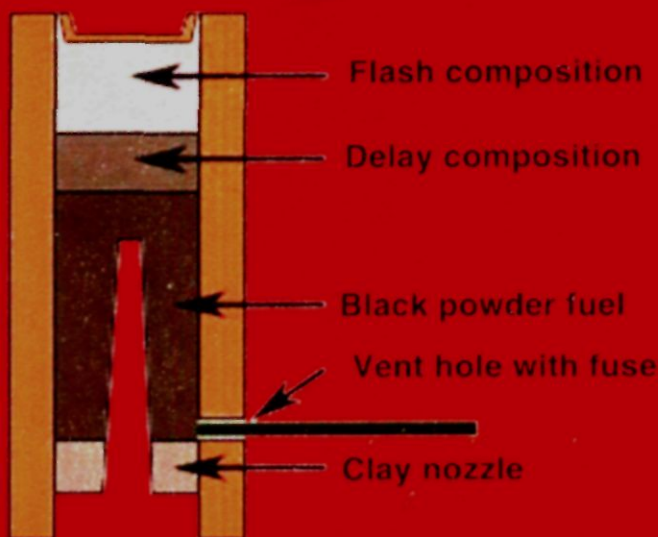


SPIN STABILIZED ROCKETS



Bottom view



Side view

SPIN STABILIZED ROCKETS

**A DEFINITIVE STUDY
BY**

**Dan Williams
Warren Klofkorn
Richard Harrison**

**And bonus section
by Donald Haarmann**

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SPIN STABILIZED ROCKETS

Foreword

Welcome to a really fun concept in fireworks, the spin-stabilized rocket. These small rockets are easy and fun to make. It does not take a great deal of pyro knowledge or years of acquired skills to make these dynamic and thrilling rockets. Their concept is close to the tourbillion or fireworks helicopter, but the flight is much more stable and reliable.

The black powder used in the charging of this rocket is a stable Meal D black powder. Reader is cautioned that the first experiments might explode on the launch pad until the correct amount of slowing agent is determined. Many times this only comes with trial and error.

Thank you for buying this handbook. We hope you will find it entertaining and enlightening. Please consider purchasing our other handbooks when they become available

Disclaimer:

Warning: This publication contains descriptions and pictures of fireworks. The information contained herein is based on the authors' experiences using specific tools and ingredients under specific conditions not necessarily described in the articles. No warranties are made, or implied. Readers are cautioned that they must form their own opinion as to the application of any information contained herein.

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SPIN STABILIZED ROCKETS

Part I:

Stinger Missiles

by Warren Kloforn

A few years ago the Chinese fireworks industry introduced an unusual, spin stabilized skyrocket into the U.S. fireworks market: The Black Panther brand *Warhead Launcher* was initially approved as Class C merchandise but was later withdrawn from the market because of its high content of titanium flash powder. Federal regulations specify that no Class C aerial item may contain over 130mg of flash, but this item supposedly contained between 4 and 6 grams of solid, pressed flash per unit! Of course, the *WHL* was an immediate hit in the marketplace. It was imported in its original form for only one season and then it was replaced with another version containing black powder and stars in place of the flash.

WHL fans need not lose hope. This *Stinger Missile* is simple to make, and actually out-performs the Chinese *WHL*. But a set of tooling is needed. Page 7+8 shows tools designed to use cut sections of standard 1 lb. rocket tubing. A machinist can turn the spindle on a lathe from brass or other non-sparking stock. The drifts are made on a drill press from hard aluminum alloy rod.

To make these Stingers, I cut the rocket tubing on a band-saw into sections 2½" to 2¾" long. Naturally, I take care to cut the tubes at a true 90° angle. Then, depending on what is free at the time, I use either an arbor press or a hydraulic press to load the tube. First comes the nozzle. A good nozzle is made

SPIN STABILIZED ROCKETS

of 4.3cc of powdered Hawthorne Bond clay. It's available from ceramic suppliers.

A great propellant is straight, homemade meal powder: 75-15-10 potassium nitrate-sulfur-charcoal, blended with hot water and precipitated with alcohol. (See *T7, Preparation of Black Powder, or CIA Black Powder Revisited* by Don Haarmann, Appendix #1.) My standard loading scoop is a 4cc cartridge reloading scoop; each motor should take about 6 scoops of meal powder.

After the propellant has been charged, the colored comet charge goes next. I dampen the mix slightly with the appropriate solvent (I like to use 99+% isopropanol) and then measure the comp into the tube. I press it firmly in place by using moderate pressure on the press. Many different comps could be used, but I must be careful to select a comet comp that is reasonably safe to press at high pressure. I have used a green formula from Shimizu. It requires between 6 and 9cc of unpressed powder to provide an adequate time delay.

The following comes from *Fireworks: The Art, Science & Technique* by T. Shimizu, available from Pyrotechnica Publications.

Green Star

Barium nitrate
Potassium perchlorate
Parlon
Red gum
Soluble glutinous rice starch

SPIN STABILIZED ROCKETS

Now the side vent is drilled. First I must determine where the propellant grain begins, just above the nozzle (probably about 1.3 cm above the bottom of the tube, depending upon how the tooling was mounted). I'm ready to drill, so I use my drill press (it's even possible to use a hand drill after a guide hole is first made with a scratch awl). I use a twist drill slightly less than 3/32" dia. and penetrate just into the propellant grain at an angle tangential to the inside wall of the tube.

When I wish to add a report, now is when I do it. 3cc of 70/30 (potassium perchlorate/dark aluminum), with a dash of Cabosil works for me. Then I place a 3/4" paper end plug over the flash charge, just touching the powder enough to keep its mass from shifting when the device spins on takeoff.

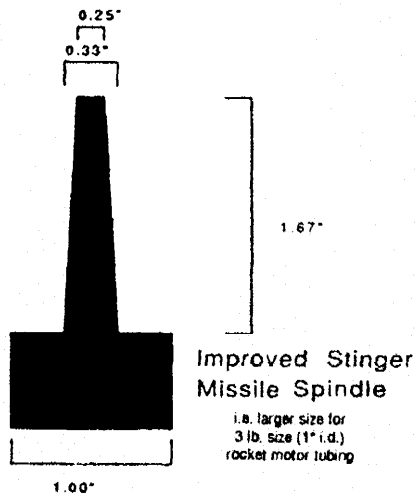
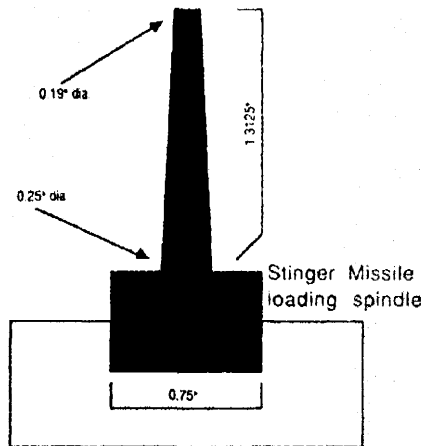
To finish the device, I lightly glue a paper disc 1 1/4" dia. over the top end of the tube and seal it with 1 1/2" wide gummed paper tape. I lightly paste some decorative paper wrap and lay that on. All that's left is the fusing and I like to use a 3" piece of slow Thermolite igniter cord, and tape it to the side of the device with a small piece of tape. (I have experimented with a 1/8" side vent hole with good results, in which case regular visco fuse may be used). It is now ready to be fired from a *Warhead Launcher* spindle.

My feeling is that the standard issue *WHL* launching spindles are too small in the base so when I use them I am sure to firmly secure them before firing. If I don't, I feel that the torque from the Stinger can tip the launcher over, with potentially disastrous results.

SPIN STABILIZED ROCKETS

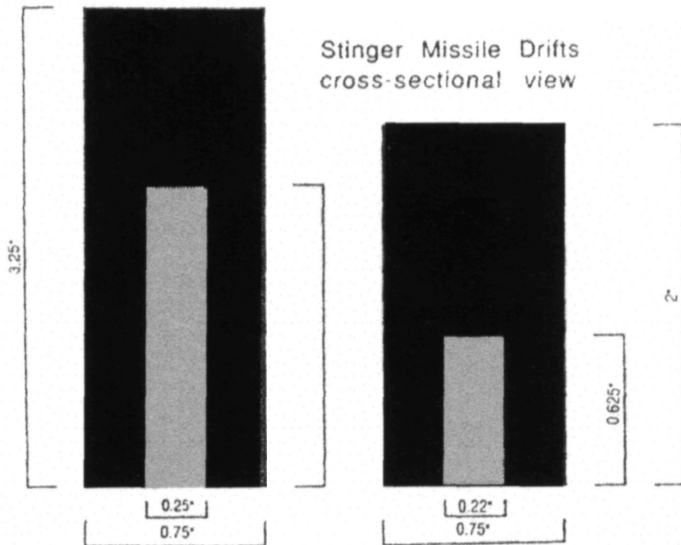
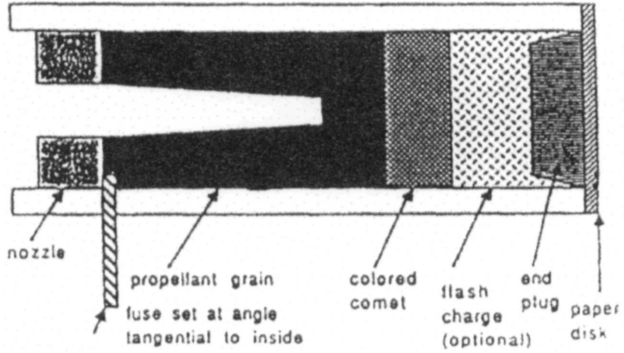
I have made my own pin-type launcher. It was made from a nail pounded through a large board and then filed round at the point.

These missiles can easily fly 1000 feet high!
Imagine a volley of them fired in a display!



SPIN STABILIZED ROCKETS

Stinger Missile



SPIN STABILIZED ROCKETS

Part II How to Make Stinger Missiles

By Dan Williams

INTRODUCTION

The name "stinger missile" seems to have become fairly common among pyro hobbyists to refer to the class of rockets that are spin stabilized. This means that the usual efforts to assure a predictable flight path of a rocket, which include body fins or a guide stick, can all be dispensed with. Consequently, the spin-stabilized rocket is extremely easy to make. This is what makes them so much fun. Unlike a girandola project, these little jewels can be made in a few minutes and launched immediately. It's a great fix for the smoke-addicted pyro who often needs to throw something together quickly. The methods presented here closely follow those first described by Warren Klofkorn some 10 years ago. His article appears in "The Best of AFN II" on page 62 and has become the standard reference for stinger missile construction. A description of my personal experience with his instructions and a few other innovations, hints and tips are included here in the hope that they might make your experience more enjoyable.

SPIN STABILIZED ROCKETS

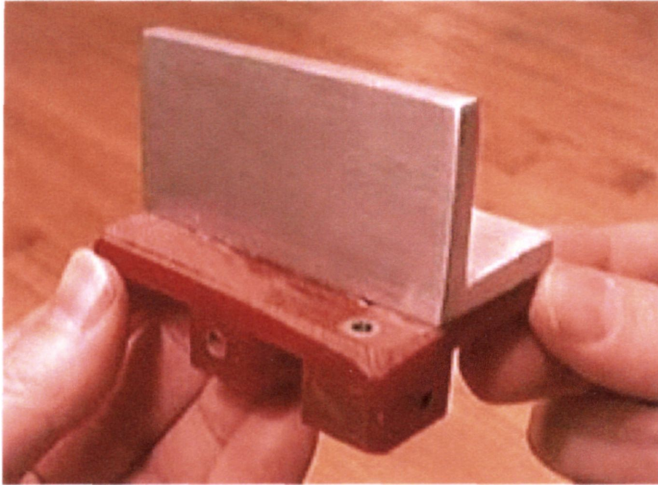
TOOLING



Tooling is usually the first consideration of any new pyro project. Since the tooling for stingers is fairly simple, it doesn't cost much to buy it from professional sources. I purchased a tooling kit for the $\frac{3}{4}$ " stingers from Skylighter for the bargain price of \$55.80 US (as of 3/15/02, purchasing information in appendix #3). Shown in this picture, a machined aluminum spindle is mounted in a ramming base and held in place with a bolt through the bottom. The rammers consist of an aluminum rod with a hole in it for pressing the black powder fuel around the spindle and a solid one for pressing the fuel and delay composition above the spindle.

SPIN STABILIZED ROCKETS

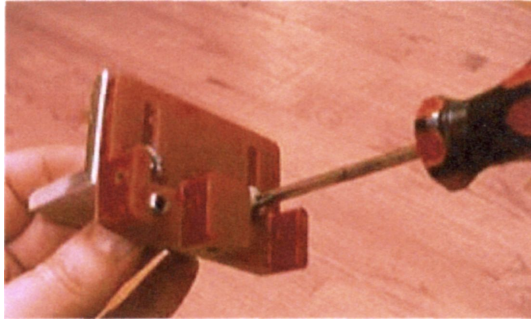
TOOLING -- JIG SET-UP



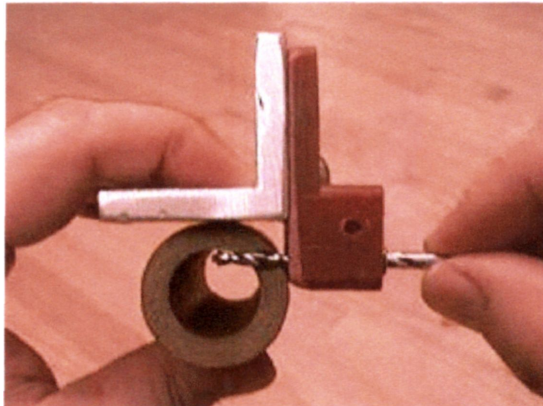
This is a close-up of the jig used to position the side vent hole in the stinger body tube. This hole is used to create tangential thrust, which will cause the rocket to spin as it flies. The angular momentum of the spinning rocket is what stabilizes it instead of relying upon positioning the center of pressure behind the center of gravity, as accomplished by fins or sticks. This jig helps to accurately position the vent hole to consistently achieve a good spin. The desired location of this vent hole is just above the clay nozzle and in a direction that is at a tangent to the inside surface of the tube. This jig may look a little different from the present Skylighter product, but the function is identical.

SPIN STABILIZED ROCKETS

ADJUSTING THE JIG



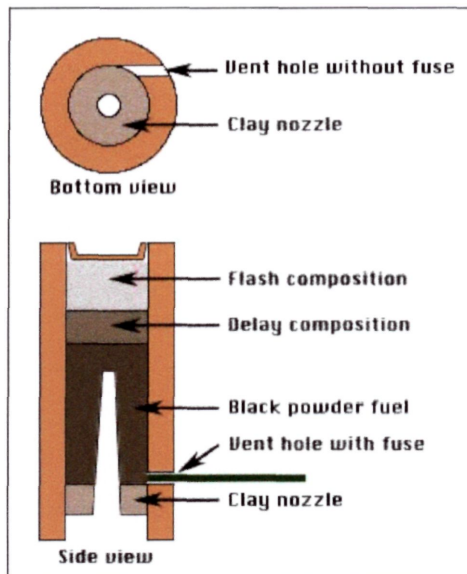
To adjust the jig for the size of stinger you plan to make, you must first loosen the two screws until they allow the guide hole plate to slide relative to the angle piece. First adjust the screws to be slightly snug so that the two jig pieces aren't overly floppy, but will slide with a little effort.



Now hold a piece of stinger tubing against the jig as shown. Place the 9/64" drill bit in the guide hole and check the alignment as shown in the picture. The drill bit should be positioned so that its side flutes are even with the inside wall of the

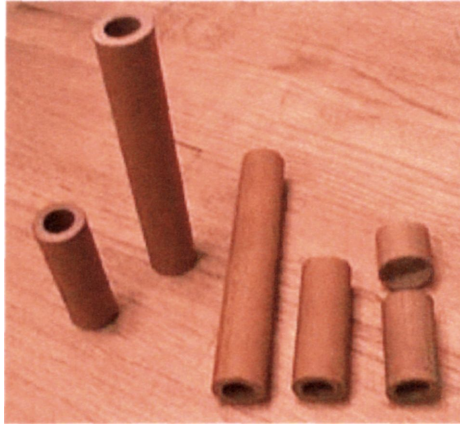
SPIN STABILIZED ROCKETS

tube. Now, if your alignment isn't correct, just slide the jig pieces until it is, then tighten the screws. This alignment will assure that, when drilling the side vent hole, the drill bit will emerge at the right place on the inside surface of the tube. With the vent hole aligned correctly, you will achieve the best thrust angle to maximize spin and stability. Be sure the adjustment screws are in the same places in the two slots. The two jig pieces should be parallel to each other. It's a good idea to put a small piece of tape on the drill bit to mark the proper depth of insertion into the guide hole, as shown in the picture. If the drill bit is allowed to go any further into the guide hole, it will begin to drill into the opposite wall of the tube, causing undesirable weakening at that point. Now the jig setup is complete. You're ready to get your hands dirty and have some real pyro fun.



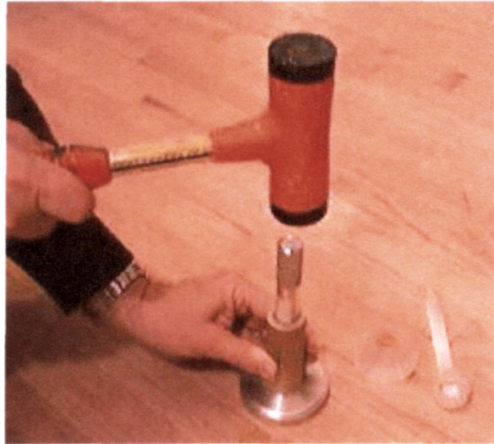
SPIN STABILIZED ROCKETS

STINGER CONSTRUCTION



Construction of the stinger starts by preparing the body tube. A typical 1-pound rocket tube may be used. The Skylighter TU1068 is a good example. It measures $\frac{3}{4}$ " i.d., $1\frac{1}{4}$ " o.d. and $7\frac{1}{2}$ " long. You can save money if you buy the longer TU1065 from which you can cut as many as 9 stinger tubes. Either way, a tube must be cut to a length that depends on what heading is planned for the payload of the rocket. Cutting these heavy tubes is best accomplished by using a table or radial arm saw because a clean, square end is desirable. A length of 3" is typical for a rocket, which contains some colored star composition for delay and some flash powder for a salute finish. Another option is to add a header extension filled with stars and some burst composition. When this option is chosen, the body tube can be cut a little shorter, enabling three stingers to be made from a single 1-pound rocket tube. The construction of these headers will be covered later.

SPIN STABILIZED ROCKETS



With the tube cut to the desired length, it is placed over the spindle on the spindle base and a carefully measured amount of nozzle clay is poured into the tube. A small funnel of some sort, as shown on the floor in the picture, is very helpful in accomplishing this. Klofkorn's original article advocated the use of 4.3 cc of powdered Hawthorne Bond clay for the rocket nozzle. I use a 60% /40% mix of bentonite and kyanite treated with an additional 5% of toilet seal wax dissolved in Coleman fuel. Instead of using a volume measurement for the nozzle clay, I recommend that you use a weight measurement so that a consistent nozzle length is achieved. The importance of doing this will become evident shortly. Stay tuned. If you are not using a hydraulic press, the nozzle clay is compacted by administering about a dozen firm blows (this is called "ramming") with a mallet of some sort, as shown in this picture. Although a little bulge in the tube wall can be desirable after ramming or pressing, be careful not to split the tube.

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DRILLING THE SIDE VENT

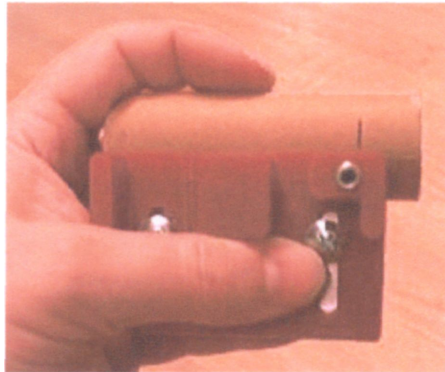


Before drilling the side vent hole in the body tube, a mark must be made on the outside of the tube to indicate where the top of the nozzle is located. Start by applying a piece of masking tape to the rammer so a mark can be easily made on it. Then place the rammer in the body tube until it seats against the nozzle. Now make a mark on the masking tape, as shown. Of course, if you were really on the ball, you could do this right after you finished ramming the nozzle clay, in the step above.

SPIN STABILIZED ROCKETS

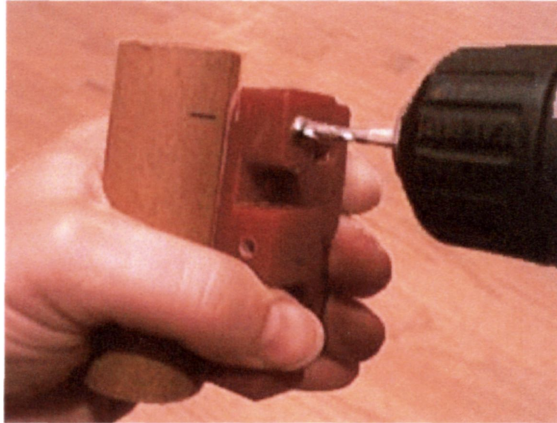


Next, remove the rammer and hold it against the outside of the tube with the mark you just made even with the top of the tube. Make a mark on the body tube at the bottom of the rammer. This mark should now indicate where the top of the nozzle is inside the tube.



Now the tube is held in the drilling jig, as shown. The guide hole should be located so that the side vent hole will be drilled just above the nozzle. In case you haven't figured it out, you should remove the tube from the spindle base before you drill the side vent hole.

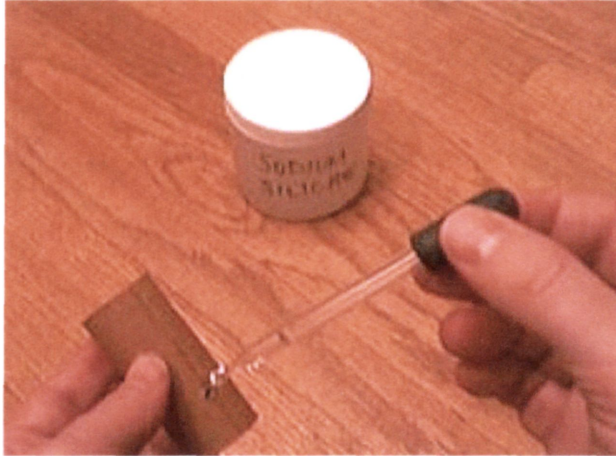
SPIN STABILIZED ROCKETS



Hold the tube in the drilling jig in one hand, properly positioned as shown in this picture. Then the hole is slowly drilled with a hand-held drill, taking care to firmly grip the tube in the jig so that it doesn't move. Again, note the piece of tape on the drill bit, which indicates the proper depth for the drill bit in the guide hole. Now pay close attention. Here comes the nifty tip you've been waiting for. Once the location of the top of the nozzle has been established, it should be measured and preserved in your notebook. This measurement can be used in all future stingers with the assumption that it will always be accurate. The assumption is a safe one to make if your nozzles are always made the same way with exactly the same compression and same amount of clay. The significance is that the side vent hole can be drilled before the nozzle is rammed, eliminating the need to remove the tube from the spindle to locate the top of the nozzle and drill the hole after nozzle ramming.

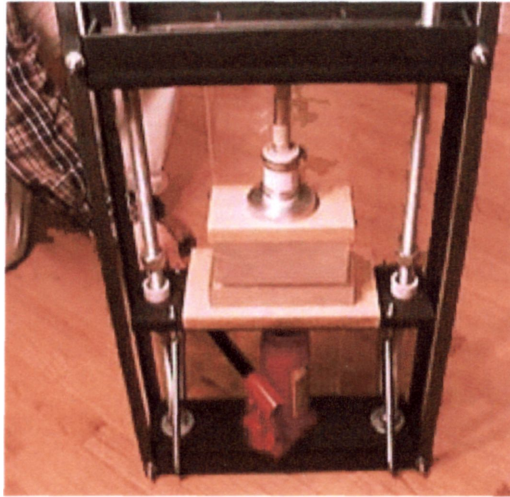
SPIN STABILIZED ROCKETS

STRENGTHEN THE VENT HOLE



The vent hole can be made more impervious to hot exhaust gasses by treating it with a few drops of sodium silicate solution, as shown in this picture. An eye-dropper is used to put the silicate into the hole. A toothpick or small nail is then used to spread it around in the hole and prevent blockage or constriction of the hole. Some of my impatient pyro friends skip this step to avoid waiting for the required 20 minutes for the silicate to dry in the vent hole. Their stingers still seem to fly just fine, albeit possibly not quite as high.

SPIN STABILIZED ROCKETS



This picture illustrates the use of a typical rocket press to form the nozzle and load the black powder fuel. When a hydraulic press is used instead of a mallet, a reinforcing sleeve is a good idea to avoid deforming the rocket tube. Whichever method is used to load the black powder fuel, a little scoop, as shown in the hand ramming picture on page 15, is handy for measuring out the fuel for each pressed increment. I made mine by hot gluing the bottom section of a film canister to a small garden marker stick. The black powder fuel must be compacted in the tube in about 4 or 5 increments, each of which should be no longer than the inside diameter of your stinger tube. For the black powder fuel, I use the same milled meal that I use to make a good lift powder. It contains willow charcoal to make a very hot rocket fuel. This fuel would be too hot for a standard 1-pound rocket, but for stingers it works very well because the rocket core is considerably shorter. I have noticed, however, that in the case of the larger 3-pound stingers, my homemade black

SPIN STABILIZED ROCKETS

powder is a little too hot. I experienced a few explosions immediately upon ignition until I cooled the fuel down a little with a few percent of mineral oil. As with most black powder-based rockets, you may need to experiment a little to dial in the proper burn rate for your stingers.

After the rocket has been charged with its black powder propellant, some delay composition should be loaded above it to allow the stinger to reach its apogee. Otherwise, your stingers will activate their payloads at very low altitudes because the actual thrust burn only lasts about 1 second. The following green star composition is suggested by Klofkorn as a safe and compatible delay element:

Barium Nitrate	28.3%
Potassium Perchlorate	47.2%
Parlon	4.7%
Red Gum	14.2%
Soluble glutinous rice starch	5.6%

Somewhere between 6 cc and 9 cc of this composition, dampened with a sparing amount of alcohol, is pressed into the top of the tube using moderate pressure only. It is a good idea to give this delay composition a little drying time before adding the final heading to the rocket. The diagram at the left shows the internal structure of the missiles after a heading of flash powder has been added. There is nothing sacred about this particular way of making a delay. Dextrin can be substituted for the rice starch or a totally different delay composition can be used. I am a little partial to some of the glitter formulas, myself, such as Winokur #39.

SPIN STABILIZED ROCKETS

HEADING OPTIONS



Now we are ready to talk about the various heading options for our stingers. After all, what's the point of making a rocket that just spins as it flies if it doesn't do something cool at the end of its flight? The easiest heading is 3 cc of flash powder in the remaining cavity of the stinger tube. This is finished by gluing (white or Elmer's glue) a $\frac{3}{4}$ " end plug that just touches the flash powder enough to keep it from shifting during the spinning ascent. An easy shell header with stars can be constructed using a $1\frac{1}{2}$ " length of paper tube whose inside dimension is $\frac{1}{4}$ ". This tube is glued to the stinger tube with a $\frac{1}{2}$ " overlap. The expanded cavity now has more room to accommodate a larger payload of stars and burst. The payload space needs to be filled completely and firmly packed so that no asymmetries can be created when the stinger spins. The cavity can be closed in a variety of ways. A typical end plug or cap will do the trick, but if you want to maximize your payload space, a molded nose cone can be

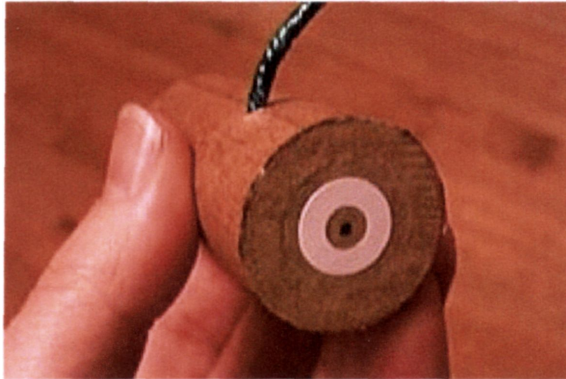
SPIN STABILIZED ROCKETS

used. The nose cone shown in the picture is molded from Kraft paper pulp bound with CMC binder. An example of each of these header options is shown in the picture. Again, whatever header is chosen, care must be taken to avoid asymmetries, or your stingers will wobble all over the sky.



Now a fuse is added to the side vent hole. A 1/8" drill bit (1/64th smaller than the one used to drill the hole in the tube to start with) is inserted into the hole and twisted gently by hand to open a small cavity in the black powder fuel grain. A glob of Meal-D (black powder) wetted with nitrocellulose lacquer is placed on the end of a 3-inch length of visco fuse. The globbed end is inserted into the vent hole as far as it will go. The lacquer will dry shortly and secure the fuse in place. I don't bother to bend it against the tube wall and affix it with tape, as recommended by Klofkorn. This practice has damaged the somewhat brittle visco and has caused failure of ignition on some of my stingers. If you use a more flexible fuse, this may still be a good idea to make the fuse more secure during storage and transport.

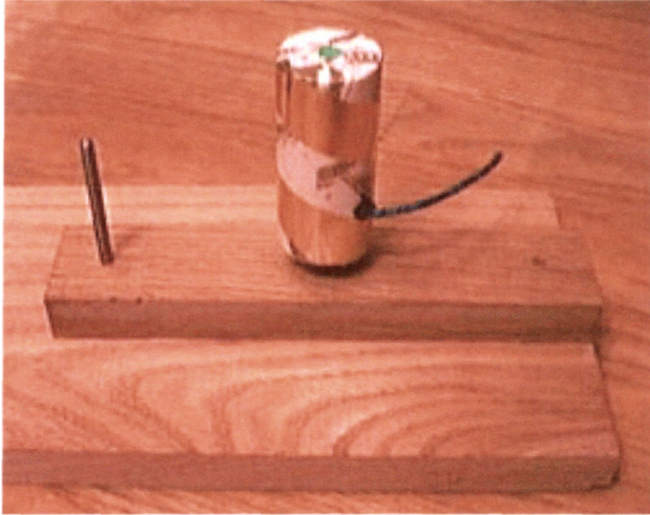
SPIN STABILIZED ROCKETS



A little bit of added stability at lift off can be achieved by gluing a custom reinforcement to the business end of the stinger. This is accomplished by tracing a circle around a stinger tube on a piece of strong tissue paper. A notebook paper hole reinforcement is then glued to the center of the circle. The circle is cut out and glued to the nozzle end of the stinger as shown in the picture. The launch spindle will be inserted through the hole of the reinforcement at launch time. The reinforcement helps the stinger spin about its central axis without wobbling. Another possibility I have seen used for this purpose is a standard paper end plug with a hole punched in it. The end plug is not glued into place so it will easily be blown out when the stinger flies. These end plugs may usually be re-used a few times before they become too badly charred.

SPIN STABILIZED ROCKETS

CUSTOMIZED THE LAUNCH PAD



The stinger missile requires a custom launch pin to support it prior to launch and during initial spin-up of the device. This can be as simple as a nail driven through a good-sized piece of wood to give it a solid footing during launch. The last thing you want when these things start spinning is for the launch stand to tip over and send an angry stinger missile into your terrified audience. The nail is rounded at the end by a file to provide a good pivot point at the top of your stinger core. This picture shows a typical launch stand with two launch pins, one supporting a finished missile ready for launch. A little decorative paper has been added to give it a festive flair. All that remains is to light the fuse, retire to a safe distance and feel the rush these marvelous little rockets give to their creator and the audience.

SPIN STABILIZED ROCKETS

TIPS AND SUGGESTIONS

Tips and suggestions for further enhancements:

- After a suggestion from Lindsay Greene, I tried adding 3% of 40-200 mesh spherical titanium to the black powder fuel. It creates a beautiful, corkscrew trail of bright golden sparks as the stinger ascends. It is a very impressive effect with little extra effort. The only drawback is that the titanium causes a little extra wear on your tooling and launch spindle. **Important note: Never pound or drill into mixtures with titanium (ed.)**
- Another possible time saver is to insert the fuse into the side vent hole before ramming the black powder. The powder will compress around the fuse and help secure it in place. Care should be taken not to insert the fuse too far, however, or it might shorten the spin-up time before the main stinger core ignites and sends it skyward.
- The launch spindle must be long enough to suspend the stinger above the launch base. If the bottom of the stinger is touching the wooden base, it will interfere with the stinger's ability to spin on the spindle.
- An exciting recent innovation is to use flying fish fuse in the header. A bundle of short lengths of this fuse will ignite to make a swarm of little wiggles all over the sky. One end of each fuse is primed to aid ignition and the other end is coated to inhibit ignition. This special fuse can be purchased from Skylighter.
- *We have heard reports of problems with exploding stingers.* If you are using large-

SPIN STABILIZED ROCKETS

grained black powder, your rocket **may explode**. Try using a very fine-grained black powder. Meal-D works well. Meal-D has a flour-like consistency. If you are using Meal-D or the equivalent, and your rockets still explode, try slowing your powder down a bit by adding 5-10% charcoal (either air float or 80 mesh). Or you can add 10-12% titanium (anywhere from 20-80 mesh should work fine). Last but not least, it is possible your nozzle is being blown out. Too thin a nozzle or a nozzle not being "seated" well most often causes this. Try making your nozzles thicker; one rule of thumb is to make their thickness equal to the inside diameter of the tube. Or ram or press your nozzle so that it bulges the outside of the tube slightly—not so much as to split the tube, but just enough to be able see or feel a slight bulging of the tube. This will embed the nozzle into the inside of the tube much more securely.

Our thanks to Dan Williams for creating this excellent set of instructions. If your stingers work, dedicate the next one to Dan for his hard work, great photos, and clear writing.

SPIN STABILIZED ROCKETS

ROCKET'S RED GLARE and GREEN, and BLUE, and PURPLE

by Rich Harrison

After playing for two years with the latest craze - stingers, and making all the sizes from 3/8" bore to the (and I believe I made the first) monster 6 lb., and garnishing them with all kinds of crap from whistles to stars to shells to cross-breaking quad stars and such, I'm starting to get bored. I've wondered hard and searched high and low for articles and whatnot on colored rockets. I thought to myself, that new ruby red star comp that's going around would make a fantastic rocket, if I could make the right size spindle.

Starting at the 4 oz. size, I figured I could scale it up or down later. It took four tries carving up some 1/2" stainless in the lathe before I got one to fly...and then only so-so. The fifth try got it! I cut up some 1/2" bore cases to 2" long (these burn longer than BP). The nozzle is 1/4" thick when rammed in and has a 0.1" bore made from the diameter of the spindle. The total spindle length is a tad over 1" (1.050"). So if you look at a cross section of the rocket, you see 1/4" thick clay nozzle, 3/4"+ of core in the comp, 1/2" comp solid over the spindle, and finished with clay plug. I've shot about 20 of these so far with no problems (other than the need to shoot more—the color is unreal). I've been ramming these cautiously with leather gloves and facemask on in case the drift decides to take off. Pressing may work fine too.

SPIN STABILIZED ROCKETS

Ruby Red Rocket Comp.

Strontium Nitrate	50
Potassium Perchlorate	8
Parlon	18
Magnesium/Aluminum. 275 mesh	12
Charcoal Airfloat	5
Sulfur	5
Red Gum	2
Dextrin	+5

All parts by weight.

This particular spindle also worked with my blue and purple comps, although with a little less thrust. BUT! Here's the interesting part. Some of them CHIRP like birds in the early lift off!

MY BLUE COMP (my variant from Beachle)
MY Wife calls it CORNFLOWER BLUE

Potassium Perchlorate	70
Copper Oxychloride	10
Red Gum	7½
Chlorowax	7
Hexamine	2½
Dextrin	3*

(leave out of rocket comp.)

SPIN STABILIZED ROCKETS

MY PURPLE (my variation on Bleser)

Potassium Perchlorate	23
Ammonium Perchlorate	40
Copper Oxychloride	5
Strontium Carbonate	12
Red Gum	5
Shellac	5*
Hexamine	7
Charcoal Airfloat	1½
Chlorowax	1
Dextrin	4½**

* (helps remove some of the yellow from flame)

**leave out of rocket comp.)

Said same spindle didn't work with my green. Well, one of them did, Harry's El Cheapo Nitrate Green, but it didn't burn green (more like yellow mud).

My ultimate favorite green and expensive (from Weingart)—9:1 barium chlorate to shellac comp—blew up! So I started carving up stainless again. Took three tries. This spindle is as long as the ruby-comp one, but has a nozzle bore of 3/16" (0.187"). I kept the case length the same, 2", and the clay nozzle the same, ¼" thick. I rammed it hard.

This mix I am real careful ramming (barium chlorate, remember?). I have had no incidents as yet. (See next page) Thrust is good and the grrrreeeen fire is there from launch to burnout. This guy also chirps/sputters on take off.

Feeling confident at this stage, I decided to scale up to the ¾" bore. Green comp first. No matter what or

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how I manipulated the spindle, the barium chlorate comp detonated every time. So, I abandoned the above green comp (I was getting too nervous ramming it anyway) in favor of some other potassium perchlorate comps. Although I could get these others to fly halfway decently, they would not give me the green thrust flame I wanted. It dawned on me that Harry was gonna get rich off of me mixing all these small batches, trying it once, and burning up the remainder. Now we cannot allow that! If I could only find a comp as nice as the Ruby Red.

Hold everything! Why not substitute barium nitrate for the strontium in the Ruby Red formula? Bingo! I went back to the 1/2" bore case and the 3/16" nozzle and it flew first try, but a little lazy and the green was a slight yellow. This is starting to look like Bob Veline's green. Yup, added some barium carbonate and the green came into play. Then to tweak the spindle, I cut it down to give me a 0.150" bore nozzle, and the rest is history.

Feeling twice as confident now, I scaled everything up to the 3/4" bore case about 3" long and before I did any calculations for the spindles, as the case reminded me of a stinger, I tried my existing stinger spindle as a regular rocket (no side hole for spin).

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RESULTS:

Ruby Red flew magnificently.

Harrison Green flew magnificently.

My Blue and My Purple flew, but lazy. Would still work as wheel drivers.

Re-cut a new spindle (skinny stinger) to give me a 0.20" nozzle and they flew much better.

Harrison Rocket Green Comp

Barium Nitrate	50
Potassium Perchlorate	8
Parlon	18
Magnesium/Aluminum 275 mesh	12
Sulfur	4
Charcoal Airfloat	4
Red Gum	2
Barium Carbonate	6
All parts by weight	

I've noticed that these colored rockets are a little hard to light, so I've been dribbling some 60-40 flash down the throat before taping in the fuse. Priming an end of some Visco with Bleser's strobe igniter mix works excellent.

All comps above are in parts by weight, and mixed thoroughly by passing through a 30 or 40 mesh sieve at least 4 times. I leave the dextrin binder (normally used when making stars from these comps) out.

Finally, I managed to design an extremely thin, long spindle to get Dave Bleser's Blond Streamer comp.

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to fly. Still using the 1/2" bore cases, 2" long, the spindle gives me a nozzle bore of, are you ready?... 1/16" diameter and is a little longer than before, being 1.125" this time. You have to use Harry's skinny visco to light these. These take off real lazy; therefore you need a long, lightweight stick, 1/8" x 1/8" x 25-30" long. The tail/streamer/fire is incredible! It blankets the launch pad and streams out 25-30 feet+ in flight.

Blonde Streamer Comp (Bleser)

Meal D	60
Airfloat Charcoal	20
Ferrotitanium 30-60 mesh	15
Dextrin	5*
(leave this out in rocket comp.)	

Just imagine these FX rockets/drivers powering some wheels! I can! Gonna play with more colors and sizes, let ya know!

DISCLAIMER: I WILL NOT BE RESPONSIBLE FOR ANYTHING because of misinterpretations and or misuse of information presented. RH

[First appeared in Skylighter's I-net *Bulletin*.]

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APPENDIX 1

CIA BLACK POWDER REVISITED

By Donald Haarmann

With the sale of the booklet *CIA Field Expedient Preparation of Black Powders* many pyros rushed out to their local stores and purchased potato ricers, and isopropyl alcohol by the gallon. Soon after the little woman had left the house, they proceeded to produce the damndest mess seen in a pyro's kitchen in quite a while, along with black powder of varying qualities.

However, all is not lost as H.W. Voigt and D.S. Downs at the Seventh International Pyrotechnics Seminar presented a paper dealing with black powder igniter pills produced in part with black powder obtained using a modification of the CIA method. This paper contained several interesting revelations, the first being an early attempt at producing black powder using a "salting out" method (aka, the precipitation method) by one Edward Greene (USP 160,053) of New York, January 25, 1875! Greene's method consisted of mixing the sulfur and charcoal in a saturated solution of potassium nitrate, as close to the boiling point of water as practical, and then removing the excess water by connecting the mixing vessel to a vacuum, with constant stirring. (The boiling point of water at 760mm of mercury (atmospheric pressure) is 100°C. However, if the pressure is lowered to say 100mm of mercury, the boiling point of water is lowered to only 52 C

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Therefore, a great deal of water can be removed rapidly (flash evaporation) resulting in the "salting out" of the potassium nitrate.) No doubt due to the difficulties in producing the required vacuum, and for other more technical reasons, this method was never used.

The second revelation is the fact that although generally credited to the CIA, the production of black powder through the use of alcohol as a dehydrating agent was developed at Frankford Arsenal, by T. J. Hennessy. ("Field Expedient Preparation of Black Powders", Frankford Arsenal Memorandum Report M67-16-1, Feb. 1967.) The method they use differed from the "CIA" process in a number of important ways. Whereas the CIA method added alcohol to a mixture of sulfur, charcoal, and potassium nitrate in hot water, Voigt and Downs method mixes the sulfur and activated carbon black (in place of charcoal) in alcohol, along with two other ingredients, and then to the mixture is added the potassium nitrate dissolved in hot water.

The details provided by them are as follows:
45 grams of potassium nitrate was dissolved in 45 ml. of water at about 75°C. 2.5 grams of potassium nitrate were added to compensate for loss in the filtrate. (A loss of less than 6% as compared with a loss of over 18% for the CIA method.)

6.24 grams of commercial flowers of sulfur (most pyros do NOT use flowers of sulfur due to the possibility of its containing free acid, so normal pyro grade sulfur should be used) and 8.76 grams of activated carbon black (not lampblack) were

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suspended with vigorous agitation in a solution of 0.135 gram of polyvinyl pyrrolidone (a dispersing agent - try wetting sulfur some time!) and 0.6 grams of mercaptan terminated polyacrylic liquid polymer (B.F. Goodrich Co. Hycar MTA - a binding agent, don't worry, you can leave it out) in 135 ml. of 95% ethanol. (Isopropyl alcohol is cheaper and just as good.)

The alcoholic suspension of the fuel components was cooled to 15°C, after which the hot aqueous KNO₃ solution was introduced gradually with vigorous agitation whereby the KNO₃ was precipitated in the form of very fine particles intimately mixed with fuel components. The resulting product was then washed with alcohol and dried.

The process was also tried: 1) using channel carbon black, and no Hycar MTA; 2) using wood charcoal that was ball milled, and no Hycar MTA; 3) using maple wood charcoal, colloidal sulfur, and no Hycar MTA; 4) and using a 50/50 mixture of maple wood charcoal, and carbon black powder, with Hycar MTA. All of these methods produced black powder equal to the standard DuPont (Goex?) black powder when tested in a "Closed Bomb".

(I would be remiss if I failed to mention that this homemade powder is listed as an explosive in 18 USC section 841(c), and anyone making it would be, in effect, manufacturing an explosive material.)

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APPENDIX #2 MATERIALS NEEDED

Part I: Stinger Missiles

- Arbor press or a hydraulic press
3/32" dia. drill bit
- Rocket tubing 2½" to 2¾" long:
- A few oz. Hawthorne Bond clay
- Homemade meal powder: 75/15/10 potassium nitrate/sulfur/charcoal, blended with hot water and precipitated with alcohol. (See bonus section)
- 4cc cartridge reloading scoop
- Isopropanol

Green Star Delay Composition:

- 5 oz Barium Nitrate
- 8 oz. Potassium Perchlorate
- 1 oz. Parlon
- 3 oz. Red Gum

- 1 oz. Soluble glutinous rice starch (dextrin can be used instead)

For a report in the header

- 70/30 (potassium perchlorate/dark aluminum), with a dash of Cabosil
- ¾" paper end plugs
- Paper discs 1¼" dia.

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- 1½" wide gummed paper tape
- Slow Thermolite igniter cord

Launcher:

- A nail pounded through a large board and then filed round at the point.

Part II: How to Make Stinger Missiles

Tooling kit for the ¾" stingers from Skylighter
Hydraulic press or soft mallet

- 9/64" drill bit
- 1/8" drill bit

Parallel wound tube ¾" i.d., 1¼" o.d. and 7½" long.

Black powder Meal D

Mineral oil (small amount to cool the BP)

A few liquid oz. sodium silicate solution

Flash powder for header (optional) can substitute any star formula

A few oz. isopropanol or rubbing alcohol

Kraft paper

Nitrocellulose lacquer

Visco fuse

Notebook paper hole reinforcement

For nozzle:

- A few oz. bentonite clay
- A few oz. kyanite clay
- 1 ring toilet seal wax
- Coleman fuel to dissolve wax

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Delay composition:

- 5 oz Barium Nitrate
- 8 oz. Potassium Perchlorate
- 1 oz. Parlon
- 3 oz. Red Gum
- 1 oz. Soluble glutinous rice starch (dextrin can be used instead)

Launch Pad:

- A nail driven through a good-sized piece of wood to give it a solid footing during launch.

Optional enhancements:

- Adding 3% of 40-200 mesh spherical titanium to the black powder fuel
- Flying fish fuse in the header.

To slow down an aggressive BP:

- Charcoal (either air float or 80 mesh), or
- Titanium (anywhere from 20-80 mesh should work fine).

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PART III: ROCKET'S RED GLARE and GREEN, and BLUE, and PURPLE

Unless noted 1 lb. each should make many rockets

For Ruby Red rocket comp.

- 2 lbs. Strontium Nitrate
- Potassium Perchlorate
- Parlon
- Magnesium/Aluminum. 275 mesh
- Charcoal Airfloat
- Sulfur
- Red Gum
- Dextrin

For Blue comp.:

- 3 lbs. Potassium Perchlorate
- Copper Oxychloride
- Red Gum
- Chlorowax
- Hexamine
- Dextrin

For Purple comp.:

- 3 lbs. Potassium Perchlorate
- 2 lbs. Ammonium Perchlorate
- Copper Oxychloride
- Strontium Carbonate
- Red Gum
- Shellac
- Hexamine
- Charcoal Airfloat
- Chlorowax
- Dextrin

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APPENDIX #3

RESOURCES : WHAT YOU NEED TO GET STARTED AND WHERE TO GET THEM

From the Skylighter website: www.skylighter.com

Rocket Tools: Stinger Missile Kits

Whether you are a rocket nut or not, you will probably get a hoot out of Stinger Missiles. Stinger Missile? This is a hot-rod version of the Class-C (1.4G) item called Warhead Launcher, a spin-stabilized rocket. The rocket flies by first spinning (on a nail) rapidly to achieve gyroscopic stability, then takes off vertically. They don't need sticks or fins. You can make them with headings (a shell, a report, flying fish fuse bursting out, or whatever) or without. Fuel is generally black powder plus some metal for sparks, but can be any rocket fuel. They are easy to make and all you need is some chemicals, the Stinger kit, and some parallel tubes.

These things are the closest to instant gratification you can get. I made about 10 of them in 30 minutes on back of my pickup's tailgate recently. We currently have them in two sizes, $\frac{3}{4}$ " and 1-inch diameters (called "One Pound" and "Three Pound" rockets, respectively). Shoot 'em "neat" or jazz 'em up with spark tails, rising comets, or headings.

Each kit consists of a base and spindle, a hollow rammer, a solid rammer, a drill bit, and a drill guide. One rammer forms the nozzle from clay and rams the composition around the spindle. The second rammer is used for ramming composition

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above the nozzle. The drill guide is used to precisely align the side hole off-center in the tube where the rocket is ignited and which causes the spinning. The drill bit we supply makes exactly the right sized hole for our standard 3/32" visco fuses (GN1000, GN1001, and GN1004). Use parallel tubes only for these rockets. Since Stinger tubes are shorter than our standard, pre-cut tubes, I suggest you get the longer tubes and cut yer own to size. Stingers can be rammed with a hammer; you do not need a press as long as you stick to black powder based fuels.

PRICING AS OF 3/15/02

Item No.	Description	Tube i.d.	Tube No.	Price
TL1610	1 pound Stinger Missile Kit	¾"	TU1065	\$59.80
TL1630	3 pound Stinger Missile Kit	1"	TU1101	\$66.45
TL1650	6 pound Stinger Missile Kit	1½"	TU1151	\$108.95
TL1684	1 pound replacement spindle	¾"	N/A	\$16.85
TL1686	3 pound replacement spindle	1"	N/A	\$18.45

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Parallel Wound (Convolute) Fireworks Tubes

What's the difference between a fireworks tube that is parallel (or "convolute") and one that is spiral? Well they're made differently and it's easy to tell by the way the paper is wound. Paper towels or toilet paper are both wound parallel. But the paper tube inside them is wound spirally.

So in making fireworks, when do you use parallel tubes and for what? Well, for some fireworks making applications, parallel and spiral tubes are interchangeable. But in general, parallel tubes are used to make fountains, rockets, whistles, hummers, and mortars. Chose a parallel tube whenever you want the strongest wall strength for your fireworks device. For instance, when ramming (hammering) rockets, you will want maximum wall strength. Skylighter offers a wide variety of parallel tubes for rockets in what are considered to be standard sizes. But if you need a shorter or longer tube, you may want to buy the uncut 24-36" tubes and cut them yourself, using any sort of saw.

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RECOMMENDED READING:

The article written by Dan Williams was published on the Skylighters Pyro Supply website, which can be found at <http://www.skvlighter.com>

Other great information on fireworks can be found at the American Fireworks News website at <http://www.fireworksnews.com>

The other articles were reprinted from issues of American Fireworks News newsletter. If you are serious about fireworks, you need to get this monthly publication.

The Best of AFN series of books, now up to Best of AFN IV, contains hundreds of great articles just like the ones that comprise this handbook.

Best of AFN II (covers years 1983-1990)

Best of AFN III (1991-1995)

Best of AFN IV (1996-2000)

Best I The Best of American Pyrotechnist (a dedication of the work of Max VanderHorck)

All four can be found at the AFN website.

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This handbook will show you a great method for making these special, spin-stabilized rockets. Another name for these fun, easy-to-make devices is the Stinger Missile. Spin stabilized rockets are like normal black powder rockets except, these have a side vent hole. The vent hole makes the rockets spin shortly on a spindle before taking off. The beginning spin makes the rocket fly remarkably straight into the air. These rockets require no sticks or fins to fly straight.

The second part of this handbook gives you interesting different formulas to create varied colors and effects to your rockets. Very interesting reading.

Bonus: Also included is the modified CIA method for making black powder.

Warning: Concerning any offer found in this book to sell or transfer products or information that are subject to governmental regulation, such sales or transfers of the product or information will be made in accordance with Federal, State and local laws applicable to the buyer or transferee.

This book contains pictures and descriptions of fireworks. It is based on the experiences of the authors using specific tools and ingredients under specific conditions not necessarily described in the book. Viewers are cautioned that they must form their own opinion as to the application of anything found in this book.