the parachute and make sure it opens in an orderly manner.

A deployment bag can help with a lot of deployment problems, because they slow things down and reduce the stress on components.

Essentially, a deployment bag is a cloth bag into which the parachute canopy is put into. The suspension lines are then stowed on the outside of the bag in cloth loops. The way the lines are put into the loops help prevent them from getting tangled like they might if they were simply wrapped around the outside of the canopy like on a small model rocket.

At ejection, the entire bag is kicked out of the rocket. Because the bag is holding the canopy, it can't instantly open like a normal parachute. So even during a high speed deployment, the parachute is protected. But the bag, flailing about in the air, is causing some drag and slowing the rocket down.

The real benefit though, is that the suspension lines have to be pulled fully out of the loops of the deployment bag before even the canopy is released from the bag. This really helps to make sure the canopy inflates in the proper sequence.

Additionally, the bag gives some extra protection to the parachute canopy from the heat of the ejection charge. But I'd still recommend wadding or a secondary parachute protector to make sure it is fully protected.

Normally, you don't see a lot of people using deployment bags. I hope that changes in the future, as they could really help with a lot of recovery issues. There is a learning curve to using them properly, but I hope this is one optional item that you do consider adding to your dual deployment project. And yes, you'll need two of them, one for each parachute in the rocket.

Figure 5: This massive rocket required harnesses on both ends of the tube.

Recovery Harness

A recovery harness is just a type of shock cord, with convenient attachment points sewn into the ribbon for the parachute and the nose cone.

The advantage is that the parachute is not attached to the loop on the nose cone, but to the shock cord itself. This can make the system more stable during descent so it doesn't sway around so much. The loop in the shock cord is not in the middle, but closer to the front end where the nose is attached. The reason for this is to prevent the nose cone from being at the same level as the body of the rocket, where the two pieces might bang into each other and cause damage.

We don't have any recovery harnesses currently at Apogee Components. But that doesn't mean that they can't be useful.

Figure 6: A simple harness can be made by tying a knot in the shock cord as an anchor point for the parachute.

Figure 7: The harness allows the chute to be attached in the middle of the shock cord.

What we do is to simply tie a loop into the shock cord itself, so the parachute has a convenient attachment point. However, any knots in the shock cord can decrease the overall strength of the shock cord, so you do have to have a cord that has excess capacity. If your rocket is large and heavy (such as a fiberglass rocket), or you anticipate high speed openings, then a sewn recovery harness may be for you.

But For most 4-inch diameter and smaller rockets, the method of creating a knot in the cord to serve as an attachment point hasn't been a problem.

Swivels

Swivels are used on parachutes to prevent the suspension lines from twisting up as the rocket sways around under the canopy. The swivel allows the parachute and rocket body to rotate independently during descent, preventing the shroud lines from twisting and tangling.

The swivels we have at Apogee Components are the higher end ball-bearing swivels using in the fishing industry. The ball bearings are lower fiction than the cheap ones you'll find at most sporting goods stores, so they work better at preventing your parachutes suspension lines from twisting up.

When selecting a parachute swivel for your model rocket, look for one rated for the weight and size of your particular rocket. The swivels are rated for a static load, which isn't quite the case in rocketry. In rocketry, we can get a big dynamic load when the parachute snaps open.

Unfortunately, we've never had them shock tested, so we can't say how much of an opening force they can handle. This might make a good university engineering test for some students.

But the good news is that we've not yet heard of any of the swivels failing so far. Usually, it is the suspension lines on the canopy that will fail first before the steel swivel lets go. And normally, they are used on the main parachute, which has much lower opening speeds than the drogue chute, and therefore they shouldn't be over stressed.

As an extra precaution, if you are concerned about a swivel coming apart, add a deployment bag to your recovery system that further slows down the opening sequence and lowers the stress on the parachute swivel.

Quick Links

Quick links are another optional item that you might use on your dual deployment rockets. However, in the Apogee kits that are specifically designed for dual deployment, we do include them as part of the components. They just make it easier to connect the different components of the recovery system. They allow you to add and remove from the rocket the parachute and the shock cords.

Figure 8: Quick links are a convenient way to attach shock cords to parachutes.

We find they are particularly helpful when you have an e-bay that you have to fully disconnect the shock cords in order to disassemble them to access the electronic devices inside of them. It is much easier than trying to untie knots that might be used to directly connect the shock cords.

Conclusion

In conclusion, dual deployment is a complex and fascinating aspect of high-power rocketry that requires careful planning, preparation, and execution.

For those who decide to pursue dual deployment, the purpose of this article was to provide a checklist of the necessary components you will need to be successful.

As with any advanced technique, dual deployment requires a significant investment of time, money, and preparation. However, for those who are willing to put in the effort, the rewards can lead to a significant enjoyment of the hobby.

In the end, whether or not to pursue dual deployment is a personal decision that depends on individual goals, resources, and preferences. By understanding the basics of dual deployment and the necessary components, I hope you can make informed decisions about whether to pursue this advanced recovery technique.

REFERENCES:

Getting Started in Dual Deployment

Introduction To Dual Deployment In Rocketry

What Do You Need For Dual Deployment

FAQs on Dual Deployment Rockets

How-To Videos

Setting Up Dual Deployment Electronics

Mounting Electronics in a Dual Deployment Rocket

Make Your Own Ejection Charge Canisters

Is Your Dual Deployment Altimeter Firing At The Correct Altitude?

Shock Cords for Dual-Deployment Rockets

Building a Dual Deployment Ebay for a Small Rocket

Construction and Flying of Dual Deployment Rockets

Turn a Payload Bay Into an E-bay for Dual Deployment

Building Your First E-Bay: Part 1

Building Your First Ebay: Part 2

Building A Hatch-Accessible Ebay

Installing An E-Bay Inside A Nose Cone

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Alternative to a Traditional E-Bay Install

Construction Ideas for Electronics Bays

Build a Vacuum Chamber To Test Your Dual-Deployment Altimeter

Advanced Dual Deployment Techniques

Making A Non-Pyro Dual Deployment Rocket

Redundancy in Deployment Systems

How to Achieve Extreme Altitude Deployment

Make Your Own Pyrotechnic Bolt

Systems Similar to the Chute Release

How to Build Your Own Parachute Release Mechanism

Make A Simple Dual Deployment Rocket

Other Slow-Release Techniques that Mimic Dual-Deployment

The Spool Chute: Low Cost Deployment?

Reefed Parachute

Gradual Parachute Deployment

Simulating Dual Deployment In the RockSim software

Simulating Dual Deployment In RockSim - Part 1

Simulating Dual Deployment In RockSim - Part 2

Simulating Drogueless Dual Deployment Rockets

About Other Types of Rocketry Electronics

How do electronic altimeters work? Part 1

How do electronic altimeters work? Part 2

Rocketry Electronics Explained - Part 1

Rocketry Electronics Explained - Part 2

Electronic Options For Staging Composite Motors

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 certified. 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 toward 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 Design and Construction, 69 Simple Science Fair Projects with Model Rockets: Aeronautics and publisher of the "Peak-of-Flight" newsletter, a FREE ezine newsletter about model rockets. You can email him by using the contact form at https://www.apogeerockets.com/Contact.

SUBMITTING ARTICLES TO APOGEE

We are always looking for quality articles to publish in the *Peak-of-Flight* newsletter. Please submit the "idea" first before you write your article. It will need to be approved first.

When you have an idea for an article you'd like to submit, please use our contact form at **https://www.apogeerockets.com/Contact**. After review, we will be able to tell you if your article idea will be appropriate for our publication.

Always include your name, address, and contact information with all submissions. Including best contact information allows us to conduct correspondence faster. If you have questions about the current disposition of a submission, contact the editor via email or phone.

CONTENT WE ARE LOOKING FOR

We prefer articles that have at least one photo or diagram for every 500 words of text. Total article length should be between 2000-4000 words and no shorter than 1750 words. Articles of a "how-to" nature are preferred (though other types of articles will be considered) and can be on any rocketry topic: design, construction, manufacture, decoration, contest organization, etc. Both model rocket and high-power rocket articles are accepted.

CONTENT WE ARE NOT LOOKING FOR

We don't publish articles like "launch reports." They are nice to read, but if you don't learn anything new from them, then they can get boring pretty quick... Example: "Bob flew a nice blue rocket on a H120 motor for his certification flight." As mentioned above, we're looking for articles that have an educational component to them, which is why we like "how-to" articles.

You can see what articles and topics we've published before at: **https://www.apogeerockets.com/Peak-of-Flight?pof_list=archives&m=education**. You might use this list to give you an idea or two for your topic.

Here are some of the more common articles that we reject all the time, because we've published on these topics before:

- How to get a L1 Cert
- How to get an L2 or L3 Cert
- Building cheap rockets
- How to 3D print parts
- Building Low Cost Launch Equipment (pads and controllers)
- Getting Back Into Rocketry After a Long Hiatus
- How to Build a Rocket Kit
- How to Build a Computer (too technical)

ARTICLE & IMAGES SUBMISSION

Articles may be submitted by emailing them to the editor. Article text can be provided in any standard word processor format (MS Word, Libre Office, etc.) or as plain-text. Graphics, meanwhile, should be provided in either a vector format (Adobe Illustrator, SVG, etc.) or a raster format (such as jpg or png) with a width of at least 600 pixels for single column images or a width of 1200 pixels for two-column images. If possible, it is generally preferable for images to be simple enough to be readable in a two-column layout, but special layouts can use the whole page width if required.

Send the images separately via email as well as showing where they go by placing them in the word processor document.

ACCEPTANCE

Submitted articles will be evaluated against a rubric (available here on our website). All articles will be evaluated and the results will be sent to the author. In the evaluation process, our goal is to ensure the quality of the content in *Peak-of-Flight*, but we want to publish your article! Resubmission of articles that do not meet the required standard are heavily encouraged.

ORIGINALITY

All articles submitted to Peak-of-Flight must not have been run in another publication before inclusion in the *Peak-of-Flight* newsletter, but it may be based on another work such as a prior article, R&D report, project report, etc. After we have published and paid for an article, you are free to submit them to other publications.

RATES

Apogee Components offers **$300** for a quality-written article over 2,000 words in length. Payment is pro-rated for shorter articles.

WHERE WILL IT APPEAR?

These articles will mainly be published in our free newsletter, Peak-of-Flight. Occasionally some of the higher-quality articles could potentially appear in one of Tim Van Milligan's books that he publishes from time to time.

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