PEAK OF FLIGHT NEWSLETTER

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IN THIS ISSUE

WHICH STARTER TO USE FOR YOUR ROCKET MOTORS?



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PEAK OF FLIGHT

Which Starter to Use for Your Rocket Motors?

By Bobby Potter and Tim Van Milligan

Starters in Model Rockets

There are so many different igniters (which are called "starters" or "initiators" in the hobby) available that it can be hard to understand which you should be using in your motor. Add in all the different pyrogen compounds, launch controllers, and different propellant types in the motors and you end up with a lot of confusion. Because in the end, you're searching for the best one for your rocket. This article is intended to be a simple guide to "starters." We'll go over your current options, proper use and the best ways to reduce misfires.

What is a Starter?

A modern starter is essentially two wires connected by a thin nichrome bridgewire at the tip. The starter is connected to the launch controller via two alligator clips. This allows a full circuit to complete when the launch button is pushed. Electricity flows through the wires and the nichrome tip gets cherry-red hot. This heat is what starts the propellant burning. The NAR safety code specifically requires that motors be started electronically for a very good reason. It is for your safety, as well as the safety of those around the launch area.

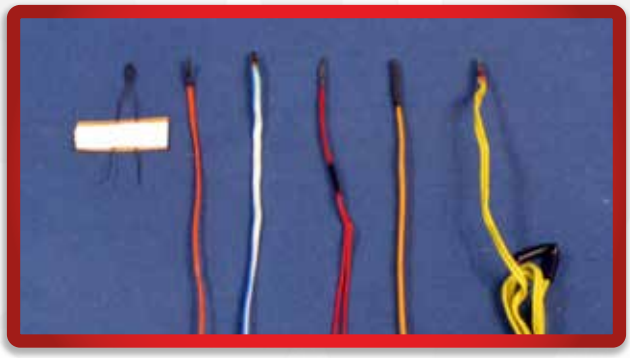


FIGURE 1: A VARIETY OF MODEL ROCKET STARTERS

The current Estes Starter is a simple and very thin nichrome bridgewire, that is dipped in a whitish glue to give it some durability from rough handling.

Essentially, all igniters operate in a similar fashion, even though they may look different than the Estes Starter. The nichrome tip may have a variety of things on it to improve ignition of the motor, usually in the form of a pyrogen that flares up like a match head to provide additional and intense heat to the propellant to get it started quicker.

The sensitivity of the igniter ("how quickly it heats up"), is determined by the thickness of the nichrome bridgewire on the tip. The thinner and shorter the bridgewire, the faster it will heat up. The most sensitive are the ones on the "chip-boards." Here, the bridgewire is so whisker thin that it is difficult to see with the naked eye. And because it is so thin, it can break easily, which can be a major problem. Once it is broken, the circuit is not complete, and the starter can't be used. It is dead. To prevent it from breaking, it is wrapped over the end of a plank - which is typically a piece of fiberglass board. Because it resembles a computer circuit chip, that is why they are called "chip boards." Unfortunately, the chip boards are physically too big to fit into most nozzles of Estes motors, so they are limited in use to larger rocket motors whose nozzles they can fit into. An e-match is one particular type of starter that uses a chipboard.



FIGURE 2: STARTER CHIPBOARD

Another problem with chip-board based starters (like an e-match) is that because they heat up so quickly and the wire is so thin, the nichrome on the tip doesn't have a chance to transfer a lot of heat to the propellant. They will work on black powder propellant motors, but not on composite propellant motors because those motors take a lot of heat to ignite. Even the pyrogen on the tip is difficult to ignite. In fact, it takes a very special pyrogen that is susceptible to low heat to even flare up. You'll see later in this article that we offer extra pyrogen dips, but only a couple are capable of being used with starter chipboards.

When you need a lot of heat to get the motor started, the starter typically has a larger diameter nichrome bridge wire in the tip. The nice thing is that they are more durable, so they don't need to be protected by a board. They can be simply embedded (dipped) in the pyrogen. But the downside of these starters is that they take more electrical

Continued on page 3

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Which Starter to Use for Your Rocket Motors?

Continued from page 2

current to get them hot. So you need a bigger battery. That is why it matters which launch controller you use with the starters.

As a rule of thumb, you want the biggest battery that is practical for your situation.

So we'll now review the various starters, and try to explain when you'd used them. But before you get too confused, please know that on the Apogee website, we list which starter comes with the rocket motor you are interested in. So if you need a replacement starter for the motor, your first choice should be to get the same starter that originally came with the motor. It is that simple! Buy the same starter that came with the motor, and it will fit and work with the motor.



FIGURE 3: COMPATIBLE IGNITERS LISTED ON EACH MOTOR PAGE.

Starter Descriptions and Usage

The Estes Starter Synopsis:

- Inexpensive; included with every Estes motor
- Durability concerns, even with the glue on the tip, they require extra care to prevent the bridgewire from breaking.
- Because of the bare wires, they can only be used with black-powder motors.
- Limited clustering of motors is possible, but is difficult because of the process of twisting bare wires.
- Not for air-starting, nor setting off dual-deployment with onboard batteries because they need bigger and heavier batteries for successful heating of the tip.

Launch Controller: Minimum of 6V system - Bigger is better. You'll find that most launch controllers will work (exception: these starters do not work with the wireless controller)

Check here for more specifications: https://www.apogeerockets.com/Rocket_Motors/Estes_Accessories/Estes_Starter_6pk

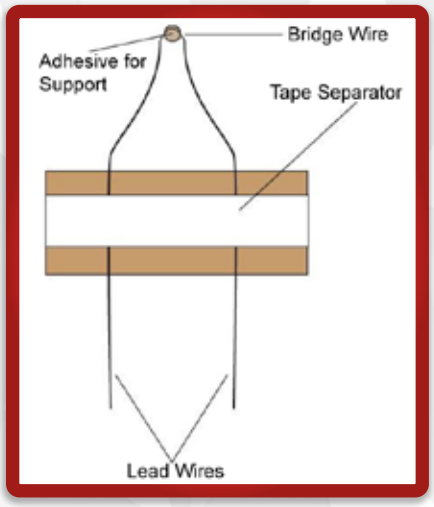


FIGURE 4: A SIMPLE ESTES STARTER

Modern Estes starters are pretty basic by design. They consist of two bare metal lead wires, connected at the tip by a thin nichrome wire called the bridge wire. It's important to keep the two lead wires separated, otherwise the current will pass through wherever the two wires touch and never pass through the nichrome at the tip. This will always result in a misfire.

To try to prevent this from occurring, Estes uses a strip of paper and tape to try to separate the two wires from each

Continued on page 4



Which Starter to Use for Your Rocket Motors?

Continued from page 3

other. The issue with this style of starter is that tape is not very strong, and you can easily end up sliding these wires too close together. Modern starters usually include some method of separation, but the basic Estes starter is the only one that uses tape for this purpose.

The other issue with the bare wires is that clustering motors by twisting multiple leads together is difficult because it is easy to accidentally short the wires together. And because of the shorter length of the bare wires, the motors need to be right next to each other to make twisting them together possible. In practical application, without some sort of clip-whip, you won't get more than three or four motors in the cluster, because the lead wires are too short.

It should be noted that Estes has announced that they plan to dip the tip of their starters in an exothermic compound starting in late 2020. Now this is not a "pyrogen," even though it may look like one. A normal pyrogen contains both a fuel and an oxidizer so it flares up and produces a flame. Exothermic compounds, something like "Thermite", are a pyrotechnic composition of metal powder and metal oxide. When ignited by heat, thermite undergoes an exothermic reduction-oxidation (redox) reaction. Most varieties are not explosive, but can create brief bursts of heat and high temperature in a small area.

Being "not an explosive" is important to Estes. This allows the starters to be shipped as a non-hazardous substance through the post office and carried on airplanes. We'll have to see how much heat they produce once they are in production. But it should be better than bare nichrome wire, which is what they have now.

The Estes Sonic Starter Synopsis:

- Insulated wires
- More durable than the simple Estes Starters
- Pre-dipped in pyrogen
- Capable of launching composite motors
- Good for clustering multiple motors on the ground
- Fits in small nozzles like the D10, D21, E6, and F10. But won't fit into the small Quest composite motors.
- Can be used for black powder motors, but using the standard plastic plugs to hold them in is more difficult.
- Not for air-starting, nor setting off dual-deployment with onboard batteries
- Any controller will set them off, except the wireless launch controller and onboard electronics that use small batteries.

Launch Controller: Minimum of 6V system - Bigger is better (exception: these starters do not work with the wireless controller)

Check here for more specifications (https://www.apogeerockets.com/Rocket_Motors/Starters/Estes_Sonic_Starter)

The Estes Sonic Starter is an improvement from the basic starter included with Estes motors. It has a similar construction, but with insulated wires, meaning they have a plastic coating to prevent the electrical current from transferring between the leads. And insulated wires are needed for composite motors, because the head has to go deep into the body of the rocket motor. If the wires were bare, they would touch each other inside the motor, short out and prevent the head from heating up and igniting the motor. So having insulat-

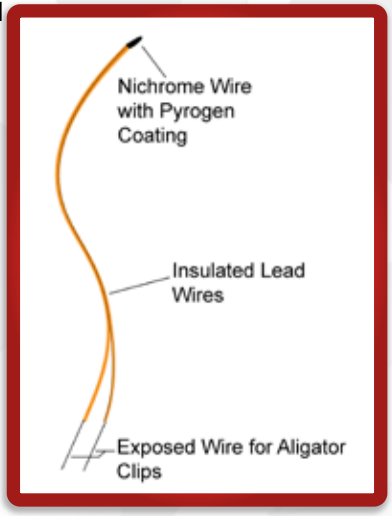


FIGURE 5: ESTES SONIC STARTER

Continued on page 5



Which Starter to Use for Your Rocket Motors?

Continued from page 4

ed wires is always a requirement for composite propellant motors.

The insulated wires also make it convenient to twist wires together for clustering motors on the ground. And the wires are long enough that the motors can be separated by a distance, so they don't need to be next to each other.

The Sonic Starter comes with pyrogen pre-applied. This provides more heat at ignition. But the downside is that they can't be held into the nozzle of black powder motors with the standard plastic plugs that come with the Estes motors. You need a smaller plug than what comes with the motor. Why? Because the insulated wires are thicker than the bare metal wires on the regular igniters, and the plastic plugs were designed for skinny metal wires without insulation over them. Just keep this in mind that you will need to find alternate methods of holding them into the nozzle than the standard plastic plugs that come with the motors. Most people use masking tape to hold them in if they are using them for black powder motors.

AeroTech "First Fire" Series

The name "First Fire" isn't specific to just one type of starter - it is a brand name associated with Aerotech. The "First Fire" starters come in several varieties, and they are slightly different and we can't lump them all together.

The big difference between them all is the size of the pyrogen heat on the tip. Ideally, you want as big of a pyrogen head as you can fit into the nozzle to give off a lot of heat. But if the head is too big, it can't fit through the nozzle opening. So you have to experiment a little bit to find one that is just the right size for the motor.

The "Micro" and the "Mini" First Fire Starters

These two starters are nearly identical. The only difference is the size of the pyrogen head on the tip. The "Micro" First Fire is the smallest of all the starters, and will fit into any composite propellant motor. They were made specifically for the Quest composite propellant motors that have really tiny nozzles. But they will also work in other composite motors, and in black powder motors as well. But like the Estes Sonic starter, the insulated wires make them more difficult to hold in the nozzle using the standard plastic plugs that come with the motors.

The "First Fire Mini" has a slightly larger pyrogen tip, and in most cases is just too big to fit into the Quest composite propellant motors. But they are great for all 24mm and 29mm motors that have lower thrust levels. As a general rule of thumb, the lower the thrust level on the motor, the smaller the throat diameter of the nozzle. Higher thrust motors will have a bigger opening, and therefore you'll be able to get a bigger starter head into the nozzle.

The First Fire Mini and the Estes Sonic igniter are pretty much interchangeable. If you can use one in your rocket motor, the other will work just fine as well. The only real difference between those two starters is the wiring (Estes uses steel while Aerotech uses copper) and the pyrogen used is a different formula between the two. Neither of these differences will make a notable difference in your rocket launch.

Micro and the Mini First Fire Starters Synopsis:

- Insulated Wires
- Pre-dipped in pyrogen
- Capable of launching composite motors
- Good for clustering multiple motors on the ground
- Can be used for black powder motors, but using the standard plastic plugs to hold them in is more difficult.

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Continued on page 6



Which Starter to Use for Your Rocket Motors?

Continued from page 5

- Not for air-starting, nor setting off dual-deployment with onboard batteries
- Any controller will set them off, except the wireless launch controller and onboard electronics that use small batteries.

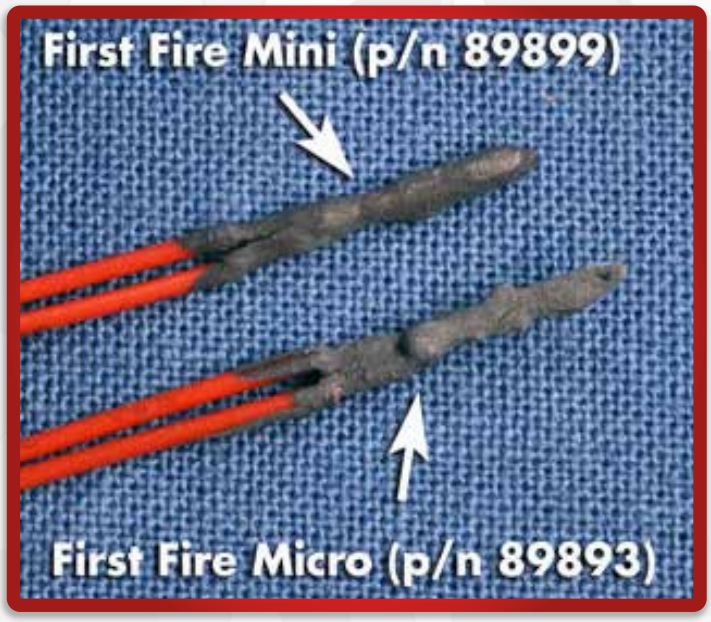


FIGURE 6: FIRST FIRE MICRO VS. MINI SIZE COMPARISON

The First Fire Micro (https://www.apogeerockets.com/Rocket-Motors/Motor-Starters/Quest-First-Fire-Micro-Initiator-Starters-3-pk)

The First Fire Mini (https://www.apogeerockets.com/Rocket-Motors/Motor-Starters/FirstFire-Mini-8in-long)

First Fire Jr.

The next size pyrogen head up from the First Fire Mini is the "First Fire Jr." It is supplied with Aerotech motors that are small in diameter (24mm or 29mm), but in general those that have higher thrust. These higher thrust motors have a larger nozzle throat, so a bigger pyrogen head can be inserted into them. An example of a motor that uses the First Fire Jr. would be the 29mm diameter Aerotech F42 motor.

One thing you'll notice is that for bigger ones like the First Fire Jr., the construction of the starter is different. A longer bridge wire is used, and it is wrapped around one of the insulated wires. The reason for this is that it increases the durability of the nichrome wire, and more wire is in contact with the pyrogen which means the composition can be ignited anywhere along the head. But the downside of the longer nichrome bridgewire is that it takes more electricity to heat it up. Therefore, with larger starters like the First Fire Jr., you will need a 12V launch controller to reliably and quickly set them off. The small launch controller you've used for small black-powder motors will no longer work reliably on these starters.

Similarly, you can't use them for air-starting motors in flight because it is difficult to carry a heavy battery onboard the rocket.

But they can still be used in clusters that are lit on the ground by your club's 12V launch equipment.



FIGURE 7: FIRST FIRE JR. BOTTOM SHOWS WHAT IT LOOKS LIKE WITHOUT ANY PYROGEN.

Continued on page 7



Which Starter to Use for Your Rocket Motors?

Continued from page 6

First Fire Jr. Synopsis:

- Insulated Wires
- Pre-dipped in pyrogen
- Capable of launching composite motors
- Good for clustering multiple motors on the ground
- Not for black powder motors because the head is too big to fit into the nozzle.
- Not for air-starting, nor setting off dual-deployment with onboard batteries
- Recommended that the controller be a 12V system.

(https://www.apogeerockets.com/Rocket_Motors/Aero-Tech_Accessories/First_Fire_Jr_Starter)

The First Fire High Power

The largest starter in the First Fire series is just called the "First Fire." It has similar construction as the First Fire Jr. (See Figure 7), but with longer wires and a bigger pyrogen head on the tip. It is used in almost all of the 38mm diameter motors and larger that come from Aerotech.

(https://www.apogeerockets.com/Rocket_Motors/Aero-Tech_Accessories/First_Fire_Starter)

E-Matches

All the Cesaroni motors come with an e-match as the standard starter. These were discussed at the beginning of this article. The advantage of the e-match is that it takes only a wisp of electricity to set them off. So ANY electrical ignition system can set them off, including the wireless launch controller and all onboard electronic systems.

There are three disadvantages of the e-matches. First, the chipboard on which they are mounted is wide, and therefore can't fit into all nozzles. Second, they don't produce a lot of heat when you fire them off. They pop when they go off, and it is so fast that very little heat is transferred to the propellant. They would be just fine for igniting black powder motors if they fit into the nozzle because that propellant ignites so easily. But it is another thing when igniting composite propellant – Which are very difficult to start. Cesaroni gets around this particular problem by wedging a nugget of black powder into the propellant of their motors. So the e-match lights the black-powder nugget, which then produces a lot of heat and ignites the hard-to-start composite propellant.

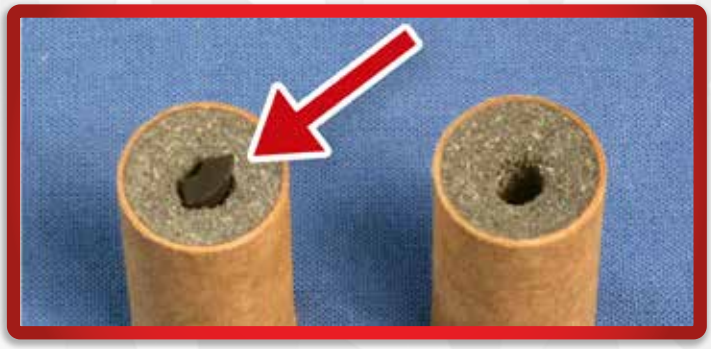
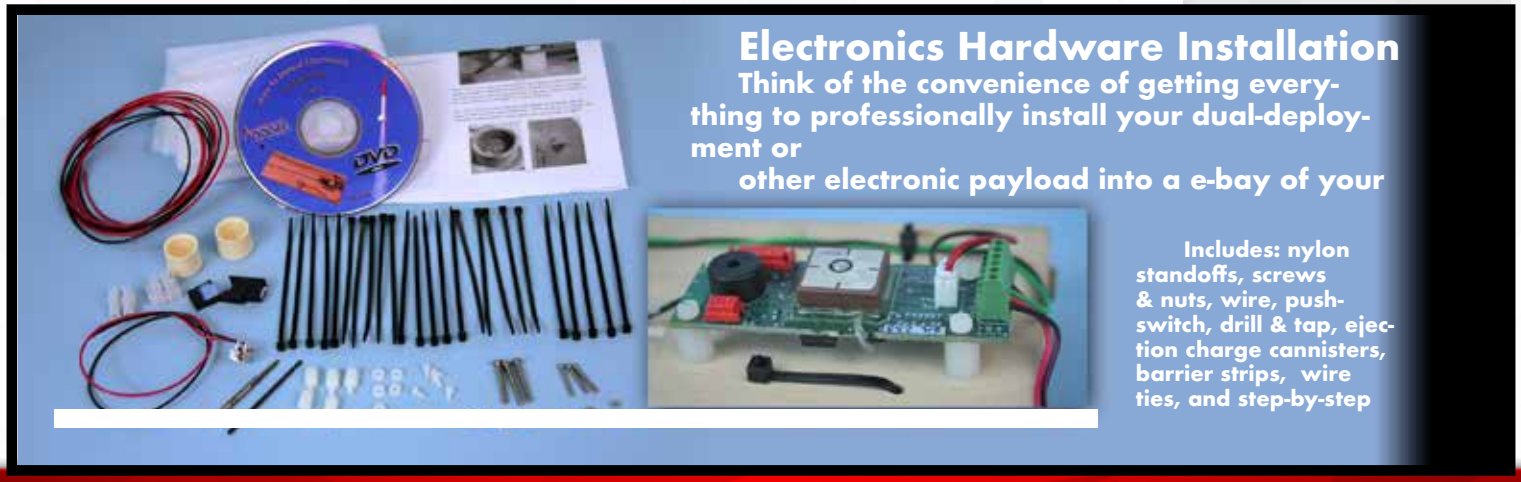


FIGURE 8: NUGGET OF BLACK POWDER WEDGED INTO PROPELLANT

Aerotech does not put in a black-powder ignition nugget into their rocket motors, so you cannot use an ematch (by itself) to start any Aerotech rocket motor. More information about this situation will be discussed later in the section describing the ProCast compound.

The third problem with the e-match is due to regulations. In the USA, the e-match is specifically regulated by the

Continued on page 8



Which Starter to Use for Your Rocket Motors?

Continued from page 7

government as an explosive device. To buy e-matches by themselves requires a LEUP (Low-Explosives User's Permit). That is why we at Apogee Components do not sell e-matches. We would have to ship them as an expensive HAZMAT material, and collect your LEUP to make sure you're abiding by the regulations. There are online vendors that are selling them, but know that the legality of those purchases are questionable. We are not the police, so we are not going to turn you in if you buy e-matches that are shipped illegally.

From our understanding, Cesaroni is allowed to ship the e-match with the motor as part of a motor system. But like us here at Apogee, they don't sell them separately either.

The good news is that if you need a replacement for an e-match that is used in a Cesaroni motor, you do have lots of options. For one, you can also use any of the Aerotech First Fire igniters. Any of them should produce the necessary heat to start that black-powder ignition nugget burning to start the motor. Other options are listed below from other vendors.

E-match Synopsis:

- Require a Low Explosive User Permit to puchase separately
- Come with the Cesaroni motors
- Will work with the Wireless Launch Controller!
- Good for setting off dual-deployment charges
- Not good in Aerotech motors, because they don't have an ignition nugget of black powder to start the propellant burning.

(https://www.apogeerockets.com/Launch_Accessories/Launch_Controllers/Wireless_Launch_Control_System)



FIGURE 9: E-MATCH FROM CESARONI

Firewire Initiator Series

The "Firewire" initiators are the direct replacement for the e-match that comes with the Cesaroni motors. So if you need a replacement igniter for any Cesaroni igniter, this would be your first choice.

Like the e-match, the Firewire initiators are a very low electrical current starter. Just about any wisp of current will set them off. So ANY launch controller will work to set them off.

The one advantage of the Firewire initiators is that they are NOT classified as an explosive, even though you'd swear by comparing them to an e-match that they are exactly the same. According to the manufacturer, MJG, they have a pyrogen that is approved by the BATFE as non-explosive.

However, they are a little bit more expensive than an ematch.

The Firewire Initiator comes in two sizes. The mini size,

Continued on page 9



Which Starter to Use for Your Rocket Motors?

Continued from page 8

and the regular size. The regular size looks very similar in size to the e-match, and needs a little bigger nozzle for them to work.

You may not have noticed, but Cesaroni has two different size e-matches, depending on the motor that they are included with. For smaller diameter nozzles like on the 24mm and lower thrust 29mm motors, if you need a replacement starter, you'd need to use the FireWire Mini igniter to get into the nozzle.

We like the Firewire Mini initiator a lot. It is the closest thing we've seen to the old (discontinued) Quest Q2G2 igniter. If you can get it into the nozzle of the black powder motor, it would be great for setting off a larger number of cluster motors at the same time. Any black powder motor that is 24mm or 29mm in diameter could use the FireWire Mini Initiator. But the same plastic igniter plug issue applies here as it did with any other insulated wire igniter. The plastic plugs don't hold them in the nozzle very well, so you'll need some other method of holding the Firewire Mini in the nozzle.

Also, if you need to set off an ejection charge in a dual-deployment rocket, this is the one we'd recommend. It is awesome for this task.

FireWire Initiator Synopsis:

- Compatible with all launch controllers
- Good for Cesaroni motors
- Mini sized can fit into the nozzles of Estes Black-Powder D's, E's and F motors
- Insulated Wires
- Comes pre-dipped with pyrogen
- Good for setting off dual-deployment with onboard batteries
- Not classified as an explosive device, so it doesn't require a LEUP

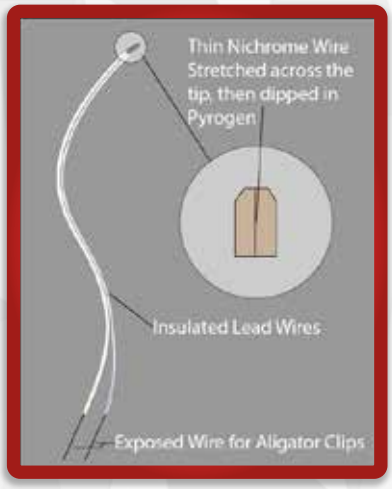


FIGURE 10: THE FIREWIRE INITIATOR

The QuickBurst Starters

The company called QuickBurst also makes replacement starters for composite propellant motors. They are made in a similar fashion to the Aerotech First Fire Jr. igniters, and therefore require a 12V launch control system to set them off.

QuickBurst claims that their pyrogen generates more heat when it fires off. That may be so, but that is probably not enough reason to choose them as a replacement for the First Fire starters from Aerotech.

What does make them worth buying is the one other little trick QuickBurst does when assembling the igniters. They fill up a little plastic straw with their pyrogen compound, and then insert the wire into this straw. So if you look at a QuickBurst starter, you will notice that plastic straw on the end of the starter. That makes them very uniform in size, so you don't have to futz around long when testing if they will fit into the nozzle.

But the best part is when the starter is fired. That little straw seems to contain the heat of the burning pyrogen and focuses the flame in one direction. So it's like you're taking all the heat and pointing it at one spot inside the motor. Whatever is in the center of that jet of flame is going to start burning. We like these starters as replacements for the First Fire line from Aerotech, particularly if you've had multiple mis-fires of the same motors. When you're tired of misfires,

Continued on page 10



Which Starter to Use for Your Rocket Motors?

Continued from page 9

pull out one of these QuickBurst starters.

They come in three sizes. That is the only difference between them; just the size of the head on the starter.

Twiggy Starters - The smallest QuickBurst starter. Similar in size to the Aerotech First Fire Jr. starter, so it would be a direct replacement for motors that come with that starter.

Slim-Gem Starters - The medium size QuickBurst starter. Similar in size to the Aerotech First Fire High-Power Starter, so it would be a direct replacement for motors that come with that starter.



FIGURE 11: TWIGGY STARTERS (https://www.apogeerockets.com/Rocket_Motors/Motor_Starters/Twiggy_Starter)



FIGURE 12: SLIM GEM STARTERS (https://www.apogeerockets.com/Rocket_Motors/Motor_Starters/Slim_Gem_Starters)



FIGURE 13: FAT BOY STARTERS (https://www.apogeerockets.com/Rocket_Motors/Motor_Starters/Fat_Boy_Starters)

Fat-Boy Starters - The largest size QuickBurst starter. Slightly bigger than the Aerotech First Fire High-Power Starter. Good for 54mm and larger motors that have a big nozzle that the head of this starter can fit through.

QuickBurst Starters Synopsis:

- Insulated Wires
- Pre-dipped in pyrogen
- Capable of launching composite motors
- Good for clustering multiple motors on the ground
- Not for black powder motors because the head is too big to fit into the nozzle.
- Not for air-starting, nor setting off dual-deployment with onboard batteries
- Recommended that the controller be a 12V system.

Making your Own Starters

Is there anything that prevents you from making your own starters? NO. You are allowed to make your own starters if you want.

Wrapping nichrome wire (https://www.apogeerockets.com/Rocket_Motors/Igniter_Wire/Nichrome_80_Wire) onto an insulated pair of wire (called shooter wire) is easy, and a lot of people do it. You may even see people at a launch collecting all the wires from prior launches just to save money on wires. There is no shame in that. Go for it.

The hard part is making the pyrogen to dip the wire into. But we've got you covered on that front, thanks to pyrogen sold by QuickBurst. The different formulas all come as kits where you have to mix the chemicals. Because all the chemicals are separate, they can be shipped without any hazmat fees.

Here are the dips we have, and when you might want to use them.

Continued from page 11



Which Starter to Use for Your Rocket Motors?

Continued from page 10

QuickDip Pyrogen

This is the standard pyrogen that is used in the Quick-Burst products: Twiggy, Slim Gem, and Fat-Boy starters.

It is a good all-around formula as it is designed to burn hot and slow to maximize the chances of rocket ignition. This is the pyrogen compound we recommend for taking your basic Estes starters, with just the nichrome wire, and turning them into a better igniter that you wish them to be.



FIGURE 14: QUICK DIP
(https://www.apogeerockets.com/Rocket_Motors/Motor_Starters/QuickDip)

Another use for the Quick Dip is to repair igniters which have their own pyrogen chipped off. The Estes Sonic starter and both the Aerotech First Fire Micro and First Fire Mini are notorious for having their pyrogen chip off due to rough handling. As long as the nichrome bridge wire is intact, the igniter can be re-dipped in Quick Dip so it can be salvaged and used in another launch.

You will find the Quick Dip is far more durable than other dips and doesn't easily chip off the wires. The reason is that one of the components in the kit is plastic pellets. The plastic is dissolved in the solvent when the chemicals are mixed together. When the starters dry out after being dipped, that plastic re-solidifies and makes the pyrogen really tough. And it is less likely to chip off from handling like many starters.

H-3 Compound

The H-3 compound is specifically formulated for low-current e-match style starters. This pyrogen can ignite with very little heat and quickly "pops" releasing all its heat and energy in an instant. This compound is a good choice for dipping "Chip-Boards" (https://www.apogeerockets.com/Rocket-Motors/Motor-Starters/Starter-Chipboard-6-pack) to make your own igniter that mimics the qualities of an e-match.



FIGURE 15: H-3 COMPOUND E-MATCH DIP
(https://www.apogeerockets.com/Rocket-Motors/Motor-Starters/H3-Igniter-Dip)

We have two different dips for chip-boards. The QuickBurst H-3 is one that can be re-used. What that means is that after you mix it, you don't have to dip all the chip-boards right away like you do with the mix from MJG. You can dip a few chipboards at a time, and can use the H-3 long into the future.

You do have to be careful when mixing the H-3 compound. The solids in the composition are heavy and want to settle to the bottom of the container during the dipping process. So you have to continuously stir the dip as you make e-matches. If you don't, the reliability of the starter goes way down because the heads aren't consistent with all the solids they need to work properly. In other words, you fire them off, they don't pop and won't make fire. And

Continued from page 12



Which Starter to Use for Your Rocket Motors?

Continued from page 11

once you put electricity to them, the nichrome bridge-wire vaporizes, so you can't go back and try to dip them again. You only get one shot when lighting off any starter that is on a chipboard, so you have to be sure the ingredients are thoroughly mixed properly.

The other difference is that the heat from the H-3 compound is not quite as intense, and it burns a little bit slower than the pyrogen from MJG. It is something you will have to determine if it is important for your application.

And like any of the chemical compositions, you can also use it to re-dip those Estes igniters, like you would with the Quick-Dip.

MJG E-match Starter Kit

The pyrogen in the MJG e-match starter kit is specifically designed to let you make your own e-matches. (https://www.apogeerockets.com/Rocket-Motors/Motor-Starters/E-match-Starter-Kit). The kit includes 80 chipboards with wires already soldered to them, and enough dipping compound to coat them all. Like the H-3 dip, it does not require a LEUP to purchase these e-matches.

I really like the dip in this kit for making e-matches. It ignites easily, and it is forgiving in the mix. You don't have to constantly stir the dip to keep it from settling during the dipping process like you do with the H-3 dip from QuickBurst. But the downside is that it is not storable. Once you mix it, you have to use it all up by dipping 80 chipboards at once. You can't come back later and re-constitute it to use up any leftover dip like you can with the H-3 composition. So don't mix it up unless you know you'll have time to make a large batch of e-matches.

Hot Shot

The Hot Shot Igniter Dip is unique among all the compositions. Unlike the other pyrogen compounds, this can be used without the nichrome bridge wire, as it is already conductive. It just doesn't need the nichrome bridge wire. With the Hot Shot Igniter Dip, you can dip an ordinary two-conductor wire and use it like you would any other igniter. So all those wires you've been picking up from the launch range can be stripped and easily turned into your own starters. You don't need to add the bridgewire, so making igniters is quick and easy.



FIGURE 16: HOT SHOT COMPOUND
(https://www.apogeerockets.com/Rocket-Motors/Motor-Starters/Hot-Shot-Igniter-Dip)

What's even better is that afterwards, you can clean it off again and re-dip that wire for reuse. It truly makes a "reloadable igniter!"

The one downside is that without a bridgewire, it does require a 12V ignition system to use them reliably.

And like the other QuickBurst dips, you can use it to add a pyrogen tip to those Estes starters too. Just because it doesn't have to have a bridgewire doesn't mean it won't work with a bridgewire. It will! If you're dipping Estes igniters, you can also use a 6V controller.

ProCast

The ProCast Castable Pyrogen Mix is specifically for those hard-to-ignite large high-power motors. Typically it is meant for motors with very large diameter nozzles because compared to small nozzles, they let the heat and pressure

Continued on page 13



Which Starter to Use for Your Rocket Motors?

Continued from page 12

from the burning pyrogen escape out of the motor more quickly. You need that heat to stay inside the motor until it has a chance to light the propellant.

This dip burns slowly but with a tremendous amount of heat. This slow burn allows the pressure to build up inside the motor and highly increases the chances of success.



FIGURE 17: PROCAST PYROGEN COMPOUND

(https://www.apogeerockets.com/Rocket-Motors/Motor-Starters/Pro-Cast-Mix)

This is the one dip that comes with a word of caution: too much of it can be a bad thing. For example, if you make a really big head of pyrogen on the tip of the igniter, it could cause motor failure because too much heat and pressure are created by this pyrogen. In other words, it could CATO the motor before the propellant inside has a chance to ignite.

The ProCast has another application that makes it unique. Remember we said that e-matches and FireWire starters can't be used by themselves in Aerotech motors because the Aerotech motors don't have a black-powder ignition nugget in them? Well, the ProCast can be used on top of the pyrogen of an e-match.

An e-match and the chipboards require a special pyrogen that ignites quickly and easily with just a whiff of heat from the whisker-thin nichrome wire on them. But that pyrogen fragments and blows off the chipboard too fast to ignite other pyrogens like the Quick Dip, the H-3, or the Hot Shot. But the ProCast is different. It can be ignited by the pyrogen on the e-match and still sizzle for a long time - long enough and hot enough that you can ignite an Aerotech rocket motor.

Normally, you wouldn't need to do this for an Aerotech motor if you were lighting it off on the ground. Because on the ground, you have access to a 12V launch system that can easily fire off any other starter to igniter the motor. But in the air, like in a multi-stage rocket that is ignited with a small low-voltage onboard ignition system, you need something similar to an e-match that will pop off instantly with very little electricity. The ProCast allows you to fire off Aerotech motors in the air with an e-match!

And for small motors like E's and F's where the nozzle is really small, this is the only way you can stage them successfully using lightweight electronics. See our Advanced Construction video at: https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_297

Tips to reduce misfires

Misfires happen, even to the best of us. Sometimes the pyrogen just doesn't produce enough heat, sometimes a simple Estes igniter just isn't enough, and sometimes it is caused by human error. You'll never get rid of all misfires, but here are some great tips to reduce the frequency of misfires at your rocket launches.

1 - When installing the igniter in a black-powder motor, turn the rocket upside down.

This actually makes a big difference. It is important to get the tip of the igniter all the way into the motor so it is touching the propellant. If they aren't touching, your chances of a misfire go way up. When inserting the plug, oftentimes the force of that plus gravity is enough to jostle the igniter out of place. Having your rocket upside down allows

Continued on page 14



Which Starter to Use for Your Rocket Motors?

Continued from page 13

you to see what is going on, and uses gravity to help keep the igniter in place when you are installing the plug.



FIGURE 18: TIM VAN MILLIGAN STRESSING THE IMPORTANCE OF TURNING YOUR ROCKET UPSIDE DOWN.

2 - Pyrogen works

Given the option, use an igniter with pyrogen on it. The simple Estes igniters with just a bridge wire can work on the small, black-powder motors, but do not create nearly the heat and pressure that a pyrogen-dipped igniter would have. Using pyrogen will always give your motor a better shot at igniting.

3 - Check your batteries

A huge cause of misfires comes from the batteries in the launch controller. Make sure you are using fresh batteries, or ground test with a simple Estes igniter. If you can burn through the bridge wire, your batteries are fine. Here, a bigger battery is almost always better.

4 - Check the alligator clips and exposed wire

Make sure that your alligator clips are not touching each other, and that any exposed wire and the alligator clips are not touching either the blast deflector or any part of the rocket. Issues like these can cause the igniter to short and prevent the current from reaching the motor.

Links to Launch Controllers:

Sky 6V Controllers (https://www.apogeerockets.com/Launch_Pads/Sky_Complete_Launch_System)

Estes 9V Controllers (https://www.apogeerockets.com/Launch-Accessories/Launch-Controllers/Pro-Series-II-Launch-Controller)

AeroTech Interlock (https://www.apogeerockets.com/Launch_Controllers/Aerotech_Interlock_Launch_Controller) and Pratt Go-Box 12V Controllers (https://www.apogeerockets.com/Launch_Accessories/Launch_Controllers/Go_Box_Launch_Controller)

Other videos that may help you:

Using the Estes Igniters and Plugs: https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_280

Picking Igniters for Composite Propellant Motors: https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_246

Selecting a Launch Controller: https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_296

How to Cluster Motors with Success: https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_282

Using the wireless Launch Controller: https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_73



Green Vortex Rocket Plans



About the Green Vortex

Designed by Tim Van Milligan, the Green Vortex is a fun flyer that has an unusual configuration of assembled fin parts. With the two tubes slung on the opposite sides of the H-shaped fin planform, the model was designed to spin as it flies. This rotation is necessary, because the inward canted fin tips are actually destabilizing. But because it spins, it overcomes this stability issue, and flies nice and straight. You'll see that it has a nice slow spin, that takes a bit of observational skill to even notice. This head-turning rocket is sure to get you stopped at the safety check table, and they'll always ask you what it is. You'll get to tell them that you built it yourself from these plans.

For additional tips on building a model rocket, from plans like these, see: https://www.apogeerockets.com/Advanced_Construction_Videos/Rocketry_Video_287

Continued on page 16

Green Vortex Rocket Plans

Continued from page 15



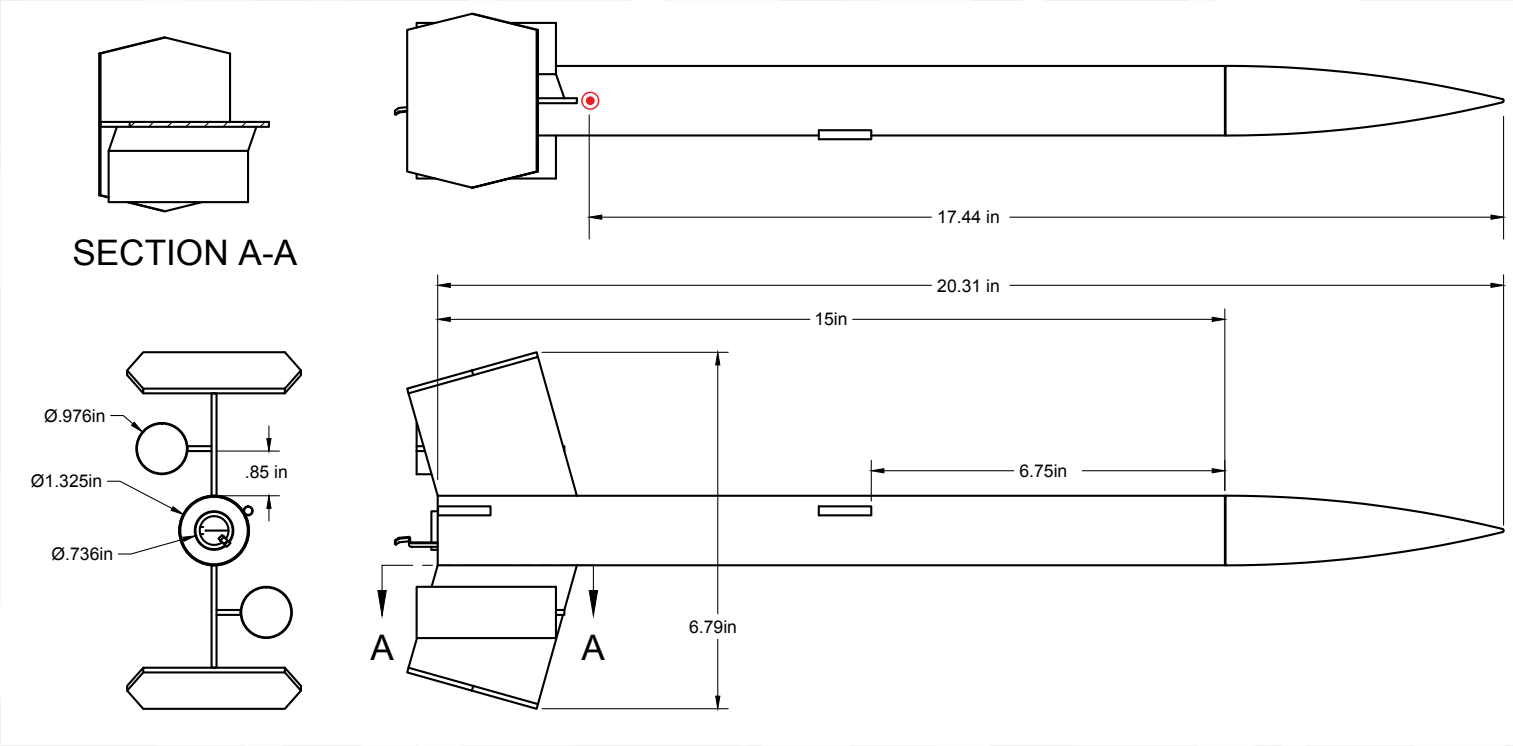


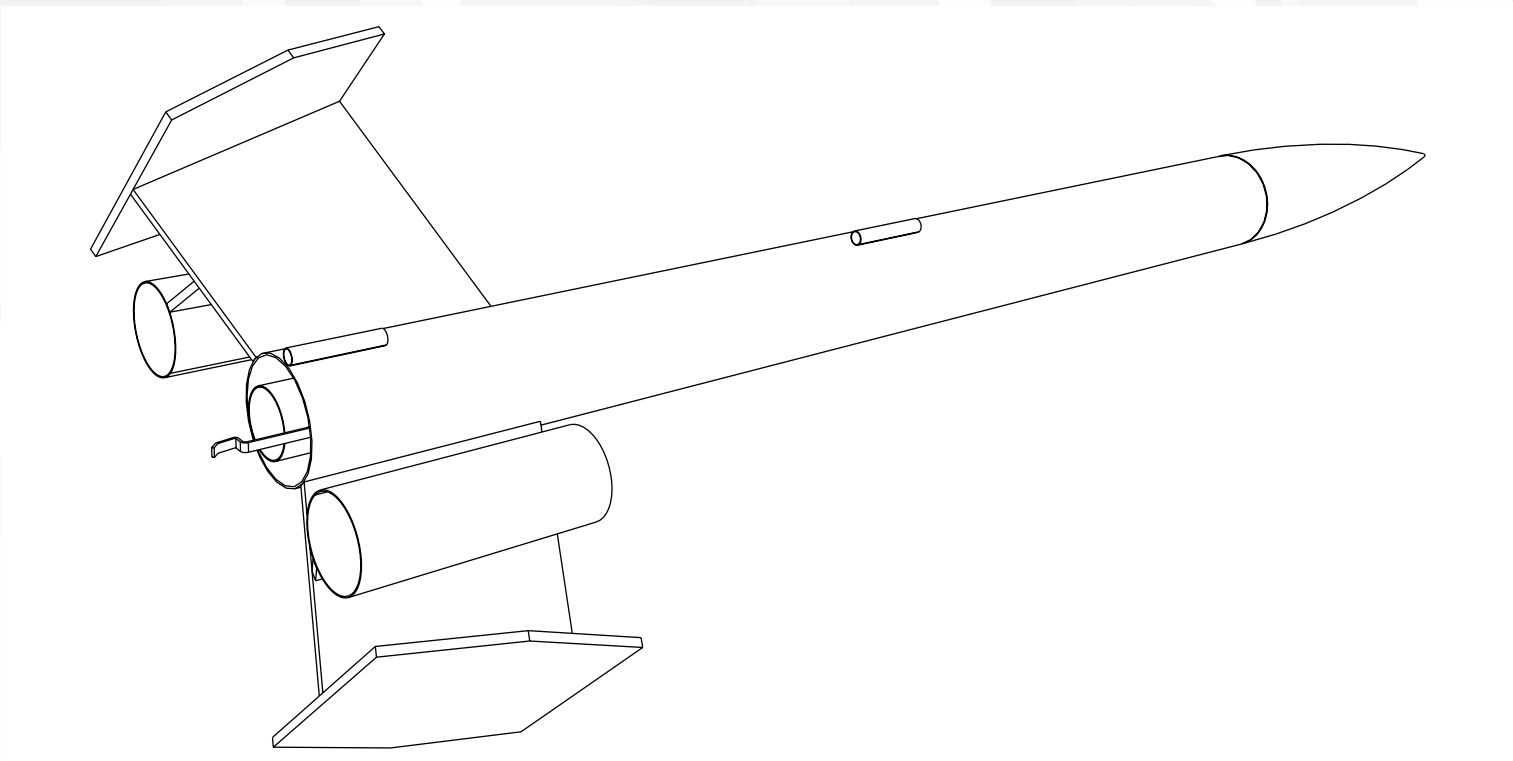


Continued on page 17

Green Vortex Rocket Plans

Continued from page 16





Continued on page 18

Green Vortex Rocket Plans

Continued from page 17



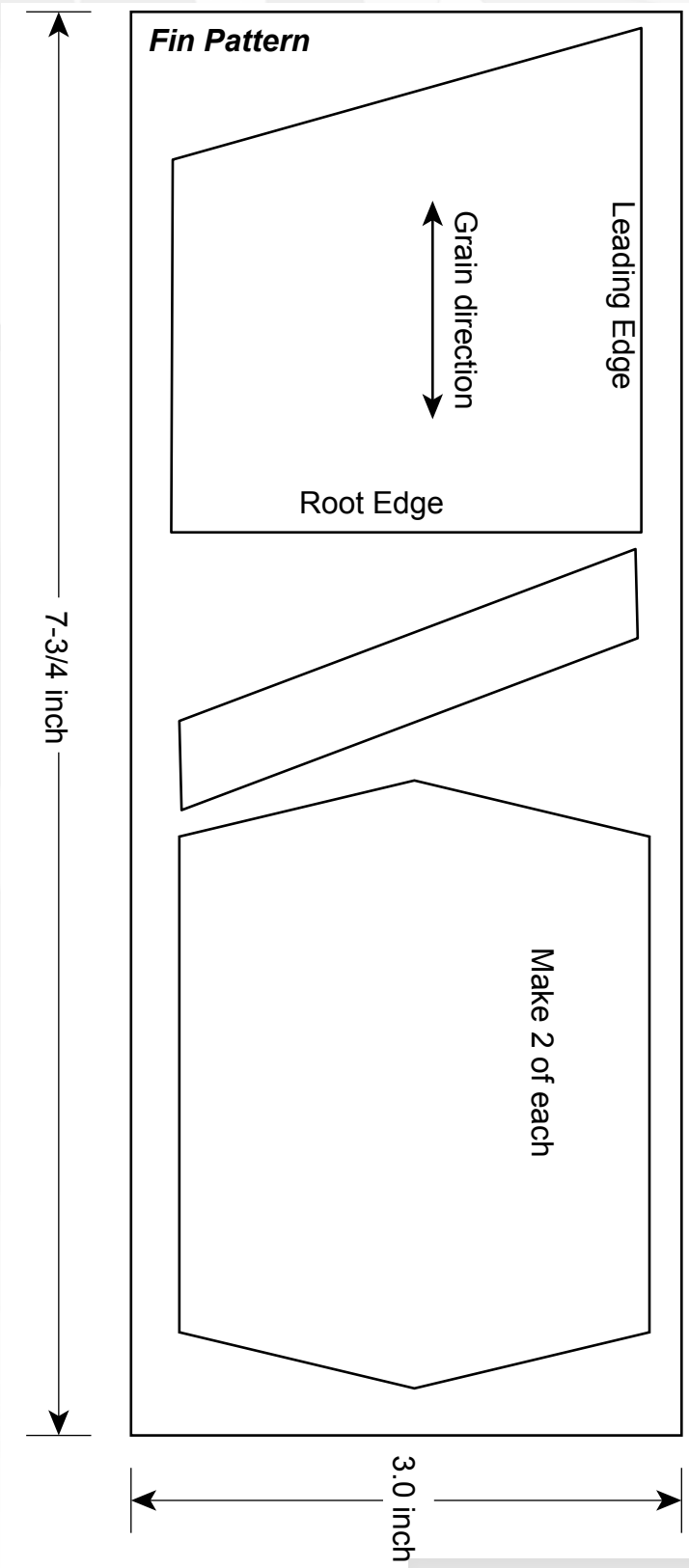
Download the ***RockSim*** design file for the Green Vortex at: https://www.apogeerockets.com/Peak-of-Flight-Rocket-Plans

Green Vortex Parts List

20068 - (1) PNC-33 Nose Cone
10131 - (1) 33mm Body Tube (15 inches long)
10100 - (2) 24mm Body Tube (2.75 inches long)
12007 - (1) Motor Mount Kit 18mm/BT-55
14097 - (1) Balsa Sheet 3/32” X 3” X 18”
30325 - (1) Kevlar Cord 100# X 8 feet
29091 - (1) 15” Printed Nylon Parachute
13052 - (2) 1/8” Launch Lug

Recommended Motors

B6-4, C6-5, C12-4, D16-6



Continued on page 19

Green Vortex Rocket Plans

Continued from page 17

Decals Sheet

