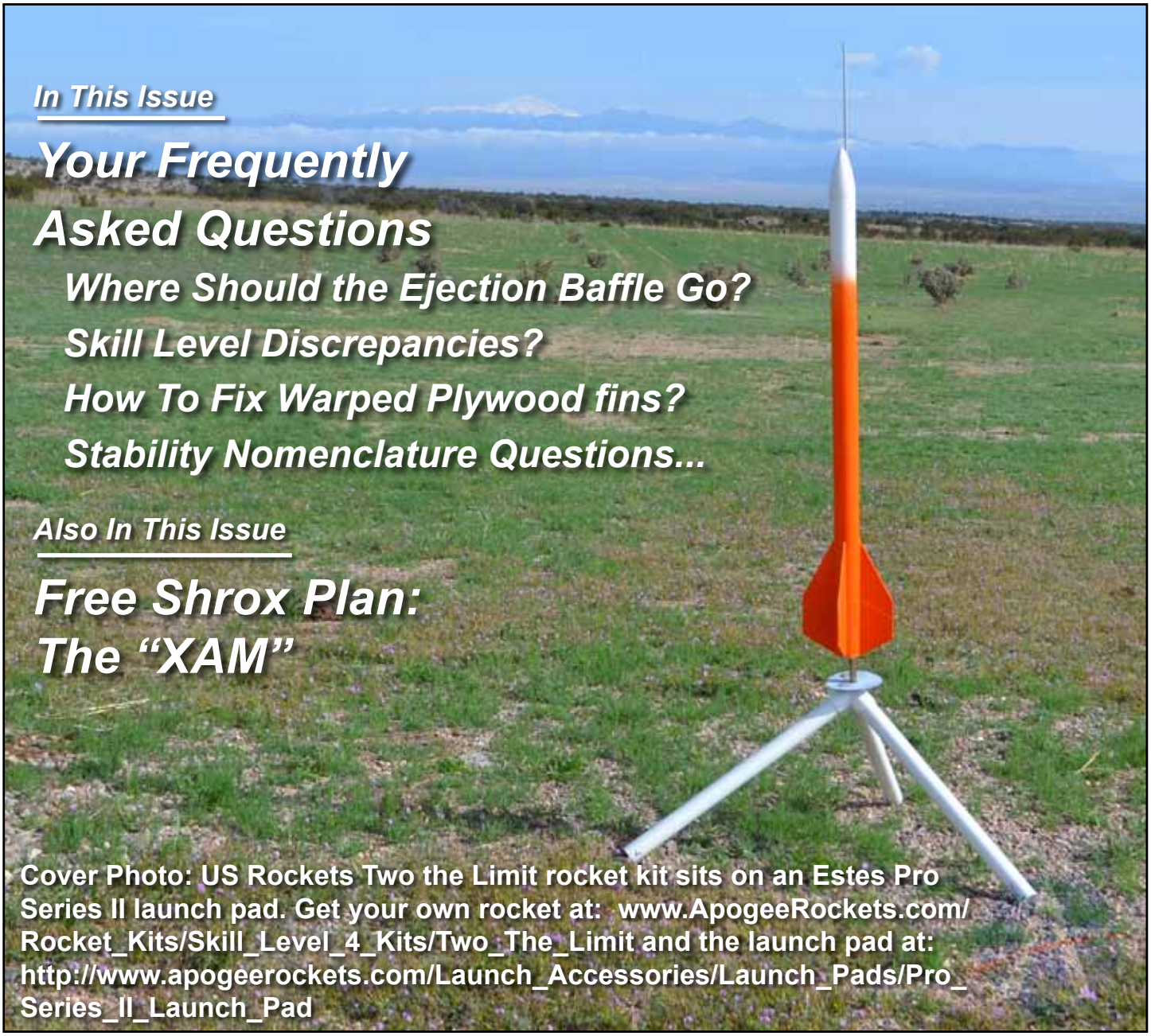
Apogee Components

PEAK OF FLIGHT

NEWSLETTER



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Cover Photo: US Rockets Two the Limit rocket kit sits on an Estes Pro Series II launch pad. Get your own rocket at: www.ApogeeRockets.com/Rocket_Kits/Skill_Level_4_Kits/Two_The_Limit and the launch pad at: http://www.apogeerockets.com/Launch_Accessories/Launch_Pads/Pro_Series_II_Launch_Pad

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Your Frequently Asked Questions

By Tim Van Milligan

At Apogee Components, we get lots of questions from our customers. In this issue, I thought I'd try to answer a few of them.

Where should the ejection baffle go?

Tim, I'm designing a rocket that will have an ejection baffle in it. How close or how far away from the engine should the baffle go?

An ejection baffle, as discussed previously in this newsletter (www.ApogeeRockets.com/Education/Downloads/Newsletter366.pdf), is a mechanical device that takes the place of wadding in a model rocket. It protects the parachute from the heat of the ejection charge, and it doesn't have to be replaced after every flight like wadding.

The location of the baffle is fairly optional in your rocket. Ideally, you want it as far away from the heat of the ejection charge as possible. The reason is that "intense heat" is still "intense heat." You want to prolong the life of the baffle as long as possible, and putting it close to the motor would mean it will get toasted pretty good.

Also, the baffle is going to have some weight, so for stability reasons it should be placed as far forward as possible. Otherwise, the weight of the baffle would move the CG of the rocket further aft, making the rocket less stable. You always want the weight to be as far forward as possible, so the rocket is more stable at launch.

But on the flip side, you need room in front of the baffle system for the parachute. So if you put it too far forward, the chute and the nose cone won't fit on the rocket. From a parachute reliability perspective, you want the baffle as far back as possible. The more room you have for the parachute, the looser it can be packed, which I've found increases the chances of it opening properly.

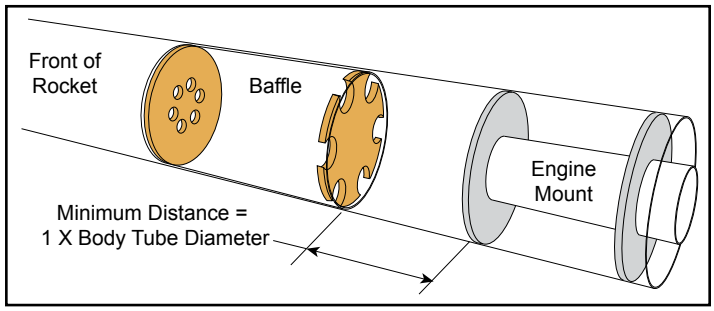

Figure 1: There needs to be a little room between the rocket engine and the rear of the ejection baffle.

As you can tell, we have a trade-off situation here, which makes it difficult to decide where to put the baffle in the rocket.

If you haven't fully assembled the rocket, then I would suggest you test fit everything together before gluing anything. In this situation, I would find out how much room you need for the parachute to fit in the tube, and move the baffle as far forward as possible.

But sometimes, space is at a premium in your rocket, and you are forced to move the baffle rearward to make room for the parachute. In this case, you can move the baffle rearward, but don't let the back end get too close to the ejection charge end of the motor. I would suggest that the rear end of the baffle get no closer than 1 body tube diameter away from the front end of the rocket motor.

Why Are Skill Levels Different?

Hi, Tim. I noticed that a certain rocket kit is rated skill level 2 by Apogee Components, but as a "beginner" level by the manufacturer. Why is that?

At Apogee Components, we can't say for sure what method a manufacturer uses to rate the complexity level of their rocket kits.

For starters, let me say that I've never seen a manufacturer over-rate the complexity of their rocket kits. In other words, from what we see, they always give the kit a lower skill level than we at Apogee would rate a kit. Why is that?

My gut feel is that they base their rating on their own assembly skills. And I would assume that those skills are pretty high. They've been making rockets for a long time, so whatever rocket they build is probably going to be put together pretty quickly using their skillful hands. And secondly, after all, they are producing rocket kits. That by itself

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About this Newsletter

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is a pretty daunting task. So by comparison, they probably underestimate the amount of skill a modeler would have to have to put the rocket together.

Here at Apogee Components, we see all types of modelers, from beginners to people that blow my mind with the quality of their artistic creations. The main difference between the two is the amount of time that they've been in the hobby, and the number of models they've built over that time.

That should bring encouragement to you if you are still new to the hobby. Your rockets will get better looking and stronger the more you practice by building models. The more time you put into rocketry, the greater your muscle memory will be and the quicker you'll build models. After a while, a skill level 3 rocket (an average build) will seem very easy to put together. And it doesn't really matter if it is a small rocket or a high power vehicle. Practice time seems to make things seem easier.

Because we manufacturers are in the situation where we are very good modelers, I try to rate kits on the type of skills that a modeler might have to use during the assembly of the kit (see *Peak of Flight Newsletter #31* at: www.ApogeeRockets.com/Education/Downloads/Newsletter31.pdf)

For example, take a common model like an Estes Alpha rocket. Everyone would assume that we're talking about a pretty basic model rocket kit that is easy to assemble.

But say, instead of having pre-cut balsa fins, the modeler would have to cut the fins from a sheet of balsa wood. If nothing else in the kit changed, this simple act of requiring the modeler to cut their own fins would force me to give the rocket a higher skill level than just a beginner rocket. In my opinion, it jumps from being a Skill Level 1 kit to a Skill Level 2 category.

I've seen my own kids try to cut fins from a sheet of balsa, and a lot of times, it ain't pretty. As experienced modelers, we often take for granted how much fine muscle control it takes to follow an edge of a ruler with a hobby knife. And the wood itself doesn't make the job any easier. I'm sure you've tried to cut cross-grain through a very tough piece of wood. You know what I'm talking about, don't you? It is a lot harder than you might expect if you've never done it before.

My own history has been to give a rocket a higher skill level. And in addition to that, I would hate for the customer to expect an easy build, and then find out that the rocket takes more effort to assemble than they anticipated. From a business standpoint, failure for the customer to get the rocket to the state of being ready to launch is the worst situation I could think of. That customer will never buy another rocket from me, nor any other vendor. They are lost to the hobby, and that makes me very sad.

Meanwhile, the expert modeler that buys a kit doesn't ever get upset when they discover the rocket is easier to build. They typically chalk it up to their own skills having improved because of years of practice. And they are probably right in that regard. It is rare for a customer to say that they bought a kit to learn a new construction technique, as most people select the rocket on how appealing it is in their own eyes.

Fixing Warped Plywood Fins

I purchased a rocket kit with plywood fins. The fin stock is somewhat warped. Are there methods for mounting these fins on the body tube so they are straight as an arrow?

I wish I would say that every kit that goes out the door here at Apogee Components is perfect. Unfortunately,

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Your Frequently Asked Questions

wood can warp with changes in humidity and temperature. Here in Colorado, the humidity level is very low, so the wood when it leaves the building is pretty straight. But when a customer gets the wood, they may notice that it has curved. And customers don't like it, and I can't blame them.

Now that we have a laser cutter of our own (see our last issue), it isn't a problem in the kits made by Apogee Components. Our standard policy is that if it is one of the kits manufactured by Apogee, we'll just send out a replacement part. And hopefully it won't warp by the time it reaches the customer.

Figure 2: Clamping the warped fin between two angles while gluing it to the rocket can straighten out the wood.

But for kits made by other manufacturers, it can be spotty on whether a replacement fin can be obtained.

One of our customers, Kevin Tramel, shared with us his idea for straightening a warped wooden fin. What he does is to clamp the wood between two pieces of heavy aluminum angle until the wood is straight again. And while they are clamped, the fin is then glued to the body tube with epoxy and a fillet of epoxy is applied (see Figure 2). Once the epoxy has cured, the angles can be removed. The epoxy will hold the root edge straight, so most, if not all the warp will be removed.

Thanks Kevin for the tip. If you have any other tips on removing warp in plywood fins, please send them in to me here at Apogee Components.

Rocket Diameter and Stability Margin

Joseph asks: "Why is the rocket diameter used as the reference unit for stability margin?"

That's a good question. The stability margin is based on the expected forces that the rocket will feel during the flight. Those forces (calculated using the Normal Force Coefficient – see Newsletter #74 at: www.ApogeeRockets.com/Education/Downloads/Newsletter74.pdf) are calculated using some reference area.

That reference area is important in calculating forces. For example, when you calculate lift, you use the formula:

$L = \frac{1}{2} \rho V^2 A C_L$

Where:

ρ = density of the air the rocket flies through

V = the velocity of the rocket

A = the reference area

C_L = the Lift Force Coefficient.

In theory, any reference area could be chosen. But

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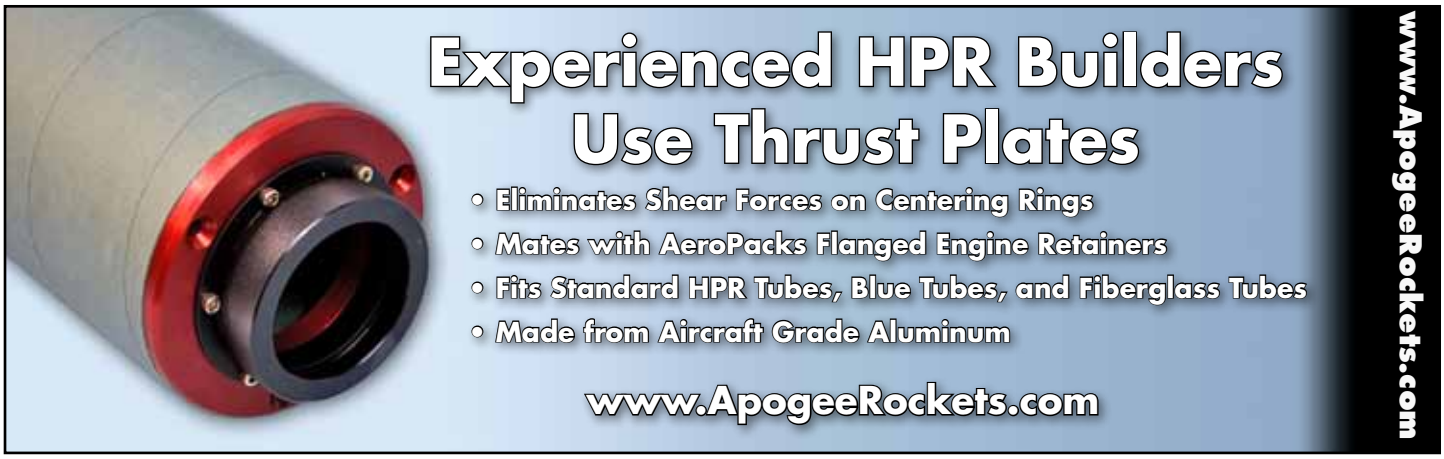

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then, whatever reference area you use has to be consistent. The reason is that the Lift Coefficient is tied to the reference area. Why is this? Because we find the Lift Coefficient last. We actually measure the actual Lift force, and then back out the Lift Coefficient.

But if the reference area changes, then when we go to calculate the Lift Coefficient, we'll find that it has changed.

It can be kind of confusing.

When talking about fixed-wing airplanes, we use the wing area as the reference area. But since rockets have such small fins, and some don't even have fins at all, some other reference had to be chosen. So a long time ago, in a galaxy far way, someone chose to use the diameter of the rocket to calculate a reference area.

And it gets even more complicated... That "stability margin" is just a number for your mind to comprehend so you can have some rules-of-thumb to go by. You can read more about stability margin and how confusing it can be in Newsletter 133 (www.ApogeeRockets.com/Education/Downloads/Newsletter133.pdf).

Why Use Calibers For Stability?

Joseph also asked: "I understand how the distance between CG and CP is the key figure, why express it in calibers? Is it just an arbitrary choice, or is there some justification in theory?"

It was chosen to make the number dimensionless. There are no units, so if you scale the rocket up or down, you still have a relative distance that is based on the diameter of the rocket.

The easiest answer to this, is that it gives something for your mind to wrap around. Most people can visualize in their mind the size of the rocket that they want to build. So having the number that is based on the diameter of the rocket makes it easier to comprehend how stable the rocket might be when launched.

About The Author:

Tim Van Milligan (a.k.a. "Mr. Rocket") is a real rocket scientist who likes helping out other rocketeers. 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 a 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 the curator of the 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 a FREE e-zine newsletter about model rockets.

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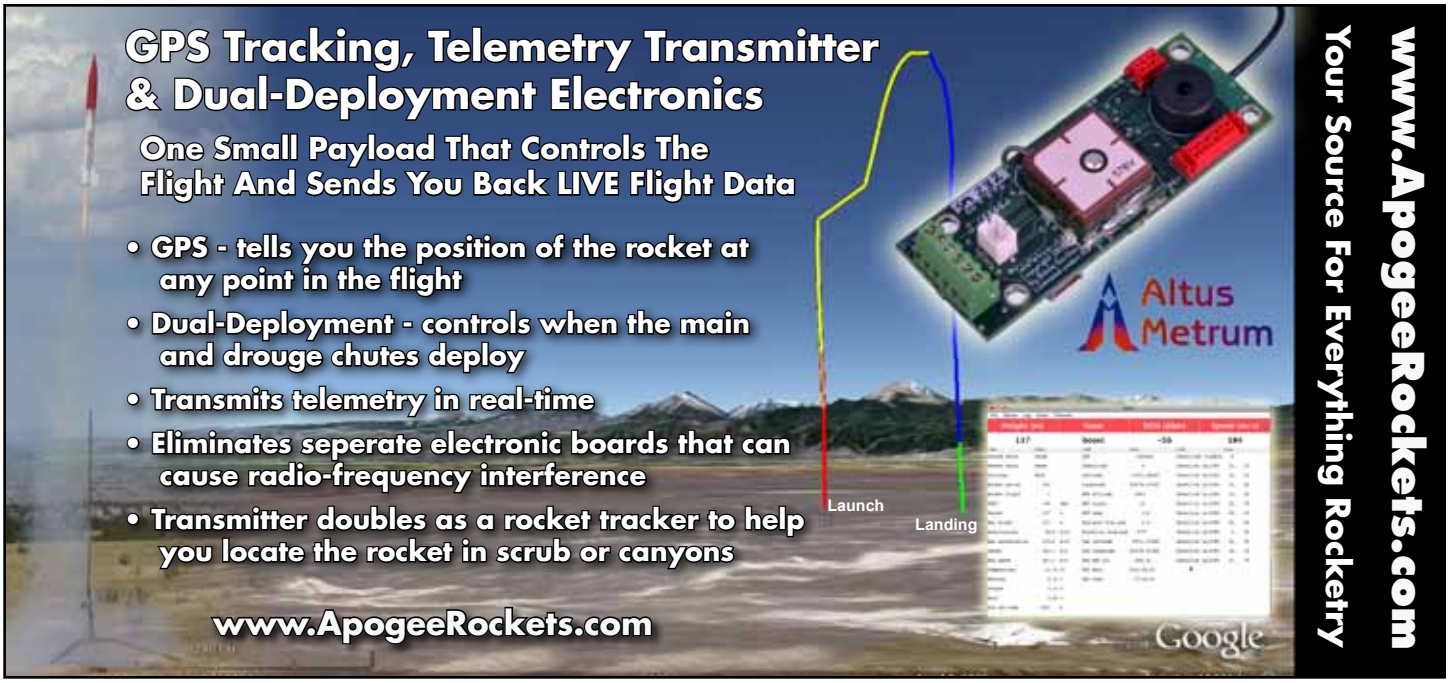

Shrox Plan: The "XAM"

By Shrox

Download the RockSim file (which includes the parts list) at: www.ApogeeRockets.com/Downloads/XAM.zip