

# APOGEE

## PEAK OF FLIGHT

### N E W S L E T T E R

#### 7 Reasons why You're Glad You Bought Rock Sim

Many people thought you were crazy to plop down \$85 for a piece of rocketry software. There are plenty of cheap programs available. Besides, you can download the FREE demo version of RockSim. Now you're considering buying our other program called AeroCFD.

Will it be a good investment? Will it be worth it?

First, ask yourself: "Was it worth buying RockSim?"

I thought I'd remind you of just seven things that RockSim software has done for you. Maybe this will help you decide if investing another \$65 for the AeroCFD will also be a wise purchase.

**1. Apogee Service** - We work regular business hours, so you can have confidence that you can get a quick answer to your questions about the software.

**2. Confidence that the company behind the program will be around for a long, long time.** Since the model rocketry market is such a highly volatile industry, you don't want to find out that the company you bought your software isn't around any longer to offer you technical support. Apogee Components has survived more than 12 years in the hobby, with many more to come in the future.

**3. Portability** - RockSim is used by so many people that you can send your design files to your teammates working on a big group project.

**4. Industry Supported** - Other manufacturers (PML, LOC, Aerotech, and more) are using RockSim to design their rockets, and they are posting the design files to their web sites where you can test fly the rockets before purchasing them. This saves you money by only buying the kits that suit your needs.

**5. Apogee Components educates customers** through workshops, one-on-one assistance, and through the e-zine newsletter. What other software manufacturer does this? That's what we call real "support." If you can't interpret the results, what good is the software?

**6. Persistent Pursuit of Perfection** - Ever since Apogee released RockSim v1.0 in April of 1996, and AeroCFD in 2001, we've been constantly updating both programs to make them more accurate and to add additional features to them. And were not done yet...

**7. Leaders in Innovation** - Because we are committed to a persistent pursuit of perfection, we've had to be innovators. Not by choice, but by necessity. Both programmers of RockSim and AeroCFD are rocket modelers, and know what would be really cool -- and that is what they strive to do when they write the software. When you buy either program, you support innovation. That has direct benefits for you - better accuracy, and more features to allow you more design freedom!

As you can see, these reasons to buy from Apogee don't even include the technical aspects of the software! When you add those to this list, I'm sure you'll conclude that buying from Apogee Components is your best investment!

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7) FREE Rocket plan by Shrox

Apogee's catalog on CD/ROM!  
[CLICK HERE](#)

Apogee's Rock Sim and AeroCFD Software  
[CLICK HERE](#)

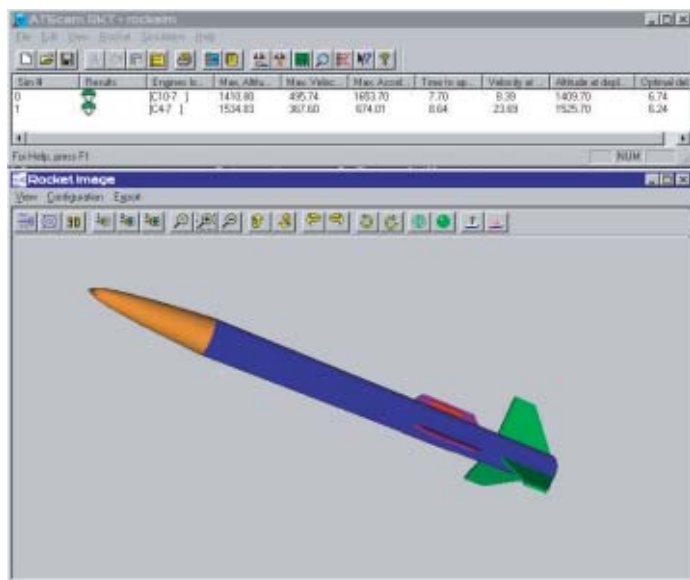


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***"What is RockSim?"***

RockSim is a collection of many unique computer programs - that are seamlessly integrated into "one" package. It has these features:

1. A **"CAD-like Drafting Program"** to aid in laying out the arrangement of the component parts; and to draw 3D images of the rocket.
2. A **"Coefficient-of-Drag Prediction Program"** to find out the efficiency of the rocket's shape.
3. A **"Optimum Mass Prediction Program"** - to find the best weight of the rocket that gives the highest altitude.
4. A **"Center-of-Pressure Prediction Program"** - to find the static stability of the rocket.
5. A **"Center-of-Gravity Prediction Program"** - to find out the overall weight of the rocket and its stability during flight.



*Actual screenshot in 3D mode of RockSim.*

6. A **"Dynamic Stability Program"** - to find out the trajectory of the rocket; including what happens when wind acts on the model.
7. A **"Flight Simulation Program"** - to find out how high and fast the rocket flies; and as an aid in helping you in selecting rocket engines.
8. A **"Component Selection Program"** - print out a list of materials to make it easier to gather parts when constructing the rocket.
9. A **"Pattern Sheet Program"** - used to print fin and centering ring patterns.
10. A **"Component Design Program"** - which helps you create new and unique nose cones, curved transition sections and odd shaped fins.
11. A **"Special Events Editor"** - used to select when, where, and how to use electronic initiation devices during the flight.
12. A **"Graphing Package"** - to create order & meaning from complex information generated by each launch scenario.
13. A **"Recovery Device Selection Program"** - to determine what size parachute or streamer is needed to safely bring the rocket to the ground.
14. A **"Landing Zone Prediction program"** - to find out where the rocket will touch down, and to see if the field is large enough. Or you can use this to find out the angle the rocket needs to be tilted into the wind for a close proximity recovery.
15. A **"Teaching Aid"** - to help explain concepts to others using a visual tool of the 2D flight profile; and to generate raw data that can be analyzed in a classroom environment.

RockSim is simply an awesome collection of programs designed to make rocketry safer and more fun for you! If you've never tried RockSim, you can download the free demo version from the Apogee web site. It is at:  
<http://www.apogeerockets.com/rocksim.asp>

**About this Newsletter** - Apogee Components Rocketry E-Zine Newsletter is a FREE optional newsletter about model rocketry. We have, and we'll continue to discuss a lot of different rocketry topics, including: rocket design philosophy, computer simulations, construction techniques, rocketry in education, happenings in the rocket industry, competition strategies, and new product announcements.

## Design, Construction, and Flying Strategies For Achieving Maximum Altitudes

by Tim Van Milligan

Jonathan D Elder writes me this question:

*"I recently got into building competition grade model rockets as a method of teaching a young friend of mine about the fine aspects of model building and also the physics behind the dance of the rocket. I have thoroughly spanked him every time he has attempted to build a better model (better = altitude achievement) than I. But he is learning fast and it has become a challenge for me to build a better model than he. One thing you might do in an e-zine article is take the Apogee Blue Streak rocket kit and describe how you would modify the design to make it competition grade."*

I get similar types of questions all the time, so I guess it is a good time to write an article on what I'd recommend.

Let me start by saying this is a really good question that illustrates something important. To achieve a objective like this, you have to consider all phases of the project: design, construction, and flying strategies.

I've seen a lot of people put a lot of effort into building a great rocket, but the design of the rocket is not optimized for maximum performance. And then, they don't consider that the flying strategies will have a huge impact on the final results too. What happens when you get out to the flying field and the wind is blowing briskly, and the sky is overcast. You have to consider this problem from all angles.

Because of this, modifying an existing rocket kit isn't going to give you the same performance in this case as building a rocket from scratch. Some of the parts may be the same as a kit, but the flight results will be radically different. So for the purpose of this article, let's start with a clean slate instead of modifying a kit like the Blue Streak.

### Design Considerations

We're in a real fortunate time period right now. We have at our disposal two really great computer programs that we can use to optimize our rockets for peak performance. These are RockSim and AeroCFD.

AeroCFD will allow us to tweak the shape for best performance, and RockSim tells us how high the rocket will fly and what will be the best choice of rocket motors for it.

Starting with the nose cone; a lot of people will tell me that the cone shape gives them the best performance in RockSim (that it has the lowest drag of all the shapes). Unfortunately, RockSim uses the DATCOM method, which is an semi-empirical method of computing drag that isn't specifically designed for this purpose.

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## Design, Construction, and Flying Strategies for Achieving Maximum Altitudes

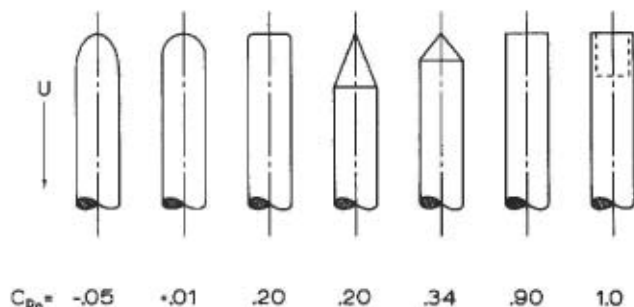
Cont. from pg 3

The equation that governs the nose cone drag for the DATCOM method (and hence, RockSim) is listed in the book: *"Topics in Advanced Model Rocketry."*

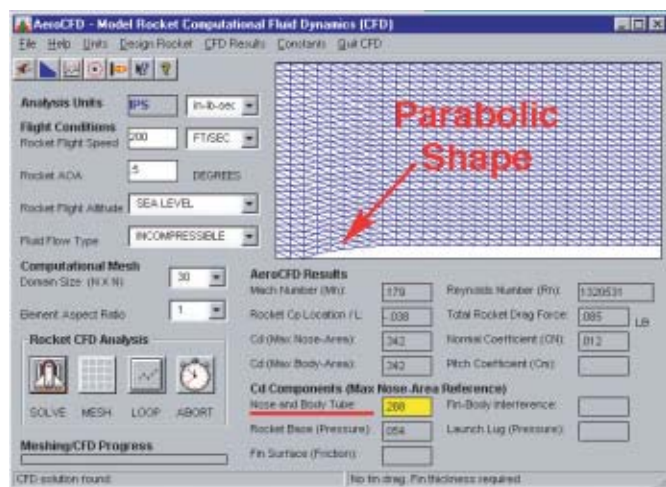
If you look at chapter six, equation 166, you'll see that the software calculates the  $C_d$  based on the "wetted surface area of the body" and the "maximum cross-sectional area" of the body. The shape of the nose really is ignored and only is taken into account by the affect it has on the surface area of the nose.

Since the "cone" has the smallest surface area, the DATCOM method predicts that it will have the lowest drag. The DATCOM method gets us in the ballpark, and it is easy to calculate, but it is not a perfect method.

The actual pressure drag of each shape nose cone is also found in the *"Topics in Advanced Model Rocketry"* book on page 381. So you can see the dilemma.



How to solve this problem? Either use a wind tunnel, or the AeroCFD software that actually calculates the pressure drag on the nose cone.



In AeroCFD, you can find the  $C_d$  of the nose and body for practically any nose cone shape. This eliminates the errors associated with the DATCOM drag method.

The AeroCFD software is really a good choice for tweaking the shape of the rocket; and I really recommend investing in it if you want maximum performance out of your rockets.

Another thing that I recommend is to make the model as short as possible. The reason is to minimize skin friction drag and reduce the weight of the rocket. The smaller the surface area, the lower the friction drag. The lighter the weight, the more room you have for errors during construction.

But you do have to be careful with short rockets. The CP versus CG relationship is critical. So you'll have to run the designs through RockSim to make sure you have adequate stability.

Whenever designing altitude rockets, it is best to use a minimum diameter vehicle. If the diameter is larger than the motor, make sure it has a boattail. But it is always better to go minimum diameter.

Fin shape has been discussed before. My preference is for rectangular or trapezoid shape fins for the simple reason it is easier to make a good consistent airfoil in them. See the article at: [http://www.apogeerockets.com/technical\\_publication\\_16.asp](http://www.apogeerockets.com/technical_publication_16.asp)

High aspect ratio fins are theoretically more efficient - less induced drag. But they can flutter easily - which is really bad from a drag perspective. So you can make some trade offs with your fins; and just make sure they are big enough by running them through RockSim. Think "small."

### Building Considerations

The big thing to consider when building altitude models is getting the weight down. This means you'll probably need to switch to high tech materials or advanced construction techniques. This includes vacuum form nose cones, contest grade balsa wood, fiberglass or vellum for the tube, etc.

You need to strip every gram of mass out of the rocket as possible without sacrificing safety.

Try to get well below the optimum mass as possible. It may be difficult with 18mm black powder motors, but is easier with high thrust or smaller diameter motors.

I like to get below optimum mass so that I can add weight back to the rocket later. When you add weight to the model to get it to optimum mass, start by painting the model. Besides making the rocket more visible in the sky, making the surface smooth with paint will help lower the  $C_d$  of the model, which always helps. If you paint the model, you can even polish and wax the surface for a even slicker flyer.

If you still need to add weight after painting the model, you can add in tracking powder and a larger streamer. Both these items make the model more visible in the sky. If you don't get tracked, you can't win.

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### **Strategies for Achieving Maximum Altitudes** Cont. from pg 4

When building, spend a lot of time sanding good airfoils on the fins. It will pay off. For minimum drag, you want a thin airfoil. I prefer balsa wood over waferglass (fiberglass). With balsa, I can sand an airfoil into the model. This is pretty much impossible with thin waferglass. Those squared-off edges on waferglass are a huge drag producer, even though the fins are thin. A real airfoil is better, even though the fins are thicker.

I've also used 1/32 inch plywood as a fin material with good success. But it is heavier than balsa; so it is a tradeoff you have to decide for yourself. The limiting factor with thin fins is that they aren't very stiff, and will flutter at slower air speeds. When they start to flutter, the drag goes way up - which is very bad. If the flutter is too much, the fins can be ripped off the model. I've seen a lot of waferglass fins strip off the model, which is likely caused by flutter of the tips.

Finally, it is worth noting that the "extreme" competition flyers go to great lengths to make sure the fins are on straight. I've seen some spend over \$300 on special fixtures to make sure the fins are aligned perfectly with the tube. They do this because if the model rotates even slightly, it is using up energy that could otherwise go toward making the model fly higher.

#### **Flying Considerations**

The first thing to you need to do after the model is built is to select the rocket motor. Again, I recommend the RockSim software for this task. It is the only software that can account for wind interfering with the flight path of the model.

With the model already built, your motor choices are probably more limited, but you still have to select the right delay. Ideally, you should take RockSim with you to the launch site and run your simulations based on existing weather conditions. Don't forget to run the optimum mass calculations based on the current weather. You may need to add more weight with tracking powder if the weather is breezy.

When you built your rocket, you should have left off the launch lug. It is a big drag producer that needs to be eliminated. So now your launcher choices are probably limited to a pop-lug, or a tower launcher. My preference is the tower launch pad. People don't realize it, but most of the towers used today are too short. Customize your tower by making it taller so that the model can get to a faster speed when it leaves the pad. This will give you a straighter boost.

In combination with the tower launcher, you should also use a piston launcher below the model. This will help kick the model higher into the air. It could help add another 5 or 10 percent to the altitude!

#### **Get Educated**

Even with great software like RockSim and AeroCFD, you still need knowledge to understand and interpret the results (like why the cone shape nose isn't the best for altitude). You need to read everything about model rocketry that you can get your hands on. Maybe you'll find a nugget of gold in an article that will give you an edge in your quest to fly your rocket to the highest altitude possible.

My personal library of "technical information" fills nearly two whole book cases. If your goal of the highest altitude means this much to you, then I'm sure you'll be a collector of good information too.

If you're reading this article, go ahead and print it out now. File it in a three-ring binder for future reference. You may also want to take it with you to your next club meeting to discuss it with your friends. They may be good sources of information too.

Also be sure to pick up a copy of both these books: "*Handbook of Model Rocketry*" by G. Harry Stine, and my book called: "*Model Rocket Design and Construction*." Both books are filled with valuable information and will help you get a good start on your own rocketry library.

Finally, here are some other articles that appeared in this e-zine newsletter that may help you:

#### **What fin shape is best? -**

[http://www.apogeerockets.com/technical\\_publication\\_16.asp](http://www.apogeerockets.com/technical_publication_16.asp)

#### **How are your flying skills? -**

<http://www.apogeerockets.com/education/newsletter01.asp>

#### **Contest Flying Preparations -**

<http://www.apogeerockets.com/education/newsletter06.asp>

#### **Altitude Flying Strategies -**

<http://www.apogeerockets.com/education/newsletter10.asp>

#### **Detecting Thermals -**

[http://www.apogeerockets.com/education/detecting\\_thermals.asp](http://www.apogeerockets.com/education/detecting_thermals.asp)

#### **Selecting Rocket Motors -**

<http://www.apogeerockets.com/education/newsletter38.asp>

#### **Piston Launchers Explained -**

<http://www.apogeerockets.com/education/newsletter47.asp>

#### **The Moving Target Called "Optimum Delay" -**

<http://www.apogeerockets.com/education/newsletter59.asp>

Author Information: Tim Van Milligan is the owner of Apogee Components (<http://www.apogeerockets.com>) and the new 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 this e-zine at the Apogee Components web site, or sending any message to: [ezine@apogeerockets.com](mailto:ezine@apogeerockets.com) with "SUBSCRIBE" as the subject of the message. This article may be reprinted as long as this paragraph is included with the text.

*Want to shape the future?  
We need you to make RockSim the best!*

### Programmers Wanted!!

Are you a computer programmer that has wanted to crack open the RockSim file format? Maybe you've wanted to use the RockSim files for some type of unique application, such as saving the flight summary data to a PDA computer.

In any case, we're looking for programmers to test out a new RockSim file format. The new XML format we're proposing will allow application developers to use the RockSim files for any number of new rocketry software products. It is a text based format that is easy to read, and stores not only the rocket designs, but also flight simulation data.

If you are a programmer, contact me at: [tvm@apogeerockets.com](mailto:tvm@apogeerockets.com), and I'll send you information on the new file format.

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**STONEBREAKER/AX****by SHROX**

An asteroid threatens Earth. You have just two days to build and fly a first line defense!

The Stonebreaker/AX.

The data file you will need is available for download at:

<http://www.apogeerockets.com/shrox/stonebreaker.html>

**DOWNLOAD THE ROCK SIM PLANS AND DECALS**

**Hurry! Order these parts right away and just hope they are delivered in time!**

- 1- 19400 - Apogee Nose cone - PNC-24A
- 1- 10099 - Apogee Body tube - 24 mm x 11"
- 1- 10085 - Apogee Body tube - 18 mm x 2. 3/4"
- 1- 13029 - Apogee Engine block - CR 13-18 ring
- 2- 13031 - Apogee Rings - CR 18-24 ring
- 1- 29115 - Apogee Parachute - "24"
- 1- 13051 - Apogee Launch lug - "1/8" X 1"
- 1- 29505 - Kevlar 8 in. line
- 1- 14 in. Shock cord and mount
- 3/32 in. Fin stock (balsa or basswood)

Get what you need by phone!  
Call Apogee at **719-535-9335**

