Issue 624 / April 23rd, 2024

PEAK OF FLIGHT NEWSLETTER

Apogee Components, Inc. / ApogeeRockets.com / Colorado Springs, CO

Picking Propellant Types from Aerotech and Cessaroni

Also in this issue:
Tim's Messy Desk

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COVER PHOTO

Habu

The Habu is an easy to build rocket intended for the first time modeler that wants to build a model that has balsa fins. It's bigger in diameter than other beginner rockets, so it is a little more impressive when it zooms skyward.

FEATURED ARTICLE

Picking Propellant Types from Aerotech and Cessaroni

by Tim Van Milligan

This article offers guidance on selecting rocket motors, focusing on the propellant types offered by Aerotech and Cessaroni.

TIM'S MESSY DESK

What's going on in my world? Glad you asked.

by Tim Van Milligan

Tim recounts his recent experiences, including his efforts to take more time off, maintain good health, and enjoy family time. He describes his trips to visit his daughters in Florida and Texas, where they experienced the solar eclipse.

Apogee Components, Inc.
4960 Northpark Dr.
Colorado Springs, CO 80918
1-719-535-9335
www.ApogeeRockets.com

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Content Editor: Martin Jay McKee
Layout Design: Ryan M. Conway

Nike Hercules test flight, SCORE, Pueblo, Colorado - September 2nd, 2023

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Picking Propellant Types from Aerotech and Cessaroni

by Tim Van Milligan

One often confusing aspect of rocketry is picking rocket motors. Even with the great tool within RockSim called "Recommend Motor," which generates a list of all the motors that will work with your rocket, you still have to pick from that list. With so many options, it can get overwhelming.

In this article, I'd like to give some additional background information on the various propellant types that are offered by Aerotech and Cessaroni, and try to give you some guidance on what motor type you might select for your next rocketry flight.

The Process of Picking Motors

For us at Apogee Components, the process of picking a rocket motor starts with Rocksim. For starters, every rocket is different, and there are so many variables that will affect the flight. There isn't a blanket statement that you can make such as: "If your rocket weighs, 120 grams, use a G54." The reason is that this tells you nothing about the rocket itself, nor the flying conditions that it will have to ascend through. If the rocket is high drag, and if it is windy, then that motor may not be appropriate.

To overcome this, we must know more information about the rocket. A RockSim file contains all the information we need to make an informed choice, which is why this is always the place we start when selecting a motor.

Most of the kits we sell on the Apogee website have a RockSim file that is already pre-made. New kits that we are coming out with will have a RockSim file posted on our website. Just go to the kit page, and download the file.

Once you open the design file in RockSim, getting a list of appropriate motors is just 3 clicks of your mouse.

1. Click the prepare for launch button in the top corner.

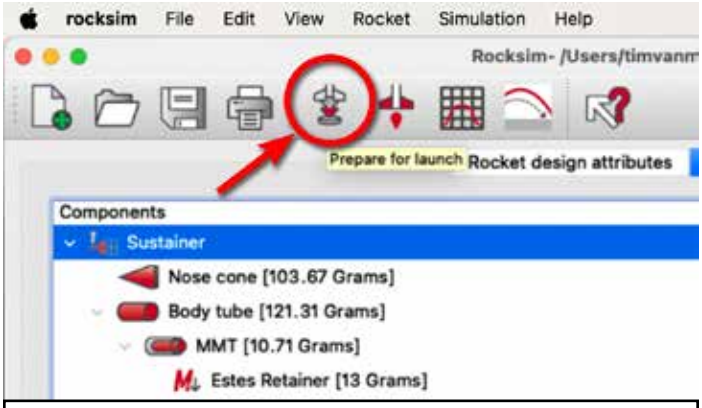


Figure 1: Click on the Prepare for launch to start the process after opening your rocket design.

2. When the simulation properties screen comes up, just click the "Recommend Motors" button in the bottom.

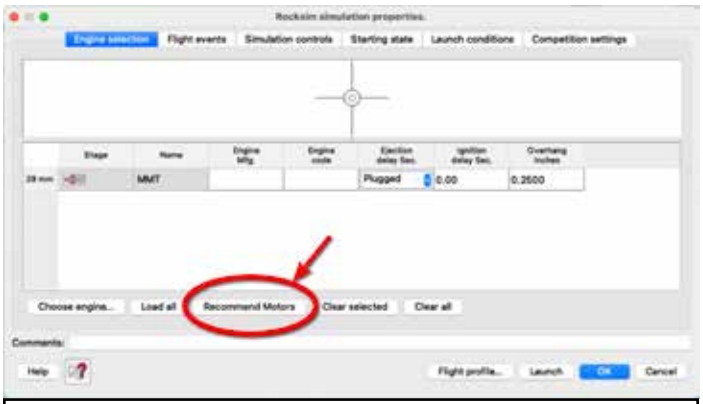


Figure 2: From the simulation properties screen, just click on the "Recommend Motors" button.

3. The next screen shows the default recommended launch conditions. You can simply change the launch guide length

(launch rod) for your particular pad, and then click the bottom: "Use Recommended Conditions"

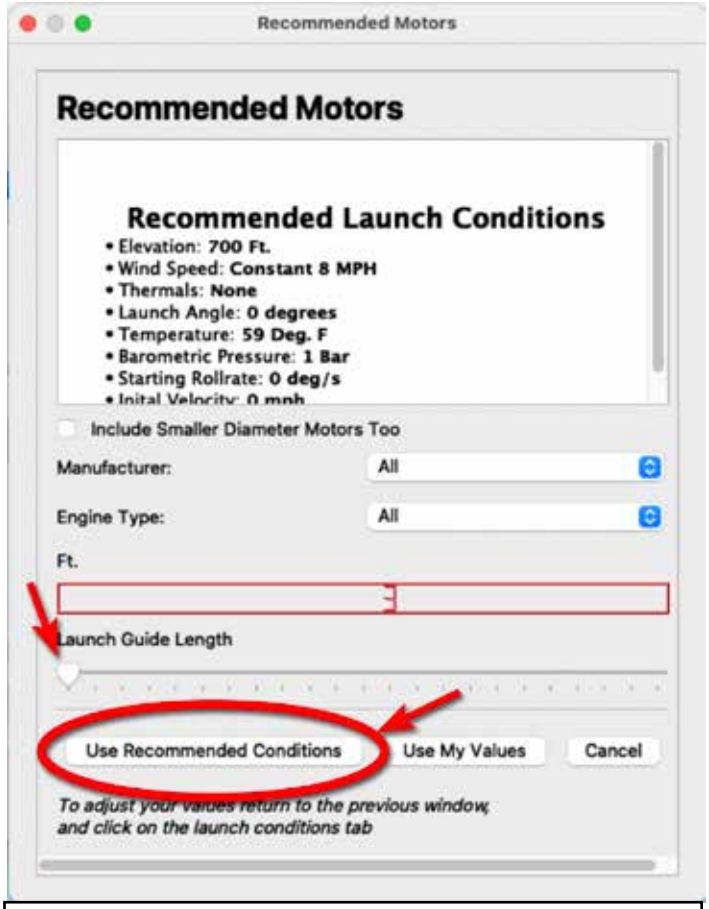
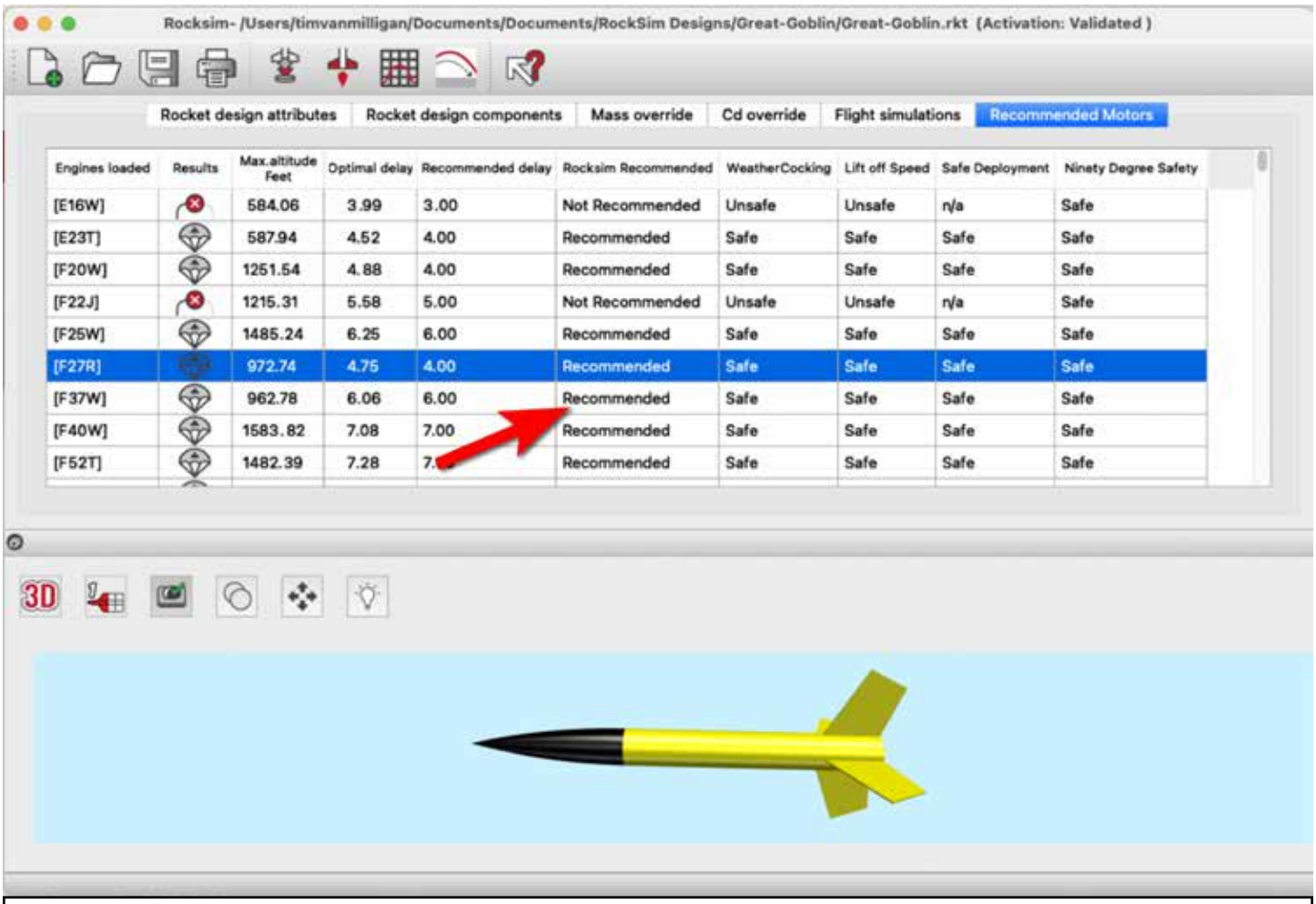


Figure 3: Adjust the launch guide length to what you expect to use, and then click on the button: "Use Recommended Conditions."

RockSim will then run a simulation of the rocket with every single motor in the database that fits into the model, and give you a list of results (Figure 4). In the results, you'll see a column called "Rocksim Recommend". If the motor is "Recommended" it will work just fine for your flight.



Engines loaded	Results	Max.altitude Feet	Optimal delay	Recommended delay	Rocksim Recommended	WeatherCocking	Lift off Speed	Safe Deployment	Ninety Degree Safety
[E16W]		584.06	3.99	3.00	Not Recommended	Unsafe	Unsafe	n/a	Safe
[E23T]		587.94	4.52	4.00	Recommended	Safe	Safe	Safe	Safe
[F20W]		1251.54	4.88	4.00	Recommended	Safe	Safe	Safe	Safe
[F22J]		1215.31	5.58	5.00	Not Recommended	Unsafe	Unsafe	n/a	Safe
[F25W]		1485.24	6.25	6.00	Recommended	Safe	Safe	Safe	Safe
[F27R]		972.74	4.75	4.00	Recommended	Safe	Safe	Safe	Safe
[F37W]		962.78	6.06	6.00	Recommended	Safe	Safe	Safe	Safe
[F40W]		1583.82	7.08	7.00	Recommended	Safe	Safe	Safe	Safe
[F52T]		1482.39	7.28	7.	Recommended	Safe	Safe	Safe	Safe

Figure 4: RockSim generates a list of all the motors that will work in your rocket.

This simple process of getting a list of motors is exactly what we use at Apogee when we make our motor charts on our website. Before we had this, we had to run every single motor combination one at a time. What took hours now just takes a couple of seconds.

If you want to save this list (a really good idea), right click with your mouse in the table, and a contextual menu will pop up. From the menu, select "Export Table," and it will prompt you to save it as an MS-excel file on your computer (Figure 5).

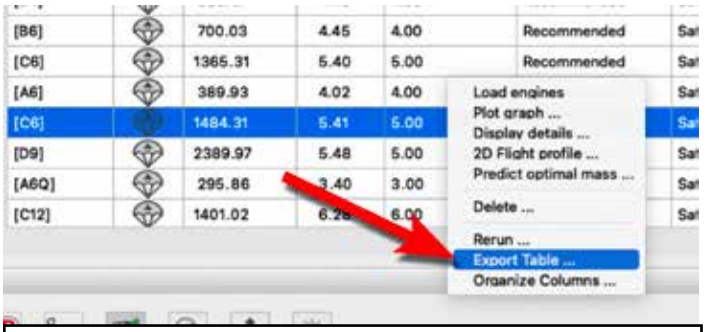
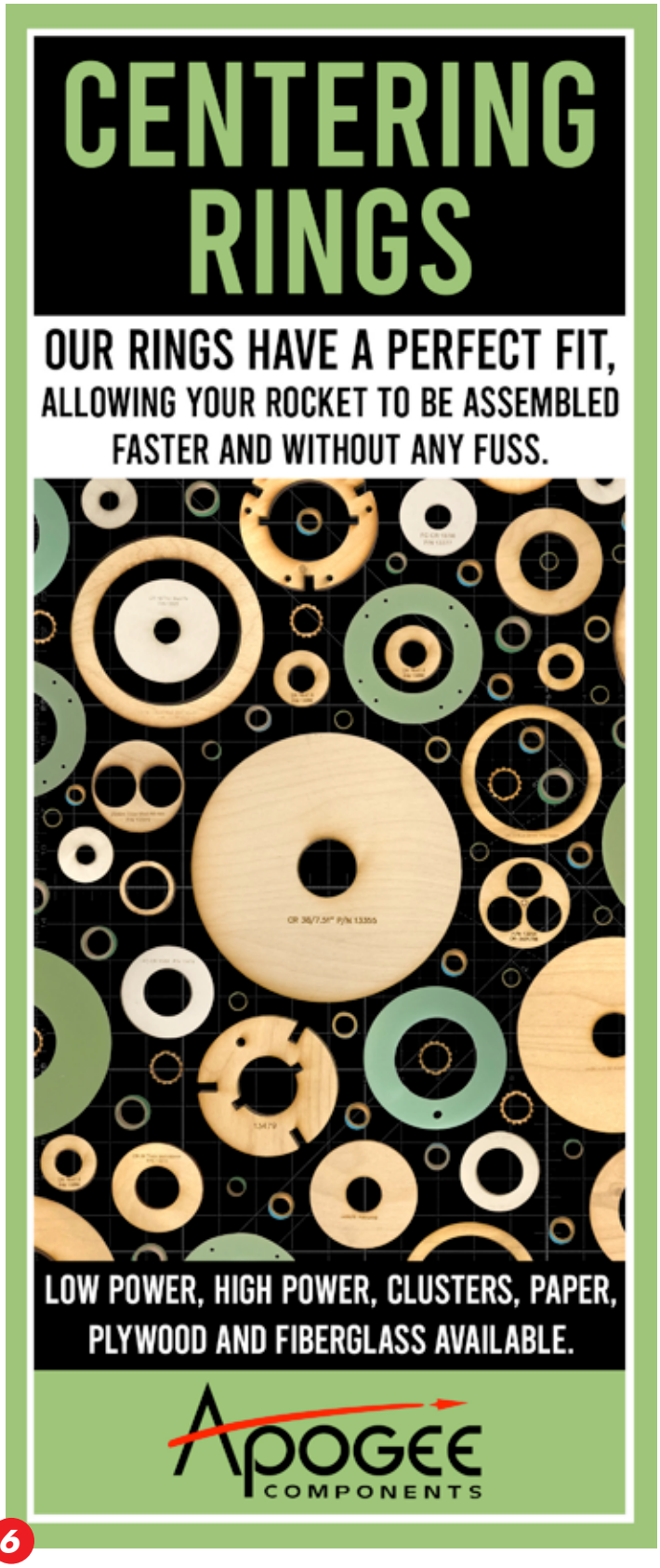


Figure 5: Save the motor list to your computer, right click on the table, and select Export Table from the contextual menu.



But there is still a long list of motors you might select. And that is where there still is some confusion.

Once you have a big list of potential motors, that would all work successfully, how can you narrow it down further?

How High Do You Want it to Go?

The next criteria that I'd look at would be the max height of the rocket. You have to consider the size of the launch field you have, and how far the rocket may drift. A lot of people are thinking into the future and have realized that the higher the rocket ascends, the further they will have to chase it. So you may want a rocket motor that flies relatively low.

So what I'd do next is to resort the recommended list of motors provided from RockSim, by clicking on the column "Max. Altitude." This will sort it from lowest to highest altitude, as seen in Figure 6.

Engines loaded	Results	Max.altitude Feet ▲	Optimal delay	Recommended delay
[F23FJ]		736.62	4.52	4.00
[F36]		744.31	[illegible]	4.00
[F36SS]		774.52	5.58	5.00
[F37W]		966.70	6.08	6.00
[F37]		966.70	6.08	6.00
[F27]		976.21	4.77	4.00
[F27R]		976.70	4.77	4.00
[F62T]		999.12	6.42	6.00
[53]		1010.93	5.70	5.00
[F36]		1013.59	5.75	5.00
[F32WH]		1022.42	6.15	6.00
[F36BS]		1027.06	6.23	6.00
[F29]		1036.38	5.65	5.00
[F23FJ]		1045.68	4.88	4.00
[F29IM]		1045.79	6.06	6.00

Figure 6 - Sort the motor list by Max Altitude, and then select a motor based on how high the rocket might go.

Single-Us vs Reloadable Motors?

Another idea you might have, which is totally legitimate, is that you might be thinking that you prefer to use a single use motor versus a reloadable motor.

The recommended motor list, unfortunately, doesn't store what type of rocket motor each simulation used. In this case, you'll just have to run the recommended motor feature again. When you go back to the screen, as shown in Figure 7, just be sure to choose from the drop-down menu the "single use" option. The new list of recommended motors will only contain single use motors, so you've just narrowed you list down quite a bit.

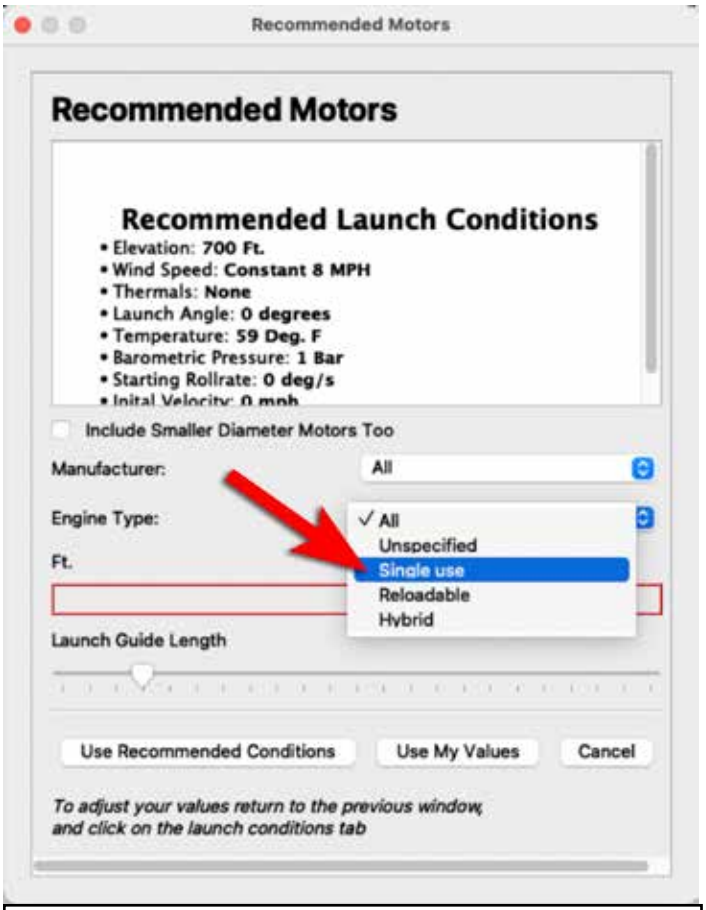


Figure 7: You can select the type of motors when you run the recommended motors option.

After you filtered the list down by altitude and motor type, how else can you limit the selection of motors even further? The answer is to look at the specific propellant formulation that is inside the motor.

Usually, the propellant formulation is listed in the motor name, right after the number, which is the average thrust of the motor measured in Newtons.

Engines loaded	Results	Max.altitude Feet	Op
[F20W]		1254.86	
[F25W]		1488.74	
[F27R]		976.52	
[F23FJ]		1045.48	
[G75M]		2288.44	
[G77R]		1986.28	
[G78G]		2116.16	

Figure 8: The letter after the number in the motor name tells you what propellant formulation is used in the motor.

Now this criteria is strictly a visual appeal. It doesn't affect the flight of the rocket; remember, we ran the recommended motor feature in RockSim, so now all that is left are motors that can be used. The propellant formulation doesn't change that at all. The only thing it will change is the visual effect the motor makes as the rocket takes off. In other words, what color is the flame, the smoke, and what the motor sounds like when it takes off.

Below is a list of the propellant's characteristics, taken from the Apogee website. Even though it may say something about how fast the motor burns, at this point we've already determined that it will safely lift the rocket for a successful flight. So you can ignore any comments about the burn rate of the formulation.

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Aerotech Propellant Types

Black Jack™ (J) and Black Max™ (FJ) - Provides the high visibility tracking of dense, black exhaust. In addition to a distinctive lift off roar, Black Jack motors give your models lower acceleration and longer powered flight than White Lightning or Blue Thunder motors of the same total impulse. Black Max provides slightly higher acceleration than White Lightning Propellant.

Blue Thunder™ (T) - Produces a bright violet-blue flame with a minimum of exhaust smoke. These motors provide a higher level of thrust than White Lightning or Black Jack motors of the same total impulse. Blue Thunder is the perfect propellant for high lift-off acceleration.

White Lightning™ (W) - A brilliant white flame, dense bright white exhaust, and a throaty roar are the hallmarks of this popular propellant. Easy to track. Exciting to watch! White Lightning looks and sounds like actual sounding rockets and launch vehicles. Special effects professionals and aerospace companies specify the AeroTech White Lightning propellant to achieve realistic simulation.

Dark Matter™ (DM) - Dark Matter is a sparky propellant but unlike Metalstorm with it's higher impulse and white smoke, Dark Matter is the black smoke sparky. These may remind you of the old black powder Rocketflite Silver Streaks, which were legendary in the early days of high-power rocketry. As with all rocket motors using spark-generating propellants, special precautions must be taken to avoid fires around the launch pad by clearing the immediate area of all combustible materials in accordance with applicable fire and safety codes.

Metalstorm™ (M) - Metalstorm has completely different visual, audible and performance characteristics than the other sparky propellants currently on the market. Metalstorm ignites easily and produces a large, brilliant white exhaust plume, a much longer yellow-orange dense spark tail, plentiful white sparks that fan out in flight and an ample volume of white smoke.

Metalstorm's high density and relatively high specific

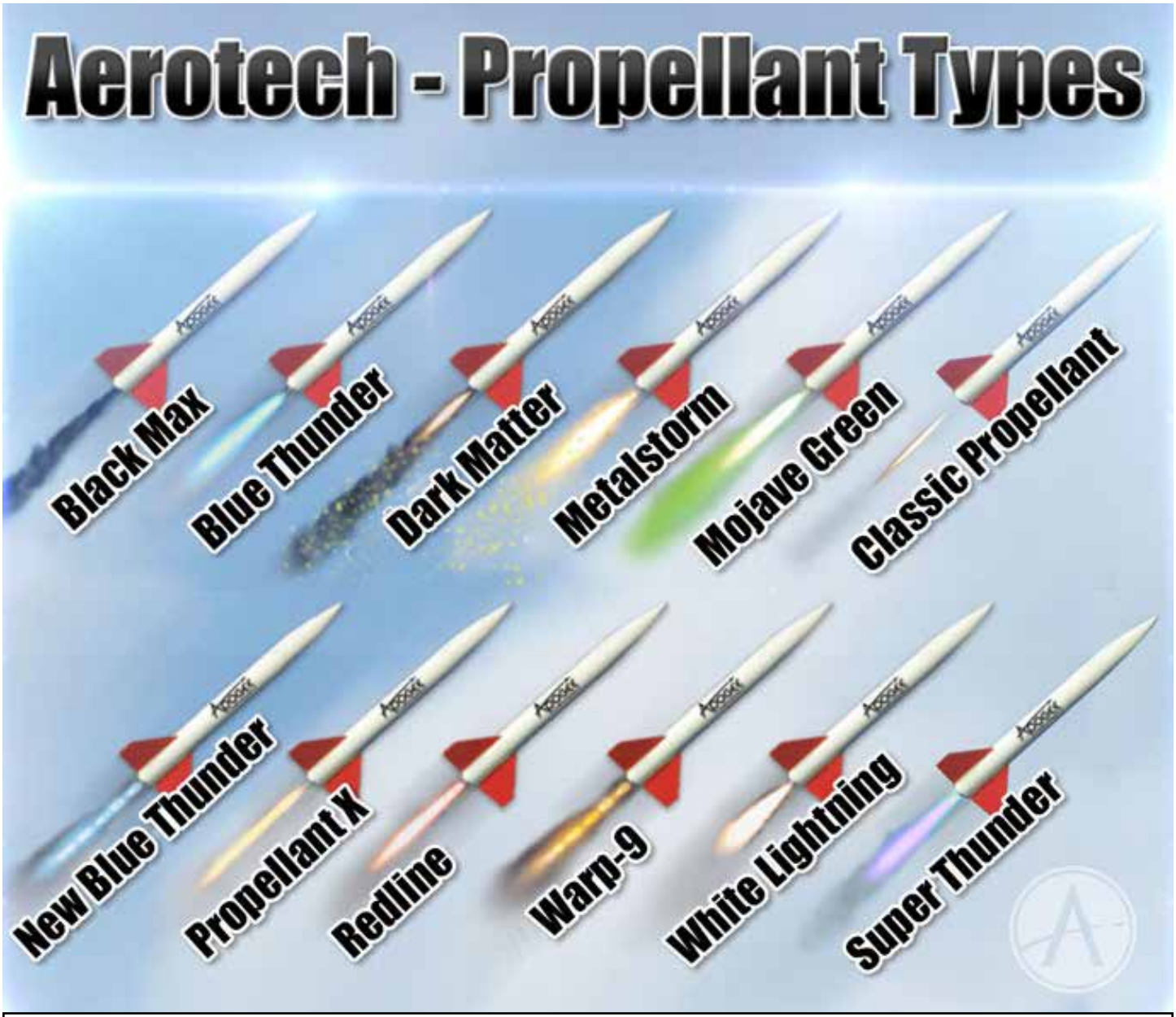


Figure 9: The Aerotech propellant types.

impulse results in a higher delivered total impulse for a given volume than some other sparky propellants. This characteristic makes Metalstorm "the performance sparky." Motor burn times using Metalstorm propellant are slightly longer than those produced by White Lightning™, but the total impulse is only slightly lower.

As with all rocket motors using spark-generating propellants, special precautions must be taken to avoid fires around the launch pad by clearing the immediate area of all combustible materials in accordance with applicable fire and safety codes.

Mojave Green™ (G) - Mojave Green™ is one of AeroTech's newer propellants designed for its single use and RMS reloadable motors. Named for an infamous green rattlesnake with two types of venom that roams the Mojave desert, Mojave Green produces a brilliant green exhaust plume with a moderate amount of smoke. Mojave Green's high-density and specific impulse deliver a higher total impulse in each motor size than any other AeroTech propellant. Motor burn times using Mojave Green are similar to those produced by Redline™.

New Blue Thunder™ (NT) - This propellant color, formulated in high power motors, produces a beautiful blue exhaust jet studded with prominent "mach diamonds." They say it's got a much more intense blue than the standard Blue Thunder.

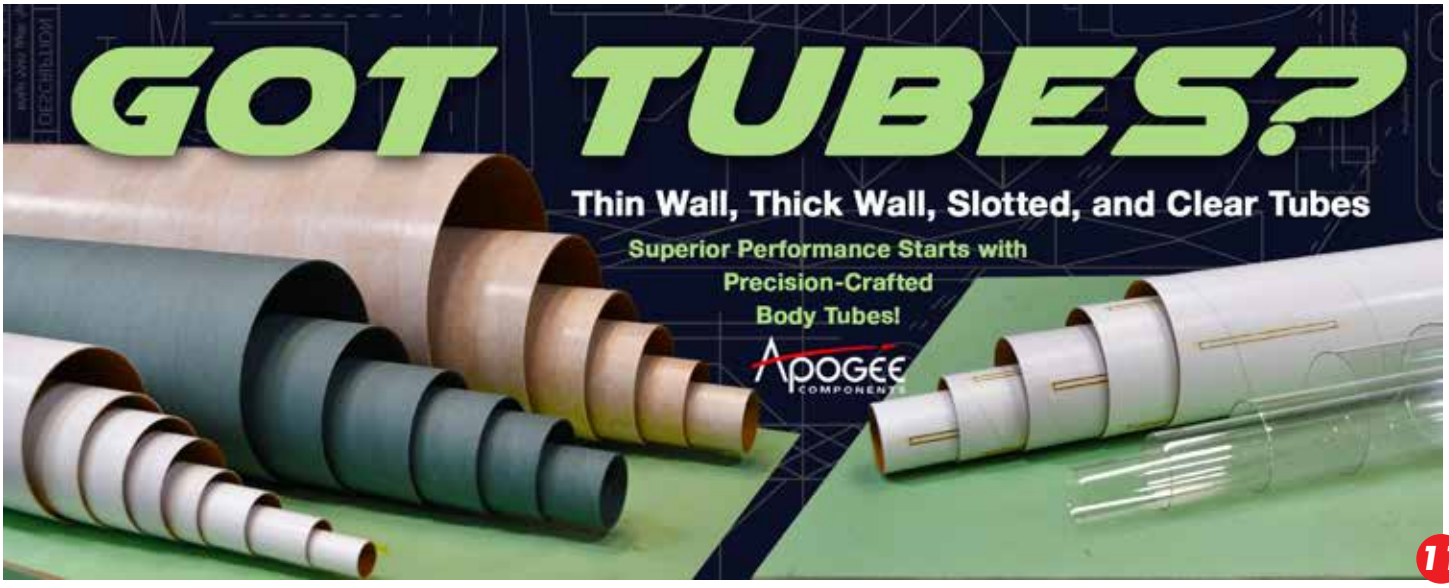
Propellant X™ (X) - Propellant X is a high impulse propellant. It is a fast burning propellant with a long yellow/white flame and low smoke.

Redline™ (R) - Distinctly different from its propellant relatives, Redline provides unique visual and thrust characteristics for larger airframes and performance oriented flyers. The proprietary AeroTech formulation imparts Redline with its signature vivid scarlet flame. Redline's burning rate lies midway between that of White Lightning and Blue Thunder. Photos don't do justice to the "laser-beam" intensity and color of Redline… you have to see it to appreciate it!

Warp-9™ (N) - If you blink, you'll miss it! Displaying a prominent yellow-orange flame studded with "mach diamonds", Warp-9 is AeroTech's fastest-burning propellant. Originally developed for Orbital's Pegasus® fin motors, Warp-9 is perfect when you need the highest thrust possible from a given motor size. Alternatively, when used in an "end-burning" grain configuration, Warp-9 delivers unique thrust curve profiles such as that produced by the new G69N model rocket reload.

Super Thunder™ (ST) - Super Thunder produces a brighter violet-blue flame with a little more smoke than Blue Thunder (T). It is a fast burning propellant with a burn rate midway between Blue Thunder and Warp-9. According to Gary Rosenfield at Aerotech, the back-story is that they wanted a formulation with an intermediate burn rate to compete with the Cessaroni V-Max propellant formulation, but at a lower cost than Warp-9, which uses an expensive burn rate catalyst. In addition, they wanted a fast propellant that would still work with a pyrotechnic time delay. From a production standpoint, Aerotech also found that it casts better than the Warp-9 formulation, which means it can be used in smaller diameter motors (such as the 29mm motor - H13ST). The original name for Super Thunder was going to be "Warp-8", but they settled on Super Thunder.

Classic™ (C) - "Classic Enerjet" propellant mimics the look, sound and performance of the original Enerjet propellant which was used in the first composite propellant model rocket motors from 1970 to 1974. For those modelers old enough to remember the Enerjet motors, this formulation will bring back fond memories from your youth. The "classic Enerjet" propellant formulation provides an impressive lift-off with visible supersonic shock diamonds emanating from a translucent exhaust plume and no smoke. This characteristic appears to make your rocket leap-off the launch pad. What's different is that today's modern ingredients have a higher propellant "solids loading," which is used to maintain the smokeless characteristic of the first Enerjets. As a benefit, these have a significantly higher "Isp" (propellant efficiency performance rating) and greater density than the original. That means they go higher!



Cessaroni Propellant Types

Like Aerotech, the motors made by Cessaroni also have a variety of propellant formulations that produce different flame and smoke effects. Here are the basic descriptions of each type:

Click the links for a video - either static test by Cesaroni, or a launch with the propellant.

Blue Streak (BS): Blue flame, thin gray smoke.

Classic (CL): Narrow orange flame, thin, light gray smoke. Medium burn rate.

C-Star (CS): High Specific Impulse (ISP) motor. High performance and bright flame, this motor is based on the Space Shuttle's solid rocket motors. ---s a highly aluminized propellant, again very efficient

Green (G): Green flame, thin white smoke.

Imax (IM): Initial greenish flame that turns orange before burnout. The total impulse of Imax™ reloads is about 10-15% higher than that of any other reload in the same motor hardware. In other words, if you want a "full gas tank" in your rocket, then the Imax motors would be your choice and typically they'll fly higher.

Mellow (M): Long, apparently flameless, burn. Gray smoke. Originally, Cessaroni wanted a yellow flame, but unfortunately the color was too pale. But the long burn characteristic of the formulation was impressive, so they kept it in their line-up.

Pink (PK): A pale, pinkish-violet flame and thin white smoke.

Red Lightning (RL): Red flame, white smoke.

Skidmark (SK): Intense orange flame, thick black smoke with sparks (called a "Sparky" motor).

Smoky Sam (SS): Dense charcoal smoke that obscures the flame.

Vmax (VM): Wide orange flame, very quick thrust. But they have lower overall impulse compared to loads in the same case. So you'll get a very fast lift-off, but the rocket won't fly as high.

White (W): Bright white flame. Medium burn rate.

White Thunder (WT): Bright white flame, light gray smoke. Most realistic looking propellant. High burn rate.

Figure 10: Cesaroni Propellant formulations

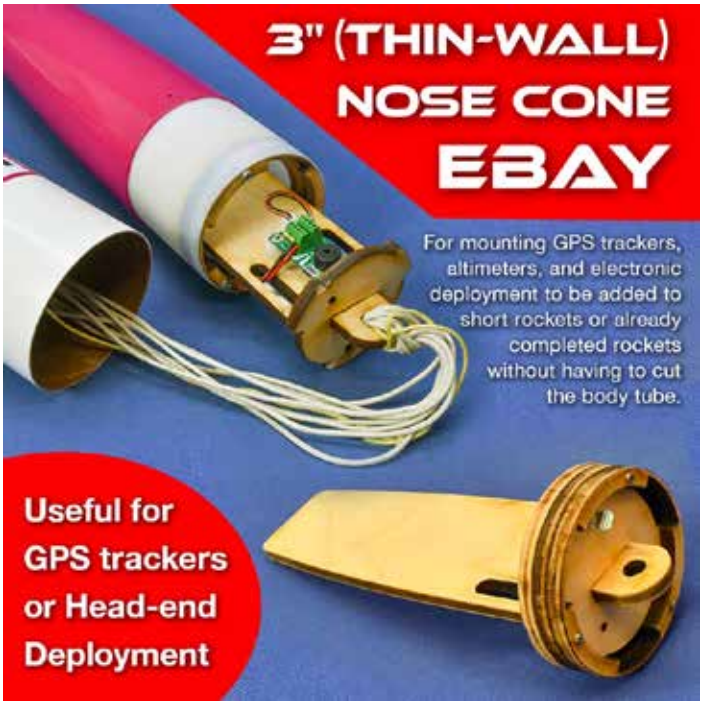
Conclusion

In conclusion, picking motors always starts by running your RockSim simulation. That part only takes a few seconds, and you'll have dozens of motors that will work successfully in your rocket. At that point, you can start looking at the different propellant formulations to get the visual effect you want from the launch.

You'll find that the various propellant types offered by Aerotech and Cessaroni provide a range of visual, audible, and performance characteristics to suit different model rocketry desires. Each propellant has its unique properties, such as flame color, smoke density, burn rate, and specific impulse. Using the information in this article, you'll have an understanding of the characteristics of each propellant, and you can choose the most appropriate one for your projects, whether you seek high lift-off acceleration, long-duration flights, realistic simulations, or eye-catching and colorful displays. The availability of a diverse selection of propellants allows you to add excitement, variety, and creativity to your rocketry endeavors.

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



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Tim's Messy Desk

by Tim Van Milligan

What's going on in my world? Glad you asked.

My personal goal for this year has been to take more time off from Apogee. First of all, we've got a great team here, and I'm trying to let them shine more, while rejuvenating my own mind and body. As they take over more of the daily duties, it should free me up to have fun in other ways besides rocketry.

But to be honest, when it comes to rocketry, we've had a long string of bad weather on the regular weekend launches of our local club. I've yet to drive down to Pueblo this year for a regular launch. It has either been snow, rain, or extremely windy conditions that have canceled our launches. I have to say that I'm getting launch fever. Hopefully, the next launch will be a "go."

Last year I made some major changes in my lifestyle in order to focus more on my health. I've always been in good health, and I want to keep it that way for as long as possible. There are so many cool things going on in the space industry right now, and it seems that much more is on the near horizon. I want to see those predictions come true, so I need to be around for a long time. Plus I'm hoping to be in rocketry for at least another 30 years or so. That is why I'm trying to stay physically and mentally fit, and why I hope you will do the same. I'd like to see you make just as many new achievements too.

Staying active and fit is one of the reasons I've been taking some time off. For Easter this year, I went and visited my daughter, Allison, in Florida. It was my own personal spring break, and it was a nice change of pace. The weather was beautiful, and I got to spend a couple of sunny days on the beach getting some high doses of Vitamin D. I used to live in Florida in the 1980's and early 1990's, so it still feels like home to me. I like the humid, musty smells of the tropical environment. It reminds me of my days when I worked at Cape Canaveral, launching the Delta II rocket into space.

Allison is moving out of Florida in July to go on to Physician Assistant (PA) school in North Carolina. We still talk about all the rocket launches that she and I did together, and how it shaped her career choice.

Golf is not my game, but I enjoyed shanking a bucket of balls.

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Tim's Messy Desk

by Tim Van Milligan

In April, I went down to Dallas Texas to visit my other daughter Ashley. The purpose of the trip was to see the solar eclipse on April 8. It was a fun trip, and even if I didn't get to see the eclipse, it was well worth it. Ashey and I did a lot of things together that were just the two of us. We went to the driving range and discovered that neither of us can hit a golf ball straight. Then we were lucky enough to get some tickets to see the Dallas Mavericks play the Houston Rockets. I've never been to a professional basketball game before, so it was a totally new experience for me. Unfortunately, Ashley had to get back to her dorm to study for a test she had on Monday, so we didn't get to see the full game. We heard later that it went into overtime, so we missed a lot of the experience.

The final event we did together, after her MathCAD test, was to travel a bit more east into Texas to view the solar eclipse. The weather was predicted to be cloudy, but we decided to chance it anyway. As we drove, it got cloudier and cloudier. But about an hour before the scheduled time, the clouds started burning off and we had a nice view of the sky.

Back in 2017, I pulled both Allison and Ashley out of school, and we drove up to Wyoming to see the last total solar eclipse, which was August 21, 2017. So we kind of knew what to expect for this one.

But I found it to be different. Maybe it was just that I was noticing more things going on this time. As the moon started covering the sun, I noticed that everything had a strong blueish tint as it began to grow darker. In my mind, I was comparing it to an evening sunset, where everything turns to a reddish tint. The sky turns red because the shorter wavelengths of blue and violet light are scattered away by air and dust molecules because they have to travel further through the atmosphere. The longer wavelengths of red and orange light pass through unimpeded, giving the sky a reddish-orange appearance.

In the Solar eclipse, the scattering of the shorter wavelengths of light doesn't happen, as the sun is nearly directly overhead so everything looks more blue.

My daughter Ashley looking at the sun with her eclipse glasses

We were looking through the tinted solar glasses, and the sun appears to be a bright orange color. Even just the smallest sliver of exposed sun is an ultra intense orange and you have to look at it through the glasses. As the moon got closer and closer to the edge to blot out the sun, I was just expecting everything to go black.

The sun is an intense orange, even when almost blotted out.

When it went black, I removed the glasses, and then you see the ring in the sky. The corona of the sun, which wasn't visible through the glasses, is now an intense bluish ring around the edge of the moon. And it isn't a red

My own photo of the solar eclipse taken in northern Texas.

color anymore, which is what my mind was still expecting to see. Even though I knew the ring was coming, my brain still wasn't, so when it became visible, I was just in awe.

I grabbed my camera, and started snapping photos. But the photos never do it justice, because it makes the sun appear larger than it really is. The sun in the sky is only about as big as the size of a thumbnail of your outstretched hand. It is small in the vastness of the sky, and you don't see the moon at all, just the bright bluish colored ring hanging in the black sky. It is so eerily different from what my mind was thinking I'd see.

As soon as the disk of the sun started peeking out the edge of the moon, it was like the second sunrise of the day. We could see on the horizon the fast approaching line of light, and looking to the northeast, the receding darkness of the eclipse.

All in all, Ashley and I had a good spot to view the eclipse, and I was able to drive back to her university dorm relatively quickly. Much faster than I expected, since they were forecasting long traffic jams after it was over. So my trip to Texas was a very pleasant and memorable one. I sure hope your eclipse experience generated some great memories for you as well.

In other news, I started a new coaching program this year. I've had a business coach since 2007, but this one is radically different, and I'm really looking forward to it. They urge me to take more vacation days, and schedule them a year in advance. That was one of the reasons I took off for Easter and to see the solar eclipse in April. My next trip that I'm expecting is likely to help Allison move from Florida up to North Carolina. Then in the fall, I'll probably do more trips to Texas to watch Ashley's diving events with the University of North Texas.

For rocketry related things, we will be heading to the National Sport Launch in Alamosa, Colorado over the Memorial Day weekend, and to NARAM that will be held in Pueblo, Colorado in early August.

Finally, it was sad news to hear that Gleda Estes passed away in the last week of March. She is a legend in the hobby, and the perfect mentor to young women that wanted to learn more about rocketry and get into STEM careers. Both my daughters were influenced by Gleda and knew her. They often chatted with her when she came out to launches and to NARAMs. My condolences go out to Vern Estes, the Estes family as well as to everyone that feels sad by this news. She will be missed, but her guiding spirit lives on.

Gleda Estes with my daughters Allison (left), and Ashley (front) in 2014.

PEAK OF FLIGHT NEWSLETTER
Article Submission Guidelines
Issue 624 / April 23rd, 2024
www.ApogeeRockets.com

SUBMITTING ARTICLES TO APOGEE

We are always looking for quality articles to publish in the *Peak-of-Flight* newsletter. Please submit the "idea" first before you write your article. It will need to be approved first.

When you have an idea for an article you'd like to submit, please use our contact form at **https://www.apogeerockets.com/Contact**. After review, we will be able to tell you if your article idea will be appropriate for our publication.

Always include your name, address, and contact information with all submissions. Including best contact information allows us to conduct correspondence faster. If you have questions about the current disposition of a submission, contact the editor via email or phone.

CONTENT WE ARE LOOKING FOR

We prefer articles that have at least one photo or diagram for every 500 words of text. Total article length should be between 2000-4000 words and no shorter than 1750 words. Articles of a "how-to" nature are preferred (though other types of articles will be considered) and can be on any rocketry topic: design, construction, manufacture, decoration, contest organization, etc. Both model rocket and high-power rocket articles are accepted.

CONTENT WE ARE NOT LOOKING FOR

We don't publish articles like "launch reports." They are nice to read, but if you don't learn anything new from them, then they can get boring pretty quick... Example: "Bob flew a nice blue rocket on a H120 motor for his certification flight." As mentioned above, we're looking for articles that have an educational component to them, which is why we like "how-to" articles.

You can see what articles and topics we've published before at: **https://www.apogeerockets.com/Peak-of-Flight?pof_list=archives&m=education**. You might use this list to give you an idea or two for your topic.

Here are some of the more common articles that we reject all the time, because we've published on these topics before:

- How to get a L1 Cert
- How to get an L2 or L3 Cert
- Building cheap rockets
- How to 3D print parts
- Building Low Cost Launch Equipment (pads and controllers)
- Getting Back Into Rocketry After a Long Hiatus
- How to Build a Rocket Kit
- How to Build a Computer (too technical)

ARTICLE & IMAGES SUBMISSION

Articles may be submitted by emailing them to the editor. Article text can be provided in any standard word processor format (MS Word, Libre Office, etc.) or as plain-text. Graphics, meanwhile, should be provided in either a vector format (Adobe Illustrator, SVG, etc.) or a raster format (such as jpg or png) with a width of at least 600 pixels for single column images or a width of 1200 pixels for two-column images. If possible, it is generally preferable for images to be simple enough to be readable in a two-column layout, but special layouts can use the whole page width if required.

Send the images separately via email as well as showing where they go by placing them in the word processor document.

ACCEPTANCE

Submitted articles will be evaluated against a rubric (available here on our website). All articles will be evaluated and the results will be sent to the author. In the evaluation process, our goal is to ensure the quality of the content in *Peak-of-Flight*, but we want to publish your article! Resubmission of articles that do not meet the required standard are heavily encouraged.

ORIGINALITY

All articles submitted to Peak-of-Flight must not have been run in another publication before inclusion in the *Peak-of-Flight* newsletter, but it may be based on another work such as a prior article, R&D report, project report, etc. After we have published and paid for an article, you are free to submit them to other publications.

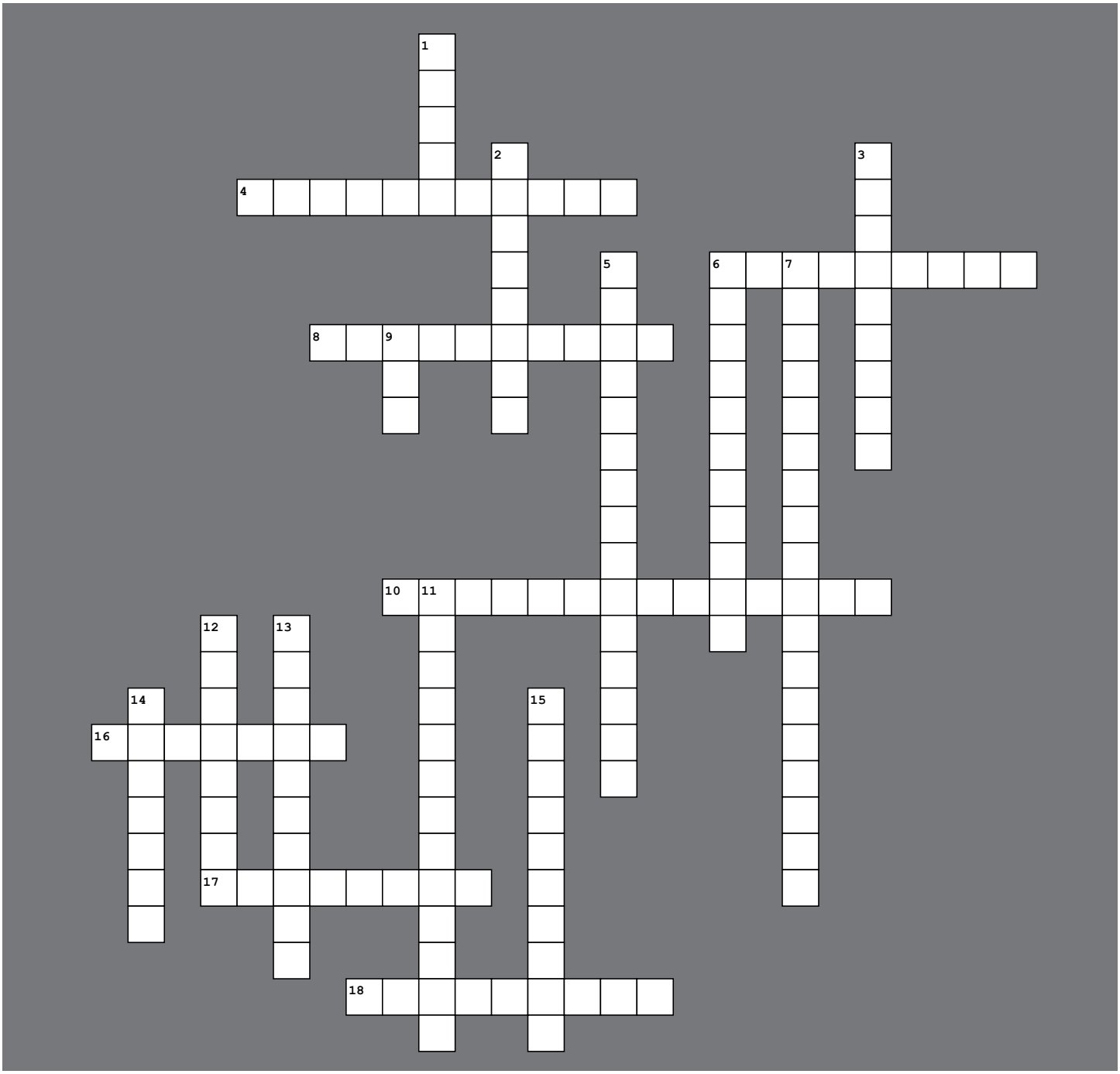
RATES

Apogee Components offers **$300** for a quality-written article over 2,000 words in length. Payment is pro-rated for shorter articles.

WHERE WILL IT APPEAR?

These articles will mainly be published in our free newsletter, Peak-of-Flight. Occasionally some of the higher-quality articles could potentially appear in one of Tim Van Milligan's books that he publishes from time to time.

CROSSWORD



ACROSS
4. Thrust Decay **6.** Parachute **8.** Skywriting **10.** Flame Deflector **16.** Coupler **17.** Range Box **18.** Stine's Law

DOWN
1. Abort 2. Headwind 3. Upscaling 5. Fin Alignment Jig 6. Plasticizer 7. Range Safety Officer 9. Yaw 11. Low Earth Orbit 12. MidPower 13. Supersonic 14. RockSim 15. Blockhouse

QUESTIONS

ACROSS

4. The gradual loss of thrust at the end of a motor's burn.

6. A piece of plastic, cloth, nylon, or other material, shaped something like an umbrella when deployed, which slows the descent of a rocket.

8. Slang term for the smoke trail left by an unstable rocket which does not fly straight.

10. Variously designed obstructions that intercept the hot gases of the rocket engine so as to deflect them away from the ground or from a structure.

16. A section of tube used to connect 2 sections of larger body tubing.

17. A box used to carry everything that you need for flying rockets.

18. "If at first you don't succeed, try following instructions."

DOWN

1. Failure of an aerospace vehicle which prevents completion of its mission.

2. Wind blowing generally into the front of an aircraft, thereby slowing its ground speed.

3. The practice of building large versions of smaller model rockets.

5. A device used to align and hold in place fins to a body tube.

6. An additive which makes a composite propellant softer and more flexible

7. the person responsible for the safe launching of a rocket.

9. A back-and-forth motion of the nose of a rocket in flight, on the axis determined as "left-and-right".

11. An orbit below 1000km

12. Typically rockets flying on motors in the E to G range.

13. A speed greater than Mach 1 (760 mph at sea level) and less than Mach 5.

14. An computer program (from Apogee Components) that allows you to design any size rocket, and then simulate its flight to see how high, and how fast it will fly.

15. A heavily reinforced building, designed to withstand blast and heat.

Apogee Components, Inc.
4960 Northpark Dr.
Colorado Springs, CO 80918
719-535-9335

Your Success Is Our Mission!

www.ApogeeRockets.com