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APOGEE PEAK OF FLIGHT NEWSLETTER

SLI Team Uses Rocksim to Push Their Aspire Past Mach One!

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Don't "Mach" These Aspirations

by Doug Knight

Using RockSim and Apogee Rockets for the NASA Student Launch Initiative (SLI) team at Statesville Christian School

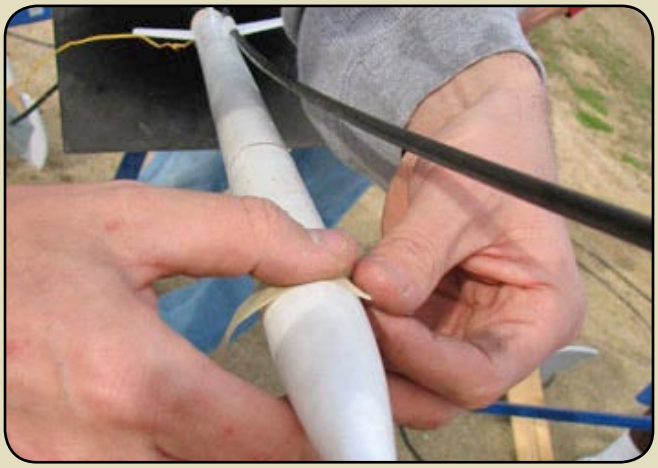
Background

Team Statesville uses RockSim as our main design tool, and has used an Apogee rocket to break Mach 1 during one of our preliminary tests. For our project, we

needed to design a rocket that had two differing payload sections, setup for dual deployment recovery, and could break the speed of sound. All this, while trying to not go over one mile in altitude if possible.

Incorporating RockSim

RockSim is our tool of choice for designing this rocket and multiple solution paths have been explored in the software with the optimal mass, length and diam-



eter of the rocket determined. Since our rocket expels Helium out the front of the rocket during flight, we are using the Engine Editor program from RockSim to modify the actual upward thrust of the rocket as we try to take into account this reverse thrust. A completed component of our project required us to send a rocket through Mach 1 and record the resulting pressure shock wave as it passes over the rocket. Looking for a cost effective alternative, the Apogee Aspire appeared to be the logical choice.

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In modeling this rocket using RockSim, we found that by making the top portion a payload section and using at minimum a medium-impulse G engine, the rocket should travel past Mach 1.

Building the Models

Due to the resulting altitude and forces on the paper tube, balsa wood fins, and plastic nose cone of the rocket, we built three Aspires and hoped we could get data back from one showing the pressure spike as the rocket went though Mach 1. We soaked the balsa wood fins with Cyanoacrylate glue to strengthen the fins and used epoxy fillets to increase adhesion to the body tube. The payload section was made by cutting the main body tube about 5 inches from the top and inserting a coupler and bulkhead assembly. We also decided to go with a Kevlar shock cord considering the amount of black powder ejection charge for the motors flown.

Flying the Models

The first flight was with a Aerotech G80-10 motor and while the flight went to about 3300 feet, we did not see the sharp altitude increase of the shock wave moving over the rocket. The second flight was with a slightly more powerful Aerotech G77R and was quickly lost in the clouds. Upon descent, we found the nosecone separated from the payload section and the altimeter was missing. Both were found later but the altimeter did not survive the fall. We decided to next go with the Aerotech H97J reload knowing, if the rocket didn't shred, we should most definitely go faster than

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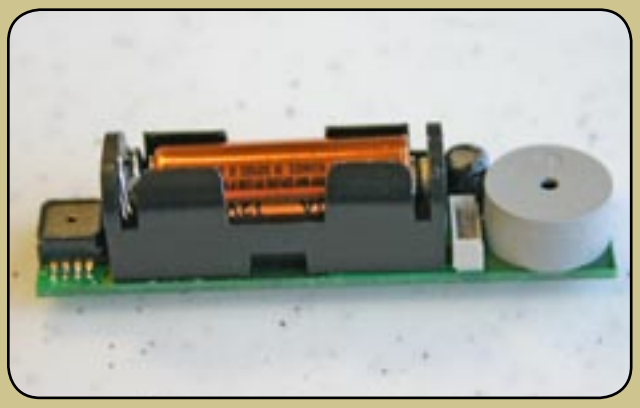
Mach 1. The rocket leapt off the pad and quickly disappeared in the sky. A couple minutes later the rocket landed about 200 yards away fully intact.

Altimeter Feedback

The data from our PerfectFlite altimeter showed the predicted pressure increase and decrease as the Mach shock wave passed over the payload bay. Success! The altimeter showed a flight of approximately 4400 ft for the Apogee Aspire, impressing the team. Having the rocket push through Mach and back, having it land able to fly again and having the pressure data behave as predicted was remarkable for a team with most members having little experience in rockets before joining the group this year.



Summing It All Up

I applaud the team's effort so far and look forward to seeing them complete their vision. RockSim and Apogee Rockets are critical components of this project. Visit www.teamstatesville.com for more information concerning the Statesville Christian School rocket team from Statesville, NC and their project for the NASA Student Launch Initiative 2007.

About the Author

Dr. Doug Knight is the physics instructor at Mitchell Community College in Statesville, NC, a born again rocketeer starting about three years ago and the mentor for the SCS Rocket Team. He has a Bach-

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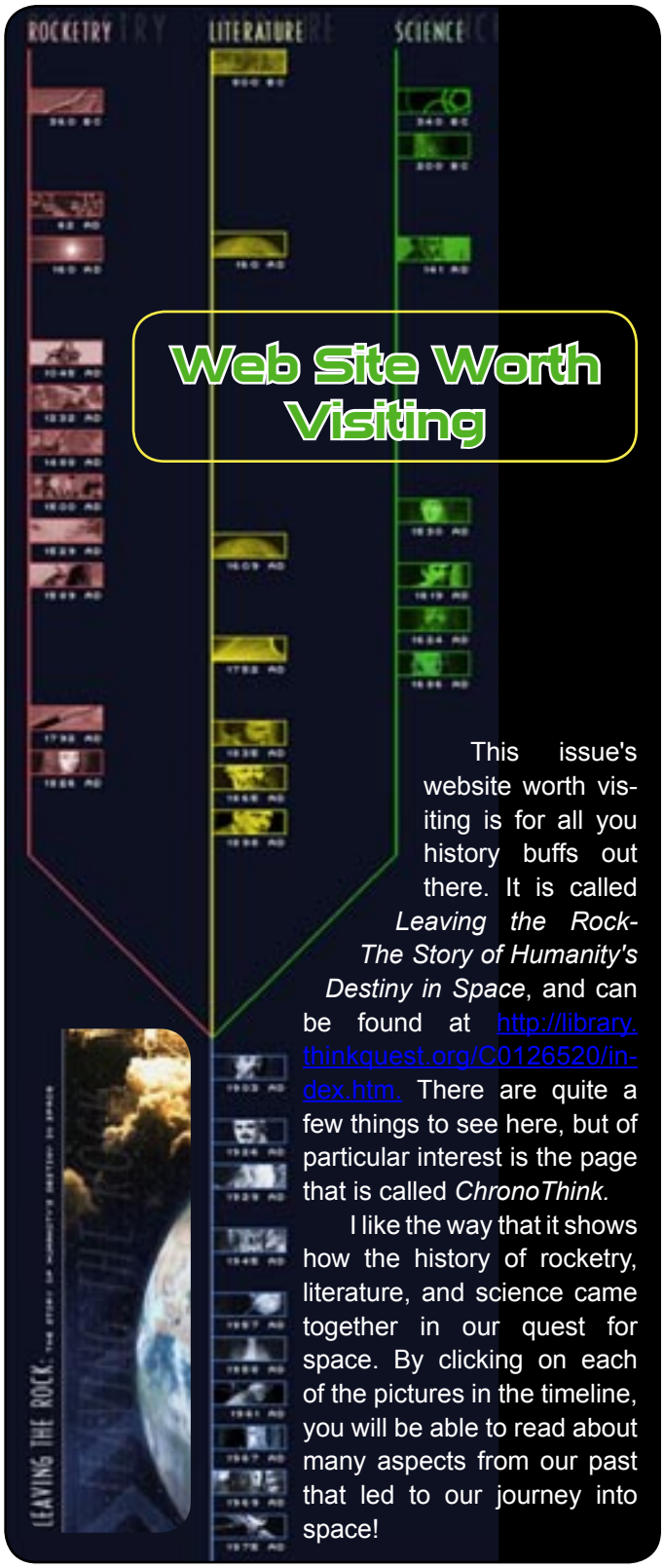

Web Site Worth Visiting

This issue's website worth visiting is for all you history buffs out there. It is called *Leaving the Rock- The Story of Humanity's Destiny in Space*, and can be found at http://library.thinkquest.org/C0126520/index.htm. There are quite a few things to see here, but of particular interest is the page that is called *ChronoThink*.

I like the way that it shows how the history of rocketry, literature, and science came together in our quest for space. By clicking on each of the pictures in the timeline, you will be able to read about many aspects from our past that led to our journey into space!

elor's degree in Physics, a Master's in Applied Physics, and a Ph.D. in Mechanical Engineering.

Doug has worked at a couple of labs and was previously a senior test engineer for an optics company before he started at Mitchell. All of his physics classes make rockets of some type during the semester. He is currently TRA level 2 certified and hopes to attain level 3 this summer. Dr. Knight flies mainly long skinny rockets and scratch builds or modifies existing kits most of the time. His favorite rocket as a kid was an Estes Blue Bird Zero that flew over 70 times before it was retired. He currently has about 10 rockets that he flies regularly. His motto so far in rocketry is "If you don't know what motor to use in that rocket, use the bigger one."

Do You Want Excitement?

The Apogee Aspire (http://www.apogeerockets.com/aspire_rocket.asp) is available for immediate shipping for those of you who would like to try some breathtaking flights! Maybe you aren't ready for something like what the SLI team did, but try putting an Apogee F10-8 Medalist motor (http://www.apogeerockets.com/composite_motors.asp) in the Aspire and you and everyone else on the field will be watching your rocket for a long burn time that seems to be never-ending! Then, you will see your sleek model to come back to earth by a bright streamer shimmering in the sun! If you would like to see some video of the team's testing, please visit http://www.teamstatesville.com/content/media/Orangeburg_1_13_07.

- editor

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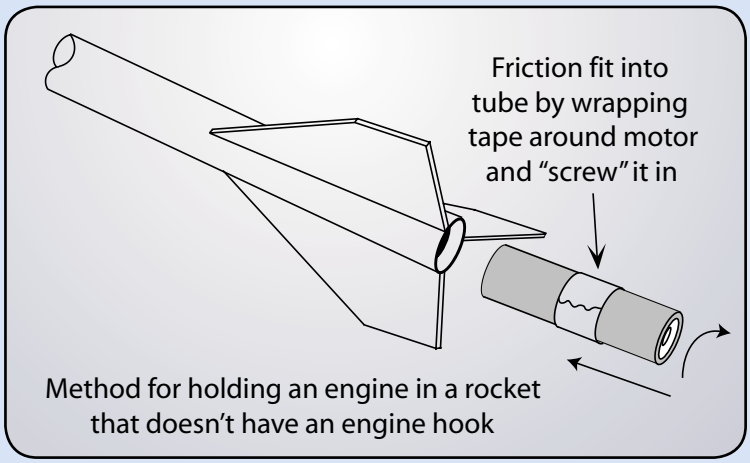
DEFINING MOMENTS

Models that are just large enough in diameter for the engine to barely fit inside the tube are called minimum-diameter models. Their usual purpose is to fly to extremely high altitudes. The most common way to secure engines in these models is to wrap masking tape around the engine so the friction created when it is installed is enough to prevent the motor case from sliding fore or aft during flight (see the illustration to the right)



Method for holding an engine in a rocket that doesn't have an engine hook

This method is not totally reliable. If the friction between the engine and the inside of the tube is not great enough, the motor may slide during the flight. Many times, after the flight, the expended engine case is hard to remove from the rocket because the hot engine case swells, which increases the friction between the parts.

Motors are available through the Apogee Components' website at http://www.apogeerockets.com/rocket_motors.asp. If you want a more positive retention for your motors, you can find engine hooks at http://www.apogeerockets.com/engine_hooks.asp.

Friction Fit Graphic from Model Rocket Design and Construction www.apogeerockets.com

Apogee Components, Inc. is pleased to announce the second in a yearly grant program geared toward model rocketry education organizations!

Apogee Grant Program

The rules are simple:

1. Entrants must submit an essay to Apogee. There is no length requirement for the essay.
2. Any club, organization, or school program, is eligible for entry. This would include rocketry clubs or prefectures, 4H, scouts, etc.
3. The content and purpose of the essay is as follows:
   - If we gave you $300.00, How would you use it to impact the rocketry community?
   - How many people do you think it will reach?
   - How many people will be involved in the organizing and running of the event?
   - How big of an effect will it have on the rocketry community?
4. One of the biggest things to keep in mind when composing your essay is **"How is what I am planning unique?"**

There will be only one winner of the grant, which is $300.00 toward any order with Apogee Components.

The deadline for entry is November 30, 2007.

Make sure it is post-marked by November 30th!

The grant winner will be anounced on January 1, 2008.

What a great way to start off the new year!

Send your essay to me at:
johnm@apogeerockets.com

Or send to:

1130 Elkton Drive Suite A
Colorado Springs CO 80907

http://www.apogeerockets.com/rocket_grant_money.asp

TIP OF THE FIN

This issue's tip is a follow up from the tip in issue 177 http://www.apogeerockets.com/education/downloads/Newsletter177.pdf and comes to us via Uditha deAlwis. Uditha says, "I read your suggestion on the 8 AA batteries to get 12V without having to lug a car battery. The current drawn by an igniter is > 2A for a few seconds and if you connect more than one igniter in parallel, the current demand doubles since the resistance drops to 1/2 of the single igniter and so on. Even though AA batteries are durable, this rate of discharge cannot be sustained for a large number of cycles. Hence, you will be replacing 8AA batteries each time you fire rockets, which I feel is very environmentally unfriendly.

You can get a 12V jump start unit from Sears or a car parts store which comes with a 12V 7AHr gel lead acid battery contained in a convenient package with carry handle and heavy duty cables which can be spliced as needed if you don't like to use the heavy duty clips. It can be recharged by plugging into your car (on the way to the launch site) or from 120V using the charger included. The prices range from $30 - 49.99. It has enough juice to launch many rockets even when it is cold. Best of all the gel battery should last 3 years or more if you don't leave it plugged into the charger all the time. Since I live in the North East US, what is even better is that I have a ready jump source for my car or lawn mower and with a cheap inverter, an emergency power source during a black out."

As a thank you to Uditha, we will be sending out a large Dynastar Nylon parachute! If you have a tip and we use it in the newsletter, you will find one showing up on your doorstep as well! Please send any tips to johnm@apogeerockets.com.

Question & Answer

Rick wrote to us and asked, "If I don't have RockSim, is there another way for me to know how heavy of a rocket a given motor will lift?" There is a formula that you can use to know the correct thrust to weight ratio.

First of all, we'll use the C6-5 motor to see how heavy of a rocket can be used with it. You will take the average thrust and divide it by 4.45 (pound-seconds), divide that answer by 5 for a safe 5:1 ratio of thrust to weight, and that will give you the answer in pounds. The average thrust in newton-seconds is (6) as in (C**6**-5), divided by 4.45 (pound-seconds) equals 1.348, and divided by 5 equals .27 pounds, rounded-off. Therefore, the maximum safe liftoff weight for a C6-5 would be a little over one-quarter of a pound. One-quarter of 16 ounces (1 pound) is 4 ounces, so a model that weighs a little over that would be fine.

Of course, if you want to make things a lot easier on yourself and more accurate, you need RockSim software. RockSim will save you time and money that could be spent on other things. If you would like to try a free 30-day demo of RockSim, please visit http://www.apogeerockets.com/rocksim_demo.asp to see how cool this software is! Once you do, I don't think you'll ever go back to any other way.

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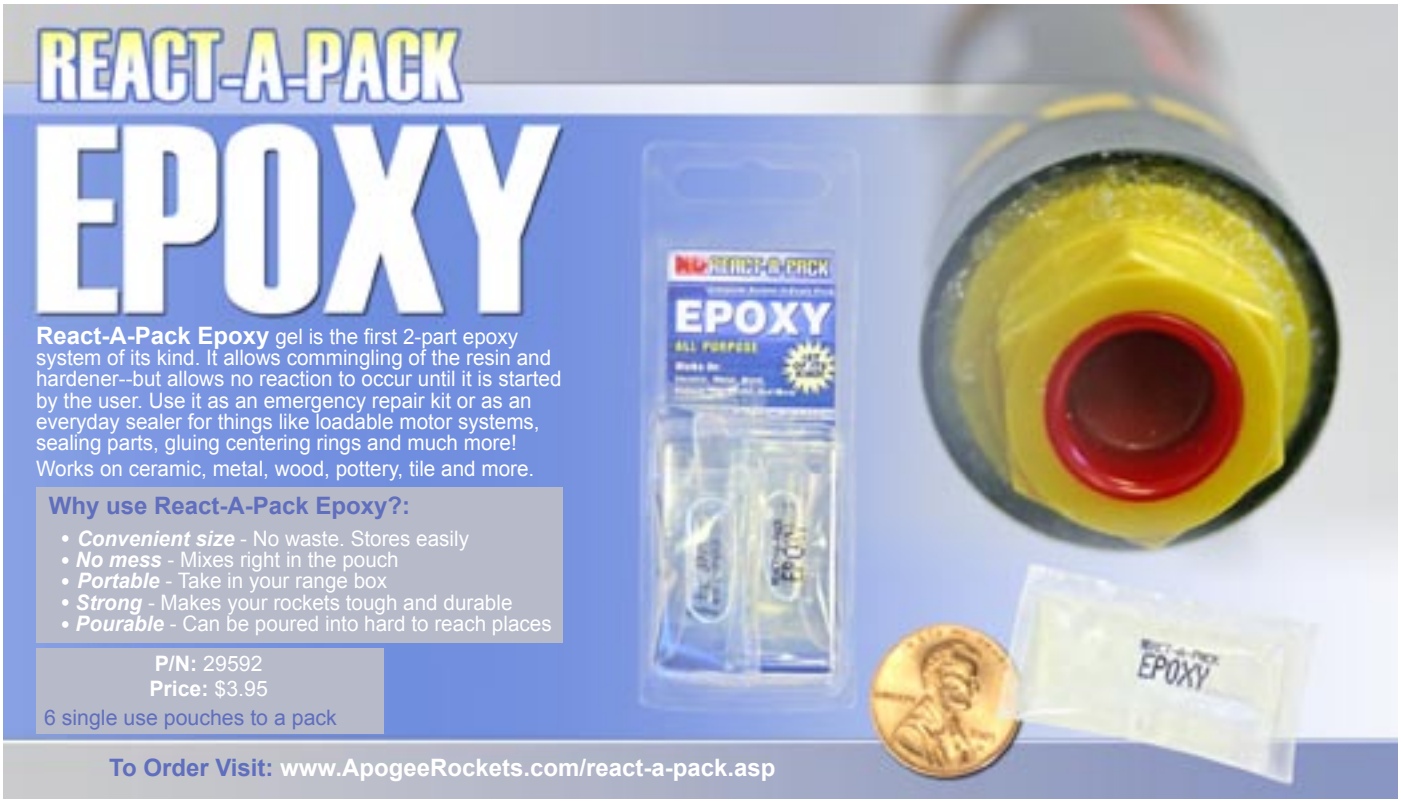
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