PEAK OF FLIGHT NEWSLETTER

Issue 614 / December 5st 2023

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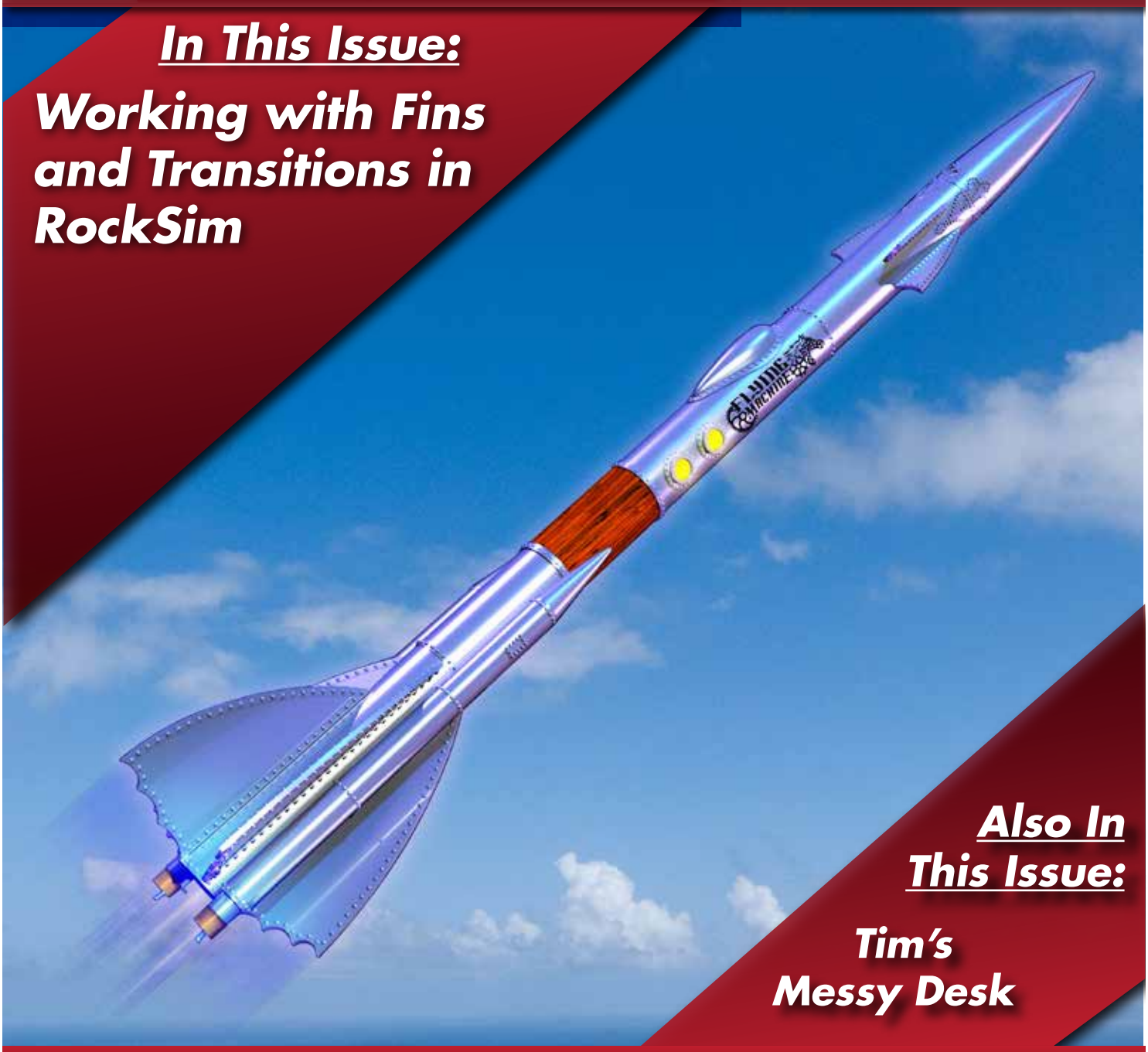
Working with Fins and Transitions in RockSim



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Working with Fins and Transitions in RockSim

By Tim Van Milligan

One of the cool features that RockSim has had for a long time is the way that fins automatically interact with transitions. For example, when you slide a fin along a body tube and past the edge of the tube, the fin will magically adjust the root edge to follow the curvature of the boattail. This saves time and effort when designing rockets, particularly when the boattail has a curved surface and you want the fins to match the curvature (see figure 1).

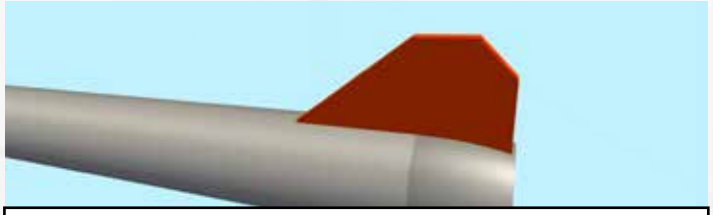

Figure 1: RockSim automatically adjusts the root edge of the fin to follow the curvature of the boattail.

But sometimes the auto-magical effect where it follows the contour of the boattail, isn't what you might have in mind.

In this article I'll show you some of the tricks that I use to force the fin to ignore the boattail.

This article started because I got this question from Michael Davis, who wrote:

> **"Hi Tim, I recently built a RS file, and I'm having an issue with the rear fin to boattail clearance and getting the raised channels in the 3D printed boattail to render correctly. The fin issue is the rear fins overhang the boattail by approximately .75" and there is supposed to be a gap between the fin and boattail but RS renders the fin so it tapers to contact the boattail. The issue with the boattail channels is they are only .125" thick and follow the taper on the boattail but RS is adjusting the thickness, so they are the correct thickness at the front of the boattail (where they butt up to some .125" thick balsa pieces) but thicken as it moves back to keep the top parallel to the body tube. I've attached the file and hope I've explained the issue clearly. I don't think the issue will affect the sim results, but I've ran into this issue with a couple other files and want to see if there is a workaround. If you want, you're welcome to use this question on Rocksim Live."**

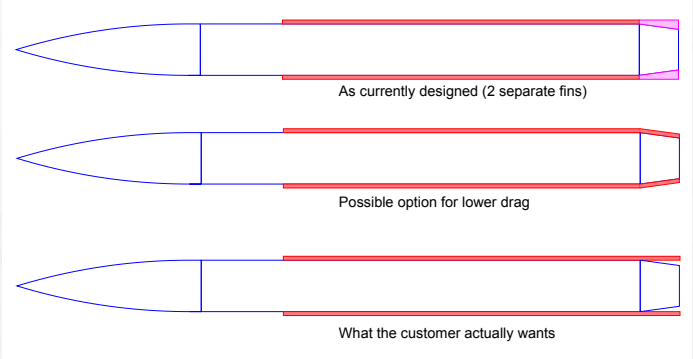

Figure 2: The rocket the customer sent me, and two possible final fin configurations.

What the customer sent me in the file is the top image in Figure 2. The red and magenta parts are "fins." He used the component of "fins" to simulate the tunnels that ran along the side of his rocket. That is a good way to make the rocket look correct.

As you can see, he used two separate fin sets, one on the body tube and a second set of fins (magenta colored) on the transition. I don't think you need to break the fin up into two parts, so in the bottom two images from Figure 2, I drew them in the sketch just a single set of fins.

The bottom most image shows what the rocketeer wanted to create, where the fin extends down the boattail, but is not attached to it.

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Working with Fins and Transitions in RockSim

By Tim Van Milligan

Endless Possibilities

When working with fins that will span across a tube and a boattail, it is important to recognize that there are a lot of different levers that you can pull to make changes to the fins. The first lever is the location of the fin on the rocket, and where it is measured from. In Rocksim, you can have the fin located relative to the front of the part, or from the rear of the part. This is set in the "General" tab on the fin editor screen, as shown in Figure 3.

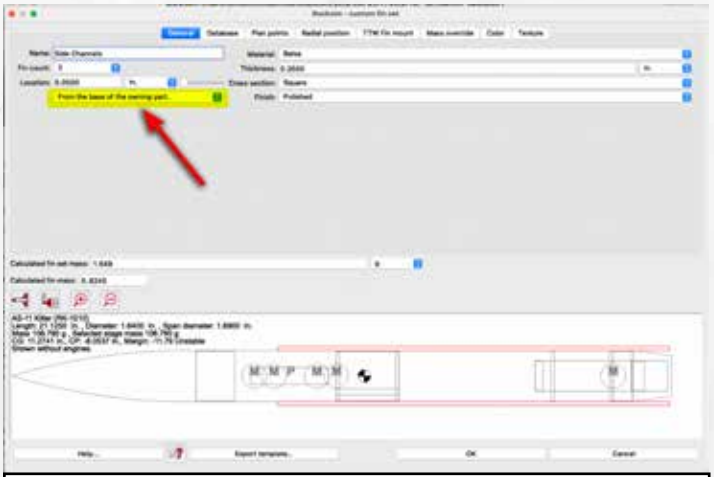


Figure 3: The location of the fin can be measured from either the front of the tube, or the rear.

Just selecting where the fin is referenced from will have a huge impact on how the fin reacts. Don't be afraid to change the reference location, it won't hurt anything. In this example, I'm setting the fin to be referenced from the base of the tube. So if the "location" is 0.0, as shown in figure 3, the back edge of the fin should be even with the end of the tube.

But as you can see in Figure 3, the fins are hanging off the surface of the transition. How can this be?

What I did can be seen in Figure 4, which is where the "trick" is shown. Figure 4 shows the "Plan points" tab, where you can click on a grid to add corner points on the edge of the fin.

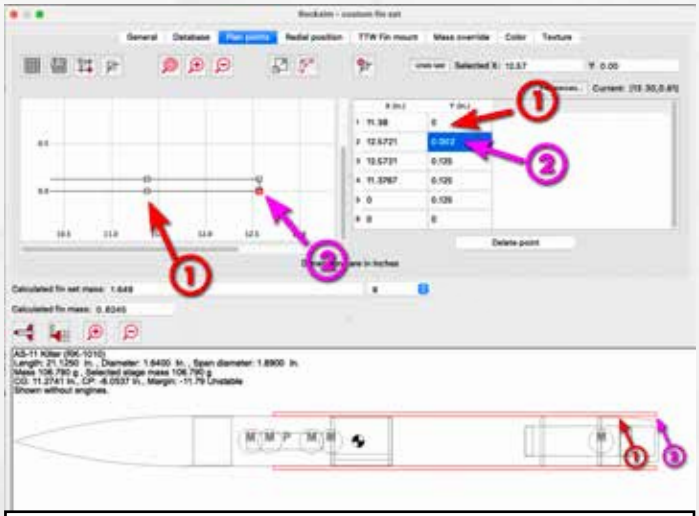


Figure 4: Point #2 is the "trick" point

There are 6 points that make up this rectangular shaped fin. The grid on the upper right side of the screen shows four of them, while the other two are hidden off the screen because they are very far to the left. We're just looking at the very base of the fin.

The locations of the points are shown in the chart on the upper right. Point #1 is at (11.38 , 0), which means it is 11.38 inches from the leading edge of the fin, and 0 inches off the tube. In other words, it sits directly on the tube.

aft-most point is the reference point. Essentially, this is the point that is at the very back edge of the tube.

Point #2 shown in figure 4 is actually the “trick” point. From the grid drawing on the left-side of the screen, it looks that it is perfectly horizontal from point 1. But if you look at the actual table in the upper right, point #2 is not 0 inches off the tube. It is actually 0.002 inches OFF the tube.

Because of this, it won’t conform to the transition surface.

By the way, if you did try to make it 0 inches off the tube, so that is was perfectly horizontal from point #1, it messes up the math in RockSim, and the image looks like figure 5.

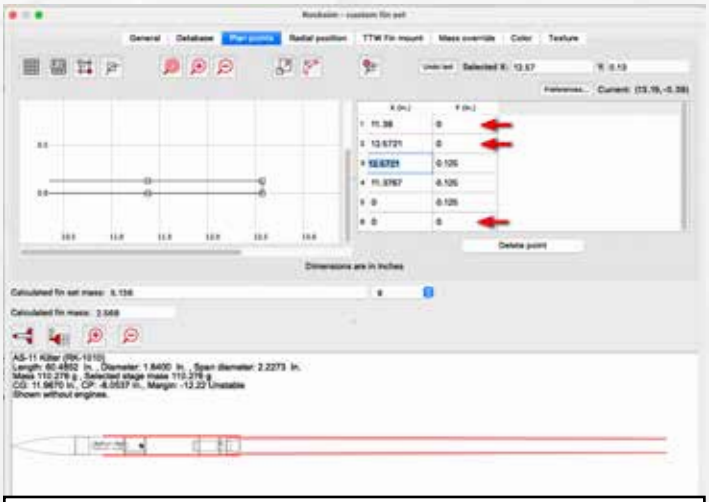


Figure 5: On this fin, there are three points on the tube. RockSim only allows 2.

What is going on in Figure 5 is that there are three points that are supposed to be on the tube. This breaks the math, because RockSim is only looking for two points so it can adequately define the root edge length of the fin. Where there are three points on the tube line, it gets confused and draws random nonsensical points. That third point (number 2 in figure 4), has to be non-zero. That is why we choose 0.002. It is very tiny, but it is not zero.

That’s the trick to making the fin not follow the curvature of the transition.

In Figure 6, we made moved point #2 to be a negative value. I just used the grid in the upper left to slide the point straight downward so it touches the transition.

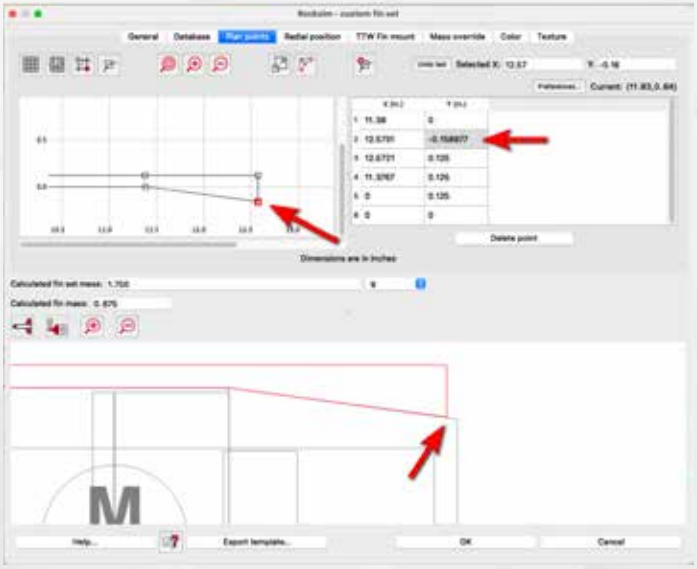


Figure 6: Moving point #2 to have a negative value, I can get it to be attached to the transition.

If you notice, this fin shape is basically the same as what the user sent me. The difference is that it is made from one single fin, instead of being broken up into two parts. See the upper-most drawing in Figure 2.

One last thing that we can do is move the location of point 3 in the chart. Basically, you can slide it down so that the tip edge extends parallel to the surface of the transition. This is shown in Figure 7.

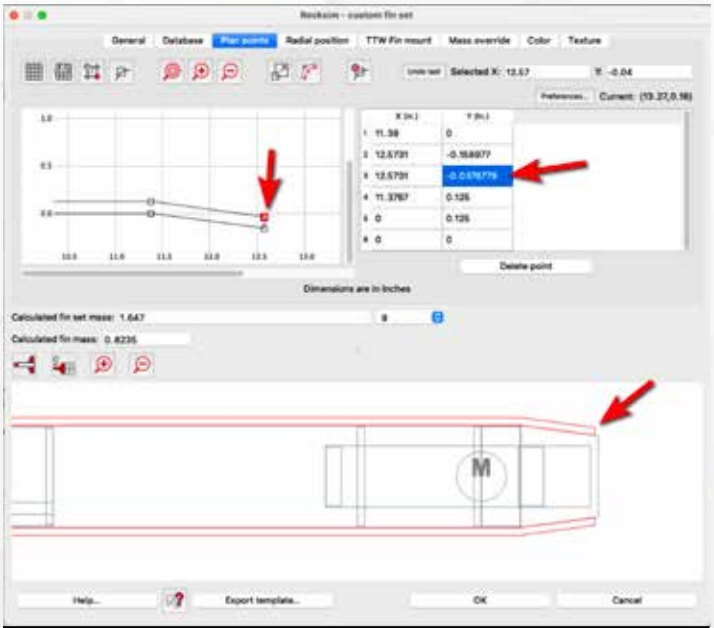


Figure 7: Point number 3 was dragged downward to make the tip edge parallel to the surface of the transition.

Figure 8 shows the 3D view of the channel on the rocket.

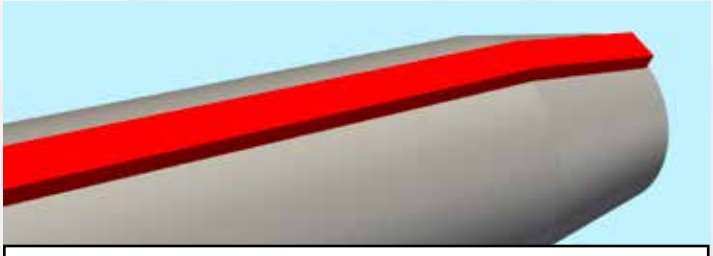


Figure 8: A channel that follows the shape of the transition.

If you wanted to make the boattail have a curved surface instead of being conical like shown in Figure you, then to make the channel follow the curve you'd simply add a few more plan-points and adjust their position so that the curvature matches the surface of the tailcone, as shown in Figure 9.

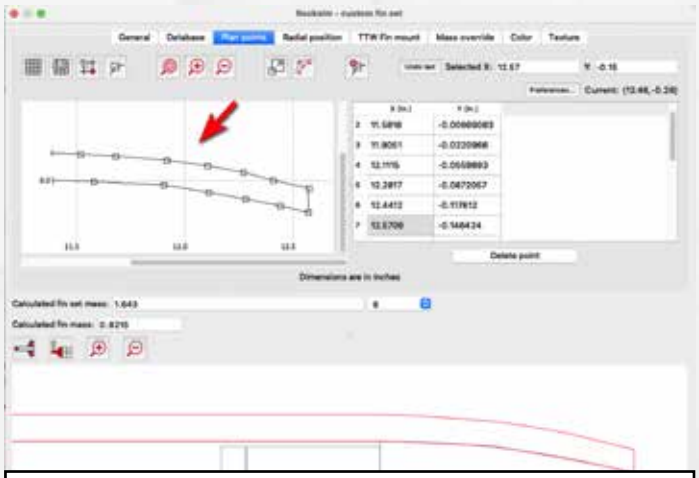
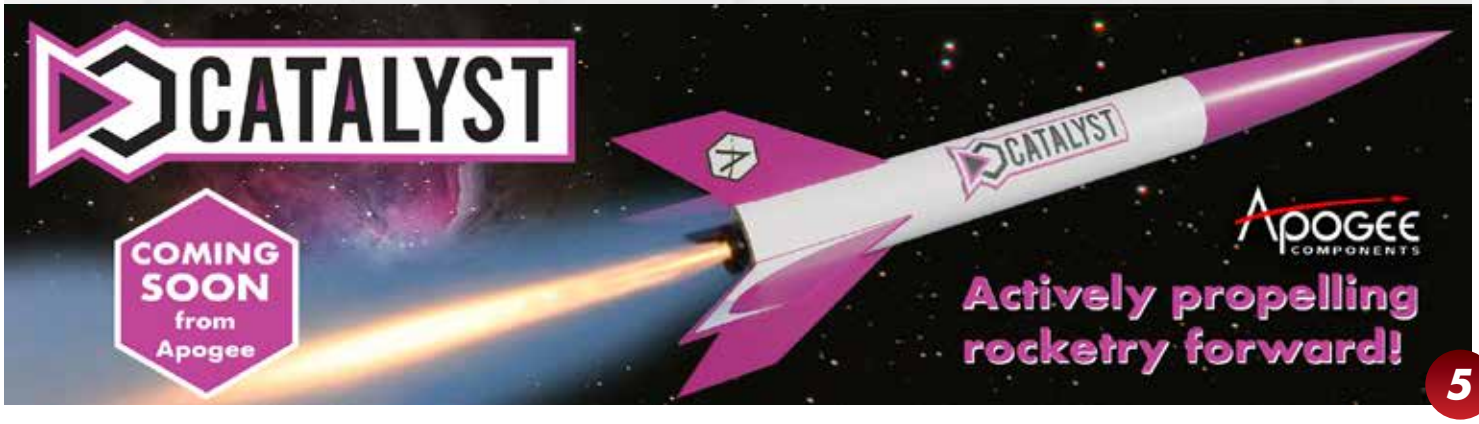


Figure 9: You can even make the fin conform to a curved tailcone by adding more points on the fin.

Conclusion

The versatility of RockSim never ceases to amaze me. Making complex rockets like shown here is possible. We did do one small trick, but it wasn't something that you might not have figured out by playing around. That is how I did it. I just move points around on the plot until the fin shape matches what I have envisioned in my head.

Don't be afraid to move things around. You're not going to break anything. And you'll have a lot of fun playing with it.



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Tim's Messy Desk - December

By Tim Van Milligan

What another great year it has been here at Apogee Components. I write these articles to catch you up on all the happenings that are going on in my world, and 2023 has been exciting.

TOOL OF THE MONTH

For this year, I wanted to try something brave by offering what we called the "Tool of the Month" program. The idea came from John Pursley, a mentor of mine from many years ago. He suggested investing a little bit of money every month to get a useful rocketry tool. The purpose is that over time, you'll have a chest full of tools that will make building rockets more pleasurable. Why is it more pleasurable? Because you'll have tools that speed up the process and also improve the precision and quality of the finished rocket.

John reasoned that if you enjoy building rockets, that you'll do it more often. The more you build, the better you get, even if you don't use all the fancy tools in your tool chest. That time spent building further raises the quality of your rockets.

When the quality rises, people notice, and they offer you compliments and applause. That further motivates you to keep building rockets, and it turns into a cycle. Build more—get better—get applause—get more motivated to build again.

And if your models are getting better, you'll be making fewer mistakes and that is less costly in terms of both time and money. So a good set of tools is also an investment that actually saves you money when building rockets.

Furthermore, while you're getting better at building rockets, other people start getting motivated as well. If you can do it, then they reason that they can do it too. And if they have questions, they can simply ask you about your building techniques.

I figured that there is very little downside to this concept of investing just a little bit of money in a set of good tools as a program for other modelers. And I was willing to make the first investment by sourcing 12 different, inexpensive tools that I thought would help you out. Most of these tools we gave away for free, as long as you also made an investment in your rocketry experience by making a minimum purchase. Others had a very low cost.

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Here are the **Tools-Of-The-Month** in the program we did this year:

January - Tip sanding burrs

February - Pocket wood plane

March - Pocket electronic scale

April - Needle file set

May - Alligator forceps

June - Dental scaler

July - Electronic digital caliper

August - Dental spatula

September - Micro drill bits

October - Machinist square

November - Curved decal scissors

December - Anodized hobby knife

I hope that you were able to take advantage of this Tool-of-The-Month program. The benefit is for you and the quality of models that you'll be building in the future. I would love to hear about how the tools helped you out and what kind of progress you've made. So write a product review for those tools that you've got in this program.

I'm not planning on continuing it into 2024. It took a lot of stressful effort to deal with each new tool supplier and get them here in time for each new month. Many of the tools were custom to Apogee Components, and that made sourcing them even harder. But we still do offer many of the new tools as regularly sold products on our website. So if you want them, we probably still have them.

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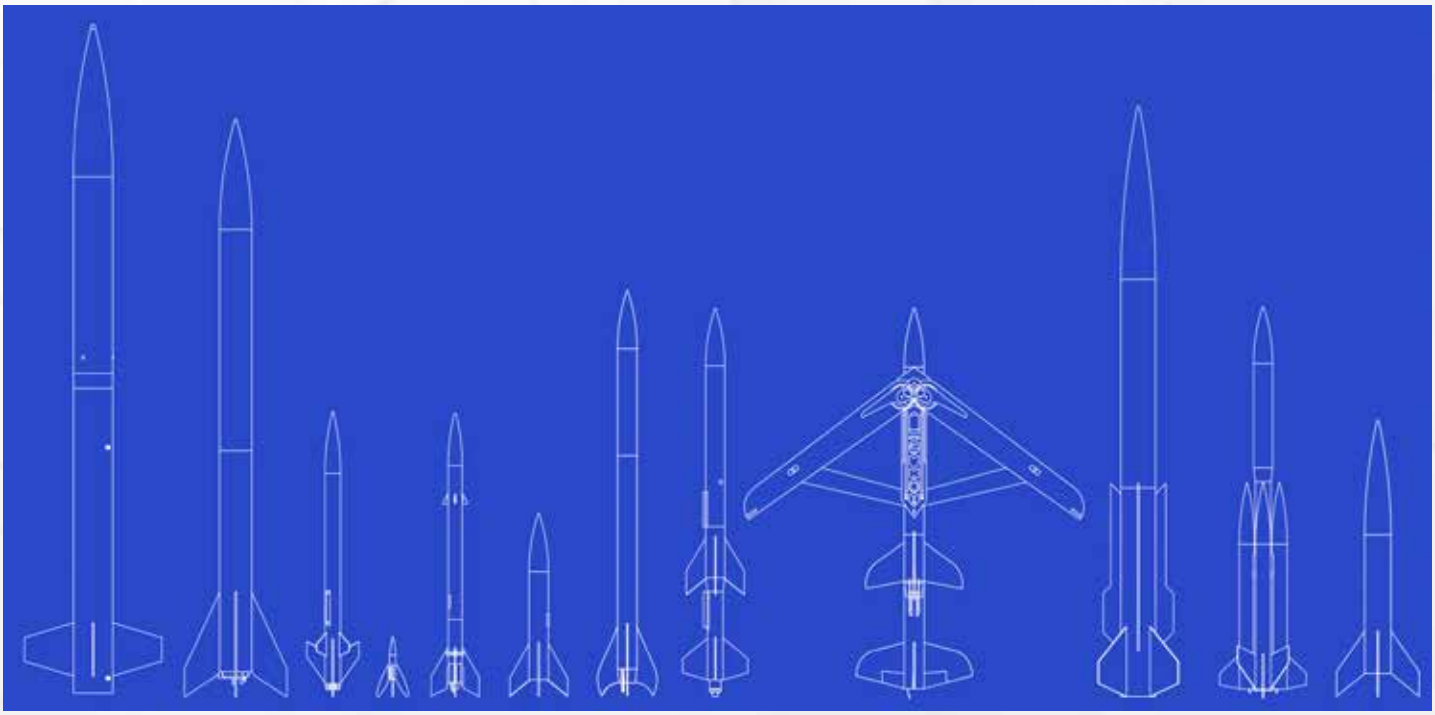

Our other major goal for this year was to come out with 12 brand new "Apogee" rocketry kits. Here's what we've accomplished so far:

QuickDraw	Kestrel
Antares Explorer	TTV
Feathered Flyer	Draco BG
Level-2	Kronos
Black Brant VC	Strap-on Booster Pods
Wayfarer	Hermes - *Releasing this week!*

The next kit is the "Catalyst," which we are still hoping to get out in the twilight of this year. It is a 3-inch diameter rocket that we feel has a lot of spunk because it is shorter and has a 29mm motor mount. It probably won't be out before December 31, but we'll definitely get it out in January.

I have to say that all of these kits, besides the Level-2, were developed by our product designer Martin. I've been quite impressed at how all of these rockets have turned out. What is your opinion? Again leave a product review on our website if you have first-hand experience with any of these models.

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While this year was about building for the future, there were some mood-deflating experiences too. I have to say that we've had more than normal staff turnover this year. It is always disheartening when one of our team decides to move on for one reason or another. We do a lot of investment in training. Not only because we want our customers to have a consistent experience, but also because we're cutting edge, and use newer technology to accomplish more than other businesses do around here. Right now we're training a lot of new people, so to be honest, I do feel a little bit exhausted. I realize that it will pay off in the future, but during the past few months, it has been an emotional roller-coaster.

As we near the end of the year, I'm planning out our goals for 2024. I don't think we're going to concentrate on the quantity of rocket kits — such as our goal of doing 12 new models that we did this year. While that was a challenging goal for us, I am always considering the long-term future of the hobby. In order to be around long-term, we need to keep the hobby exciting and fresh. Rather than investing in "me-too" rockets, such as knock-offs, upscales or clones of popular kits made by other companies, I think we should concentrate on kits that challenge modelers.

For example, I think customers are more satisfied with a successful experience that pushes them to do something that they've never done before. Something that inspires modelers to go a little further - challenge wise - than they typically expect from a rocket kit. We saw this in the sales of rockets like the TTV and the Draco BG, which were instant "popular" rockets as soon as they came out. They are not "me-too" rockets, but are designed to teach new skills and techniques. The instruction booklets are by-themselves, works of art that provide a treasure of new building techniques. That is what makes these special.

So in 2024, I'd like us to come up with out-of-the-ordinary models that you'll be talking about for years to come.

Frequent Flyer Program

In addition to planning new kits, I'm also currently in the middle of revamping our "Frequent Flyer" program in order to roll it out on January 1. The main issue with the old program was that we had been giving out DVD's and CD-ROM's as gifts to customers when they ordered from us. But who regularly uses a DVD or CD player anymore? Technology has made this mode of information storage extinct. So we'll phase out the physical DVD's and replace them with other gifts. What kind of gifts? Because of the success of the Tool-of-the-Month program, our gift levels will include some basic rocketry tools that encourage quality construction. So look for that at the beginning of the year.

Tim's Messy Desk - December

By Tim Van Milligan

On a personal level, my goal for 2024 is to take more time off. I've been a work-aholic since… forever. But I'm planning on being around Apogee for at least 30 more years, and I've come to the conclusion that I need to start pacing myself. I don't want to overdo things that result in physical or mental health issues. To be open about this, I've had great improvements to my physical fitness in 2023, and I'd like that to continue.

What will I do with my off-time? Well, I think I'd like to experience more rocketry stuff. There is so much going on in the space industry right now, and I want to see it. For example, I'm kicking myself that I didn't go to the Starship launch in November and see the world's most powerful rocket lift off. What a thrill that would have been. So I want to do stuff like that to energize me and motivate the company. And maybe go on more hikes… we are in Colorado after all.

I'm looking forward to 2024, and I hope you are too. Together, we're going to push model rocketry forward to make it more exciting and bring new modelers into the hobby. The future is taking off, and I'm going to be a part of it. How about you?

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 e-zine newsletter about model rockets. You can email him by using the contact form at https://www.apogeerockets.com/Contact.