Apogee Components

PEAK OF FLIGHT

NEWSLETTER

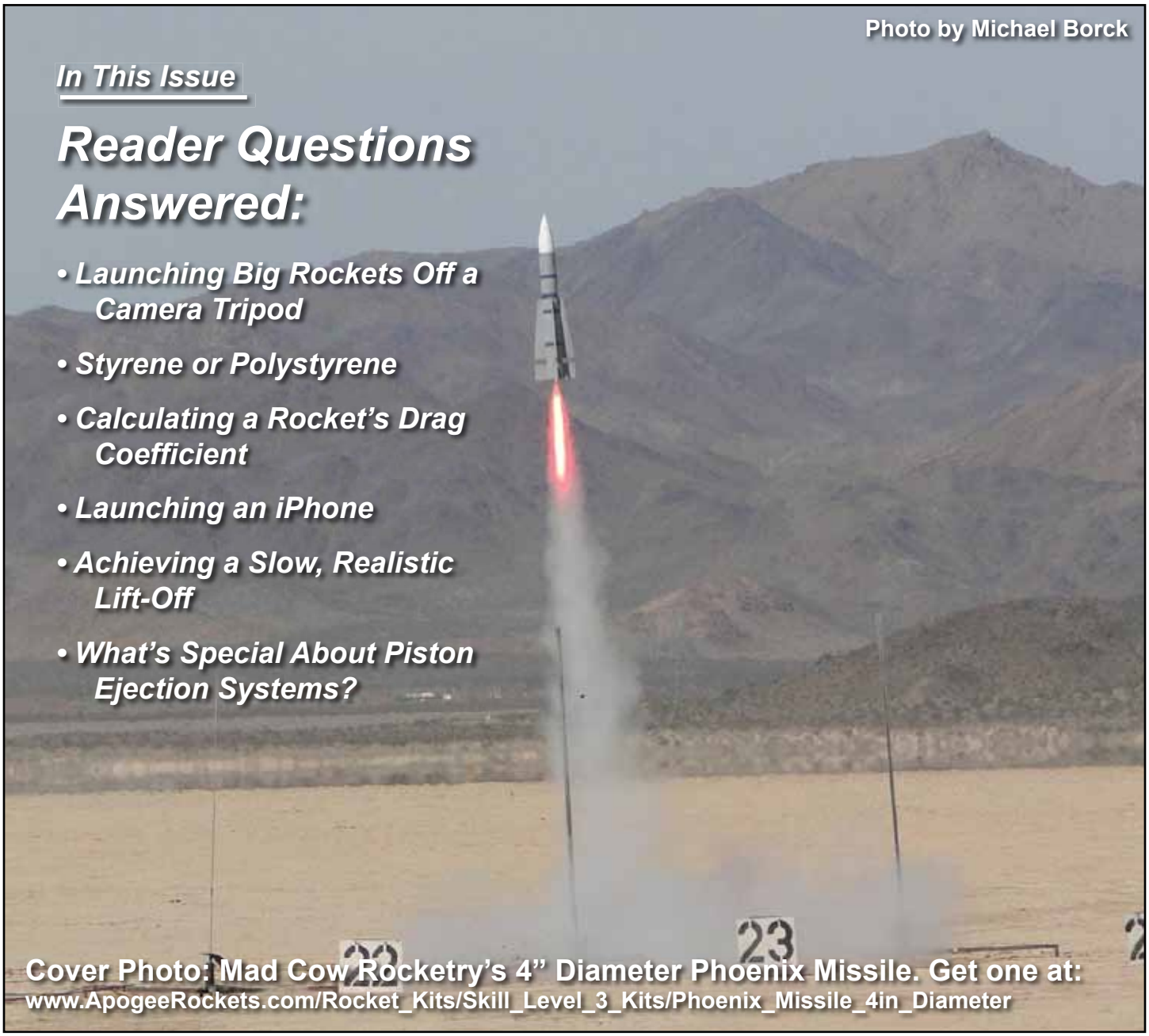

Photo by Michael Borck

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Cover Photo: Mad Cow Rocketry's 4" Diameter Phoenix Missile. Get one at:
www.ApogeeRockets.com/Rocket_Kits/Skill_Level_3_Kits/Phoenix_Missile_4in_Diameter

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ISSUE 315 JUNE 19, 2012

Reader Comments, Your Questions Answered, and Article Corrections

By Tim Van Milligan

Credit Where Credit is Due

Bob Wingate writes: *"I recently saw the flip-out fins article in your newsletter #313 (*www.ApogeeRockets.com/Education/Downloads/Newsletter313.pdf*), and I have to give credit where credit is due. The upper stage Saturn V* (shown in the figures 11-15) *is not mine - it was built and is owned by John Palmer of Hutchinson, Kansas. I was in Hutchinson for NARCON 2012 and enjoyed talking with Tim Van Milligan, and I may have brought the Saturn to his attention (I don't recall for certain). I apologize if I was the source of any misunderstanding, and I appreciate the opportunity to clear things up here."*

Thanks for that correction. I'd like to give credit to John Palmer too for that model. It was impressive.

Launching Big Rockets Off A Camera Tripod

Inge Eide Johnsen asks: *"Can I use a tripod with a adapter when using an E-power engine?"*

Figure 1: The Odd'l Tripod Adapter allows you to launch rockets off a camera tripod.

Great question, Inge. To start, the size of the rocket is more important than the power of the engine. The tripod adapter from Odd'l Rockets (www.ApogeeRockets.com/Launch_Accessories/Launch_Pads/Adeptor_Camera_Tripod_to_Launch_Rod_Adapter) is sturdy by itself and clamps down hard on the launch rod. Any weakness is going to come from the camera tripod itself.

Figure 2: A heavy object, like this full water jug, hung from the hook on a tripod, makes it much more stable and able to handle larger rockets.

Camera tripods are designed to be lightweight, so they are easily carried around by photographers. And it is this lightweight aspect that can be a negative for a launch pad. Ideally, you want a heavy base, so that the rocket can't tip over when sitting on the pad. The Gun Turret pad (www.ApogeeRockets.com/Launch_Accessories/Launch_Pads/Gun_Turret_pad_only) is a great example of a pad with a lot of heft to it, because it is made out of heavy-gauge steel.

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About this Newsletter

You can subscribe to receive this e-zine FREE at the Apogee Components web site (www.ApogeeRockets.com), or by sending an e-mail to: ezine@apogeeRockets.com with "SUBSCRIBE" as the subject line of the message.

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Apparently, photographers have the same problem with creating a stable platform as us rocketeers. So to make them more stable, a lot of camera tripods have a hook on the bottom center pole. This is to tie the camera to the ground. I've seen people hang heavy objects (like water jugs) to the hook to make the tripod more stable. If you do that, you can launch some fairly impressive size rockets with big motors off of them.

A Correction of Terminology

Joseph Avins sent in this comment: "*A letter regarding a back issue of Peak-of-Flight, and a pet peeve of mine: In the article on constructing flip-out fins (Newsletter #313 at www.ApogeeRockets.com/Education/Dowloads/Newsletter313.pdf), you referred to a styrene tube (used as the rotating collar around a dowel pivot.) This tube was not styrene. Styrene is a highly inflammable, highly toxic, and most likely carcinogenic volatile liquid. It is also the precursor chemical for the manufacture of polystyrene, the thermoplastic of which your tube, and many other modeling parts are made. I'm taking the time to write not just to pick nits with you, but because this error is made widely and often by modelers (in rocketry and otherwise) and also by the sellers of polystyrene parts. It's wrong, and we should all do what we can to stop referring to a very useful and safe material by the (admittedly similar) name of of a very dangerous (admittedly related) chemical.*"

Thanks for the clarification. It is good to be technically accurate, since it prevents misunderstandings in the future.

Calculating A Rocket's C_d

Dan Moses writes: *"In response to your interest in deriving a rocket C_d from altimeter data* (Peak-of-Flight Newsletter 303 at www.ApogeeRockets.com/Education/Downloads/Newsletter303.pdf), *I would like to direct your attention to the results obtained by the NASA SLI group I mentor at Falls Church High School. They used one of the AltusMetrum altimeters (*www.ApogeeRockets.com/Electronics_Payloads/Altimeters/TeleMetrum_Starter_Set*) pur-*

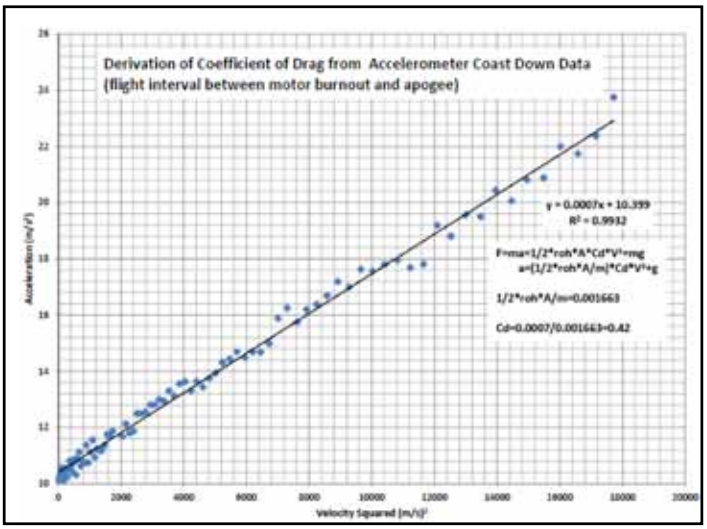

Figure 3: Flight data used to calculate the actual Cd of a rocket.

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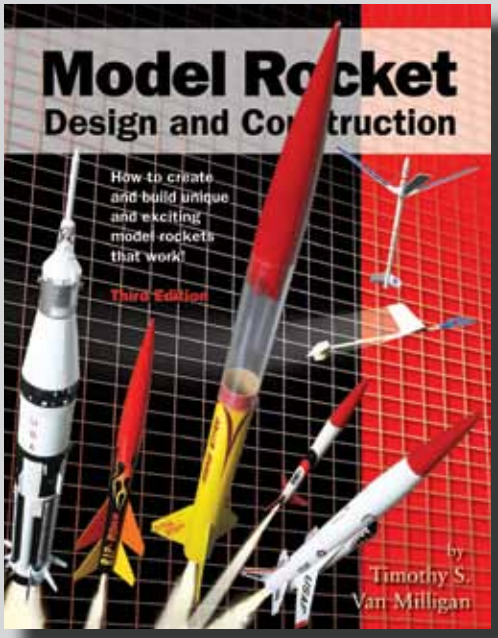

Model Rocket Design and Construction

By Timothy S. Van Milligan

The Expanded 3rd Edition

This massive, 328 page guidebook for serious rocket designers contains the most up-to-date information on creating unique and exciting models that really work. With 566 illustrations and 175 photos, it is the ultimate resource if you want to make rockets that will push the edge of the performance envelope. Because of the number of pictures, it is also a great gift to give to beginners to start them on their rocketry future.

For more information, and to order this hefty book, visit the Apogee web site at: www.ApogeeRockets.com

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chased from Apogee in their full scale test flight in March. From a plot of acceleration vs velocity squared during the coast phase, they came up with a very good estimate of the rocket C_d. Have a look at slides 11 and 12 of their FRR presentation posted on their web site: http://www.fallschurchsli.org/documents (See Figure 3).

FWIW, Rocksim would be much more useful in this kind of work if one could export an excel (csv) file corresponding to the simulation points plotted in any given graph Rocksim produces. Most kids know how to make graphs from the chart function in ms excel."

That is a very cool confirmation of the C_d method from Newsletter. I'm happy to see that it results in very good data.

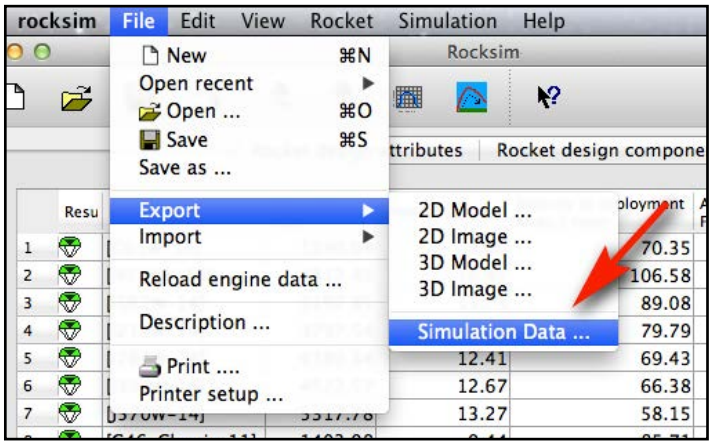

Figure 4: RockSim can export the raw flight data to a spreadsheet program.

Regarding your suggestion about RockSim exporting data in csv format, it already does allow you to export data that way. Go to the "File" menu in RockSim, and select "Export" and then "Simulation Data..." (see Figure 4). From there you will get a dialog box that will ask you what data you wish to export.

If you need additional help on this, see our video "20. Export RockSim simulation data to a MS-Excel spreadsheet, and combine data to make comparison graphs." You'll find it at: www.ApogeeRockets.com/Rocksim/RockSim_Video_Tutorials

Launching an iPhone

Pat Murphy tells us of his cool project involving an iPhone.

"We're going to launch my daughter's science project iRocket6GS next weekend.

I'll be putting the iPhone App that records the video and rocket telemetry on the App Store for $0.99, it's going to be called, "iRocket6GS or MyRockets", and will work in iOS5.0 with iCloud of course. It will work on an iPad for the Ground Control, and an iPhone 3GS for the Rocket-the same App will run on both. The iPad will take the ground video, and the rocket iPhone 3GS will take the launch video, and rocket telemetry. When the rocket comes back, the iPad will talk to the iPhone to get all the rocket telem-

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Figure 5: This Jay Hawk rocket was modified to carry an iPhone.

etry data so you can see the Altitude, Acceleration graphs on the iPad.

Attached is a photo of the Rocket. It is basically a modified Madcow Jay Hawk Rocket (www.ApogeeRockets.com/Rocket_Kits/Skill_Level_3_Kits/Jay_Hawk_AQM-37A) with a payload bay for the iPhone. The rocket weighs 32oz fully loaded. The iPhone payload bay is actually very easy to build, it would only take someone an hour or less to do with the proper parts."

Achieving a Slow, Realistic Lift-Off

Austin R. von Kleist asks: "*One thing I've always wanted to achieve with a model rocket is actually a slow, dramatic launch - one that builds speed more like a large 'real life' rocket. My question is this: What are some methods for achieving a nice slow and dramatic launch that will build in speed?"*

This has got to be one of the most frequently asked questions of all time. I remember hearing this one when I was a designer at Estes in the Early 1990's. I've probably answered it a thousand times, so if this is redundant to you, I beg your forgiveness.

The problem with slow lift-off speeds with model rockets is that they aren't usually stable. In other words, they go horizontal more often than they go vertical. This means they are highly unsafe. UNSAFE!

Why are they unsafe?

The reason is how the rocket is stabilized. Our rockets use the aerodynamic forces created by the air flowing over the fins to keep the rocket oriented and flying straight. The more air that flows over the fins, the greater the force that is created – which means that the rocket stabilizes faster in response to a disturbance.

This comes from the Lift-Force equation, because it is the lift-force that stabilizes the rocket.

$$\text{Lift} = \tfrac{1}{2}\,\rho\, V^2\, C_L\, A$$

The important term is the V, which stands for velocity. Lift is proportional to the velocity squared. In other words, when you double the velocity, and the lift force goes up by four times. This is great news.

But on the flip side, when you reduce the velocity of the rocket (by making it fly slower), the lift force decreases, and the rocket becomes sluggish to respond when there are disturbances to the flight -- such as a sudden gust of wind when the rocket takes off.

The Space Shuttle, and other NASA launchers are different. They don't typically rely on the fins to steer the rocket. They use active guidance systems, such as nozzles that pivot. These are called gimbled nozzles, and are why big rockets no longer have fins. See Peak-of-Flight Newsletter 248 for a detailed description of how they work (www.ApogeeRockets.com/Education/Downloads/Newsletter428.pdf).

The only models that are safe at slow speeds are those

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that use drag (not LIFT) to stabilize the flight. These models rarely have fins on them, so they are less susceptible to gusts of wind than a typical rocket. While this sounds like good news, they are probably not something that would fit your criteria. For example, they don't look like a rocket, and they don't accelerate like you'd want to see. They look more flat and squat than long and slender. An example of this type of model would include the pyramid shaped rockets (like www.ApogeeRockets.com/Rocket_Kits/Skill_Level_4_Kits/King_Tuts_Pyramid), UFO disks, and Spool rockets (as shown in Figure 5).

Figure 5: Ernie Puckett loads a spool rocket on a launch rod. Two other spools are in the lower right.

If you are going for slow lift-offs, then I strongly suggest a really long launch rod. A typical rocket needs to be traveling at around 30 mph by the time it clears the rod. There isn't any way to find the exact minimum speed, but this 30mph is a good rule-of-thumb to use. It is based on 50+ years of experience by members of the NAR. Rockets that exceed this speed at lift-off are generally safe, while those that take off at lower speeds are much more likely to veer off course.

You can find this lift-off speed in RockSim, as it is

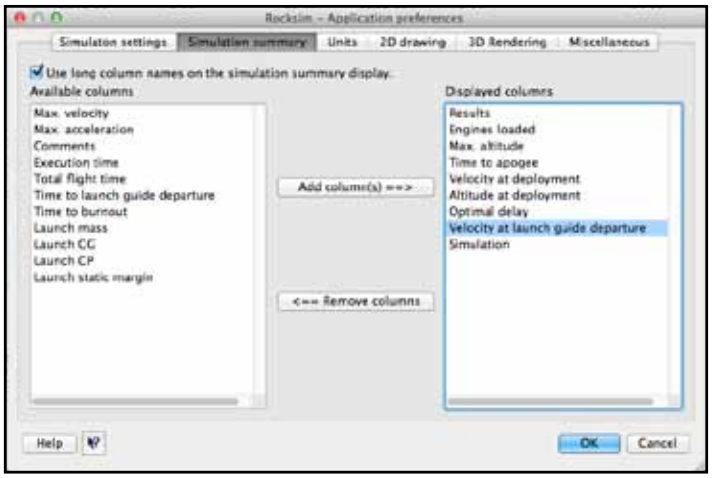

Figure 6: In RockSim, go to the preferences and in the Simulation Summary tab, make sure to display the "velocity at launch guide departure."

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For Great Articles for This Newsletter

Are you a writer looking for some serious pocket change? We're paying up to $350 for good how-to articles for this newsletter. If you're interested, see our submission guidelines on the Apogee web site.

www.ApogeeRockets.com/Newsletter/Newsletter_Guidelines

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Cd override | Flight simulations

delay	Velocity at launch guide departure Miles / Hour	Simulati
6.56	34.16	
8.21	42.87	
9.45	53.21	
10.02	63.53	

Figure 7: The Velocity at launch guide departure should be greater than 30 mph for a safe launch.

called: "velocity at launch guide departure." It can be displayed on the main summary screen by selecting it in the preferences. I always display this when my computer's running RockSim, because of its critical importance. If your rocket doesn't reach this speed, then the first option is to make the launch rod longer. This gives the rocket some additional time to accelerate up to that minimum lift-off speed.

The Realistic Effect

I really do understand what is trying to be achieved by having the rocket take off slow. It is a "visual effect." You want to be close to the pad so that you can hear the roar of the motor at a higher decibel level, you want to see voluminous clouds of billowing smoke, and you want it to appear "majestic."

How would you like some ideas that allow you to cheat, so you can get some of this same effect without the danger of the rocket going unstable? That would be cool, wouldn't it?

What I've seen a lot of modelers do is to build a special launch pad for their model. Under the pad, they have some additional motors that are there just for their special effect. They ignite this motor to make a pre-roar and to build up the amount of smoke at the base of the launch pad. So when the rocket takes off, it creates the impression that it lumbered off the pad because of the loud noise and the smoke at the base.

To increase the effect, what I like to do is use "White Lighting" propellant motors in the rocket itself. These motors produce a huge white flame coming out the base of the rocket. It really does make it look like a big powerful rocket. In fact, if you look at a lot of the photos on the Apogee Components web site, you'll get the impression that it does seem that I prefer these types of motors. Example: www.ApogeeRockets.com/Rocket_Kits/Skill_Level_3_Kits/Wart-Hog

By the way, do you know how fast the Space Shuttle takes off? It is going over 100mph by the time it clears the tower. It only looks slow because the size is big. So that is another option to make your rockets look slow. Do what NASA does, build bigger rockets so that it is easier to follow skyward, and therefore appears to be slow.

Finally, another way to achieve the effect is by video-recording the launch and then replaying it at a lower frame rate. This makes it look like it took off slow, and you get to see it over and over as many times as you want.

Sorry... I know that is not what you wanted to hear. Everyone likes the Slooooow - Reeeeeeeeeealistic effect. But it can be really dangerous.

What's Special About Piston Ejection Systems?

Bill Leyrer writes: *"As I have been preparing for my Level One Certification, I have been reviewing the forums*

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related to this subject and I can't help but notice a continual "debate" over Piston Recovery. It's "go" - "no go" from entry to entry.

Some guys say they are so pro towards piston recovery, that they implement it into their 18mm and 24mm rockets as well.

Anyway, due to the huge number of first time inquiries I see on the forums related to this recovery method, I was wondering if maybe this could be the topic of a future newsletter and/or newsletter.

Personally, I would like a greater understanding of piston recovery and especially how it can be added to a rocket that wasn't/isn't originally designed for one.

As always, thanks for all that Apogee provides for rocketry."

In any aspect of engineering, there are trade-offs. This is one of those situations where you gain some admirable qualities by adding a piston to a rocket, but you also get some undesirable aspects too. If you minimize the negative aspects, then pistons are just fine-and-dandy.

To start, the purpose of a piston is to forcefully push out the recovery device from the rocket. It was developed because many rocketeers experienced the issue where the chute didn't eject fully out of the rocket tube. I'm sure you've seen many rockets like this, because they are far too common. According the NAR's safety records, recovery device failures account for the highest percentage of safety incidences.

A piston solves at least one aspect of this, in that it pushes everything out of the rocket. So at least the laundry is out on the line. Whether it opens or not is a completely different issue. That is where deployment bags come in handy (www.ApogeeRockets.com/Building_Supplies/Parachutes_Recovery_Equipment/Parachute_Deployment_Bags).

The piston itself is a "plug" that slides within the rocket tube. Because it completely fills the tube, no ejection gases can get past it. So all the ejection charge gases are captured for use in pushing the plug and the parachute out of the rocket. Additionally, it serves as "wadding" to protect the parachute from the head of the ejection charge gases. So if you use a piston, you don't need any other device (like wadding, Nomex chute protectors, or baffles) to protect the chute. It is already protected.

In high powered rockets, there is usually a shock cord tied to each side of the piston as can be seen in Figure 8.

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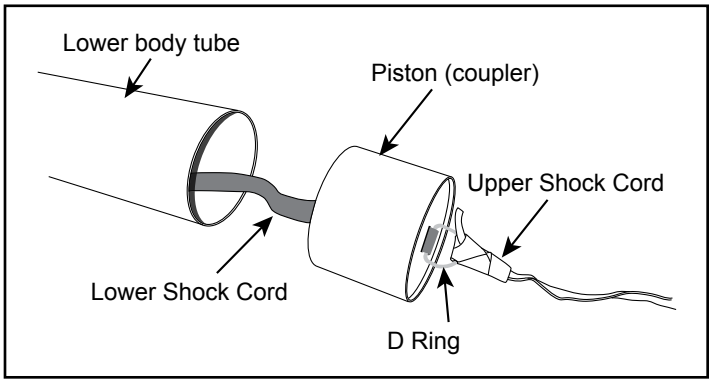

Figure 8: Typical arrangement of a parachute ejection piston.

This makes the piston completely resuable. One drawback is that the cord and the anchor get pretty toasted by the hot ejection charge gases. Therefore, you should always tug on the cord to make sure that its strength and integrity hasn't been compromised by a previous flight.

In small rockets, the plug is disposable, and usually made from a small cylinder of foam. This presents a problem, in that the nose cone doesn't have a shock cord attached to it. Either the rocket has to come down in two pieces, or you have to find a way to attach the pieces together. This is usually done by putting the anchor on the outside of the rocket, like gluing the shock cord into the fin fillet. This adds to the drag of the rocket (since part of the shock cord is external), so it is mostly used on competition style rockets where you want the rocket to come down horizontal anyway.

The big issue with piston ejection systems is that they have to slide easily in the rocket tube. If they don't slide in the tube, you have a big problem, since the parachute is never going to come out. And the ejection charge gases want to escape the tube somehow. Either they are going to kick the engine rearward out of the rocket, or it is going to burst the tube, ruining the rocket. Either way, without the parachute coming out, the rocket is going to have a ballistic reentry and is going to smash itself up pretty good.

When using a piston, you have to make sure that the tube you use is long, because you can't use them on rockets with tube couplers inside the tube. The coupler would prevent the piston from sliding forward. If your rocket has a coupler in it, then the piston has to be placed forward of that part so that it slides freely in the tube.

It really does come down to the fit of the piston in the tube. Too tight, and you better hope that the ejection charge has enough kick to push it out. Too loose, and the piston can tilt slightly in the tube, and actually get wedged in place. Also, the sooty residue from the ejection charge builds up in the tube, and changes the fit of the piston sliding in the tube. You really do have to clean off this residue between launches, because it has been known to cause problems.

The nice thing about piston ejection systems is that when they work, it really pushes the nose cone out with authority. The small rockets have a distinctive POP sound (like a spud gun) when the piston exits the tube.

Would I use a piston? Sure. They work fine. But that being said, I wouldn't use one on a rocket that you're using for a Level-1 certification attempt. The reason it that it adds to the complexity of the rocket. Whenever you increase complexity, you decrease reliability. And on a critical flight like a L1 certification attempt, you want to keep things as simple as possible.

We do have one kit at Apogee Components that uses a piston ejection system. It is the Aerotech Sumo rocket kit (www.ApogeeRockets.com/Rocket_Kits/Skill_Level_3_Kits/Sumo). It is a nice kit if you'd like to test out a rocket that uses this type of recovery device helper.