PASSFIRE FORUM

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SECURITY

PROTECT YOURSELF

To protect yourself when making this mix, I wear a protective face shield and leather gloves. At least if it does blow up in your face, you won't have the bare flame licking you in the face. Any kind of cotton sweat shirt or long sleeve jacket will protect your arms. And use common sence. From this I think there are some take home messages:

1. Wear a heavy glove and safety glasses or face shield when pounding rockets. If it blows up your hand is what will be the most damaged. Do wearing only leather gloves and not nitril gloves, because they will burn.
2. Prevent static ignition: Make sure you ground everything in your work area, including yourself.
3. Never pound whistle and strobe mix ! Even pounding black powder rockets is dangerous. Do never pound any composition that contain titanium or any other sparking ingredients. Rockets should be pressed behind a bullet proof shield.
4. Always, always check the fit of each rammer before you start ramming to make sure where they jam onto the spindle. Then mark this point on the rammer to show where this point is and don't go beyond it.
5. Always look into the rammers before each use and check to see if any fuel is built up inside. This reduces the size of the hole and it will jam on the spindle before it reaches the line scribed on the rammer.
6. When you change fuels, especially when going from pressing whistle rockets to pounding black powder, make sure you clean out the bores of the rammers throughly before you begin your next project.
7. Keep your tooling in complete sets in their own containers. If you have more than one set of tooling of the same diameter, perhaps you should mark the tooling itself as well.
8. If you use a universal tool set with whistle fuel, then perhaps you should dedicate that tooling to pressing only.
9. If you press whistle or strobe mix, then don't let the pressure well on the mix. Release it immediately.
10. If you are building in an unfamiliar place, then do things in slow motion because you're more likely to make a mistake.
11. Be extra careful when you are teaching someone how to do things. Being safe is more important than your student knowing what the hell you're talking about.
12. Adding titanium to the mix while pressing, makes the operation much more sensitive to ignition. And anybody that uses sponge titanium in they're fuel for pressing is just making the sensitivity much more prone to ignition. I would never use sponge titanium in any mixes that I press. I never press whistle rockets with titanium in the core, I do use it in the delay portion of the rocket.
13. Vasoline reduce sensitivity of whistle mix. It's safer to press pyrotechnic fuels if vasoline is present in the mix. So be careful to press whistle mix without vasoline.
14. NC lacquer makes makes any mix much more sensitive to ignition.
15. Strobe mix is the most sensitive mix . It is a very sensitive mix to both shock and friction.
16. Check each flight stick you've made and bend it slightly in all directions and check for a weak spot. If there is one, it will break. Better to break in your hand that in the air 50 feet up.

ALWAYS MARK AND CLEAN RAMMERS

What I think happened was that there was a trace of whistle fuel inside the rammer, and when Jeff put that final blow to the rammer with the hammer, it ignighted. This wasn't the worst of the problem. Since the rammer bottomed out on the spindle before it got tight on the spindle, there was direct metal to metal contact. This was a very unfortunate event, but it caught somebody who didn't check the rammer fit with the spindle before he started ramming. All I can say at this point is Jeff violated one of the most important rules when you start to make rockets.

1. Always, always check the fit of each rammer before you start ramming to make sure where they jam onto the spindle. Then mark this point on the rammer to show where this point is and don't go beyond it. Once you begin to collect different spindles, along with their rammers, it becomes more of a concern to keep them separated. I don't permantly mark them, but always mark them with a sharpy or place a piece of tape at the jam point right before I start to press. I do this every time with each motor, then remove any rammers and place them someplace else. This is a ritual with every motor I go through. It's part of the necessary process to stay safe.
2. Another point to consider when using your tooling to make different rockets. When you change fuels, especially when going from pressing whistle rockets to pounding black powder, make sure you clean out the bores of the rammers throughly before you begin your next project.

So, in a nut shell, make sure you know the jam point of each rammer before you begin ramming or pressing. After you finish using a rammer, clean it out throughly before you begin using the next rammer, then place that rammer at least one step away from you, then grab the next rammer that is at least one step in the other direction. Leave the proper rammer inside the rocket before you leave the scene, and remember where you are after you come back. When I get back, I make a thorough inspection of the process before I begin.

USE TITANIUM ONLY IN THE DELAY - NEVER USE SPONGE TITANIUM

I never mix sponge titanium with it either or press sponge titanium with whistle mix. I only use atomized or flake titanium. Why? Would you press whistle mix with a hand full of gravel thrown in ?

A titanium to titanium shear could have caused the heat that caused the ignition. Some how, I believe this is the culprit. When I press the fuel increment in a motor, I bring up the pressure very quickly and release it immediately. I even take a slight moment before I reach around the blast shield to grab my motor to add the next increment, after the pressing operation. So adding titanium to the mix while pressing, in my opinion, makes the operation much more sensitive to ignition, and that's why I only do it in the solid portion above the spindle in my motors. And anybody that uses sponge titanium in they're fuel for pressing is just making the sensitivity much more prone to ignition. I would never use sponge titanium in any mixes that I press. This would be like adding gravel to the whistle mix while pressing. Why have I been so lucky for the past 17 years ?

OTHERS

And the dangers of static ignition are present more in the winter time than in the summer. I don't even make whistle mix anymore in the winter.

If I used an electric mixer for all the whistle mix I've made since 1991, I would't be here now on this site. The kitchen mixer I use is a hand held device with no moving parts, no electricty involved. It's a pie crust doe mixer with metal teeth and a handle to incorparate the chems together. Go to Magic Chef web site and search for pastery mixer.

When I first started making whistle mix, without a catalyst and without vasoline, I used to bind it with NC lacquer. Give this mix a friction test and an impact test and see for yourself. It does explode and ignite. Now, for anybody that wants to make whistle mix without vasoline, fine. I think it's a little more sensitive without it.

And one more thing. With all the rockets I've made for the past 44 years I've been making them, I never had one blow during construction. Thank God and good common sense.

BLACK POWDER ROCKETS

Making Black Powder Rockets

1 increments of clay choke, about a teaspoon. Then black powder #1 to one increment above the spindle. 2 to 3 additional increments of a slower burning fuel, like willow mix or chrysanthemum of mystery or a color fuel, as long as it doesn't have potassium chlorate for an oxidiser. You want about a 5 second delay above the rocket for which this fuel above the spindle gives you.

Ricing Black Powder - how much solvent ?

What I like to do is add enough water with 10 % alcohol added, that when you press it through a window size screen, you get little worms that fall through that slightly stick to each other. It won't be difficult to spread this out on paper. If you get big blobs sticking together, then you added to much water. I use at least 16 - 18 % weight of water-alcohol mix for all the fuels I make up. With different mesh sizes of charcoal in the black powder mix that you are making, water percentages will vary to get the exact amount to use. I do know that when ricing a ballmilled mix, such as a willow mix, the screening process takes more elbow grease to push it through the screen. So if you start with about 15 % with any mix, this should be OK. In the event you add to much water to the mix, rice it anyway and spread out the globs and let it dry for 20 minutes in the sun and then rice it again, If it's just right, you will have some fairly fine granules of black powder. This is what I do now with all my black powder that I make up. I over wet it slightly, screen it and sperad it out on paper and let it dry for awhile, then re-rice it. What I end up with is the perfect mesh size to make my hybrid # 2 mix. This is exactly the way I do it now for all the black powder mixes I make up. I don't like the coarse mix you get if you only rice it once. It flows nice and settles nice inside the rocket tube when you dump it in. While loading a rocket motor, if you use the clumpyer fuel, it tends to cock the spindle inside the tube when you are pressing up the motor. If you look down inside the motor when you have it half pressed up, you can sometimes see your spindle isn't in the center of the grain where it should be. This can bend your spindle if it gets severe. With the finer grained fuel, this doesn't happen.

BLACK POWDER # 1

75	potassium nitrate
15	charcoal, ballmilled
15	charcoal, 36 – 40 mesh
5	charcoal, 80 mesh
10	sulfur
5	dextrin, water & alcohol

Delay and tail for rockets

A good delay for such a short distance would be to use willow or tigertail mix. The one I like to use is:

WILLOW MIX

44	potassium nitrate
44	charcoal, ballmilled
6	sulfur
5	dextrin or 3 parts SGRS
	water

You have to wet this and rice it and let it dry before using it. If you press a 3/8 inch column above the spindle, this should give yo plenty of delay. If you use enough loading pressure on two increments of this above the spindle, you won't need a clay bulkhead either. If your rockets have pretty good zip, then press as much as you can get into the tube. For an even slower delay, you could use chrisantemum of Mystery which is 50 parts ballmilled charcoal, 45 parts potassium nitrate, and I always put at least 5 parts of sulfur into the mix, although it's not in the true formula,

and then at least 3 parts SGRS or 6 parts dextrin. This mix also has to be riced and dried before use. These are the main powders I use for my delays in all my black powder motors. To brighten up the tail a bit, you could add an additional 8 parts 400 mesh atomized aluminum to each mix as you are making it. This gives the tail a brighter hue or kind of increases the light output from the charcoal.

I only use slow burning fuels above the spindle for my delays, and hardly ever use the same fuel that the main core was pressed with. Using chrysantumum of mystery is my choice for this particular type of rocket. It's a very slow burning, very fine spark tail that is very pretty and long lasting, time wise, even if you don't put a heading on the rocket. When you add titanium to this fuel, the charcoal tail is washed out and you get a long hanging, bright white, flowing tail that will form a long, 300 foot long tail that forms a large arch in the sky. I found if the charcoal isn't ballmilled very fine that's used in this mix, for some reason, the titanium won't ignite and burn with this long tail. In fact, the rockets I took to the WWB didn't burn at all, they just went out when the fire hit this area in the rocket. You could use willow or tiger tail mix to substitute for the chrysantumum of mystery mix, but I prefer to use chrysantumum of mystery mix because it burns so slow. You only need a colum of about 3/4 inch in a rocket to get around 5 seconds of burn time. And I use around 1-to 1-1/2'' colum in my rockets to get the effect I'm looking for.

Chrysanthemum of mystery Need more sulfur, if you don’t use willow Charcoal

Silver maple makes good charcoal also. It gives a real nice tail and plenty of power also. I've found that if used for chyrsanthemum of mystery and titanium tailed rockets where you get the real long, bright tailed rockets, you have to add about 8 parts sulfur to the fuel or the titanium doesn't ignite. Normally, when I used to make those long tailed rockets, I used willow charcoal and only used 3 parts sulfur with no problem. But when you use silver maple charcoal, add 8 parts sulfur.

MAKING WHISTLE MIX

Whistle rocket fuels

WHISTLE MIX # 2

76	potassium perchlorate
23	sodium salicylate
1	iron(III)-oxid
2.5	vasoline (2.5 to 3)
	lacquer thinner

WHISTLE MIX # 3

64	potassium perchlorate
32	sodium benzoate
1	iron(III)-oxid
5	vasoline
	lacquer thinner

How to do ?

It takes me about 1/2 hour to weigh out and mix a 1000 grams batch of whistle mix. Once you have the dry mix ready for the laquer thinner-vasoline mix to be added, it takes another 10 minutes to mix in, then I'm ready to push it through the ricing screen. This takes about 10 minutes. After the ricing is finished and the little piles of mix are spread out over the drying paper, it takes another hour for it to dry in the sun. The total time from raw chemicals to finished whistle mix is around 1-1/2 hour, 2 at the most. I always start this process around 9 AM so I get the most from the suns drying affects. I usually make 2, sometimes 3 batches at a time.
I do screen it through a gravy strainer, though, very carefully. The final mixing comes after I add the thinner and vasoline. I use a 40 mesh screen for all my screening purposes. I don't use it for screening benzoate or salicylate, though. For that, I use a 12 mesh screen only. After the chems are screened and you are ready to add the vasoline, I melt the vasoline in an aliminum container, add the lacquer thinner to the bowl of mix and knead the liquid into the mix. This only takes a few minutes when using a pastry mixer like the wife uses to make pie crusts. I found that adding about 20 grams of liquid, lacquer thinner and vasoline mixed to about 100 grams of dry fuel is about the right amount of liquid. If you need more, just add straight lacquer thinner. I find myself adding more thinner as I do this because it drys out real fast. I like the way lacquer thinner evaporates out real fast. If your mix is a little to wet with lacquer thinner, which is the way I always make it, the kneading process is easier. I like it to be a little on the wet side at first so I can smear out the granuales of benzoate or salicylate in the mix. As I do this, the mix becomes dryer and closer to the screening texture I want. Mix it real good until you can't see anymore white particles of benzoate in the mix after you are finished. When the mix has the right texture, I screen it through a 10 mesh screen and spread it out on a large sheet of craft paper to dry in the sun and it’s finished. The best mix to screen has just the right amount of liquid so when you rice it through the screen, it falls through the screen and spreads out very easy. If you add way too much lacquer thinner at first and it's like a semi-liquid, just stirr it up in front of a fan with a fork a few minutes. This evaporates the thinner real quick. and it's right back to a putty consistancy. After you made a few batches, you get the feel for when its ready to rice. When to screen this stuff will take experience. The grain should feel some what firm but not real hard. You can smash the grains pretty easy between you fingers. If you let it sit in the AR sun for at least 1 hour, stir it around at least once during this time, your mix will be as dried as oven baked. As far as screening the chems together in a dry form, this operation is probably the most touchy. It takes a fair amount of pressure to generate enough heat to start burning. The biggest factor in having this material go off unexpectedly as you are making it is generating a static spark. This can happen anytime. Make sure you ground everything in your work area, including yourself. I like the texture after screening and drying the mix. It doesn't stick to anything and flows so easy. I would only use lacquer thinner as my solvent. And after it's riced and spread out to dry, it's only a short time later that I can put it away securely and store it out of

danger. All the fuels I make are dried outside in the sun. When dried completely, they go into there respective container and locked up. I feel very uneasy if I know something is sitting out some where drying and not protected from the elements. After you are finished, you have a very pourable, easy to handle grainy mix which doesn't stick to anything. And that's based on my overall experience for the past 44 years of making rockets.

Vasoline to reduce sensitivity

I would never make it without vasoline. It serves more than one purpose. First, it's a burn rate regulater. Second, it protects the fuel from absorbing water from the air. Third, with this lubricant in the mix, it presses much easier to a compact grain. And last, which is the most important of all, the addition of vasoline decrease the sensitivity of the mix when pressing it into the casing. As many rockets I've made in the past 17 years and never had an accident is proof of this. At least I can say it does reduce the sensitivity. I do know it's safer to press pyrotechnic fuels if vasoline is present in the mix.
When I first started making whistle rockets, I bound the fuel with NC lacquer. A tiny speck of this fuel when rapped with a hammer on concrete or steel, it bangs just like a cap. I found that after adding vasoline to the mix, without using NC lacquer, it's difficult to get it to bang. And the worst or most sensitive mix I use is the strobe mix. It is a very sensitive mix to both shock and friction. Just try this experiment on either surface and see for yourself. Once at a PGI convention while presenting a seminar on the strobe rocket, I jammed the rammer onto the spindle while pressing the strobe mix into the rocket. And I had just finished describing how to remove a rammer if you inadverdantly allowed this to happen. What shocked me most was what I had just done, and secondly, the tremendously high friction that was imposed on the rammer-spindle contact area. No explosion. I think God had his Powers working there. Then I had the opportunity to show people how to remove a jammed rammer.

WHISTLE RIPPING SOUND

When I used the higher percentage of vasoline in any of the mixes used for the whistles, benzoate or salicylate, the sound was always more raucous. During the convention at Fargo in 1993 I believe, I used a 3-1/4" long spindle with a 1" diameter rocker, and using benzoate with a ratio of 64-32-1-5 mix, these rockets had a sound you could not believe. And, of course, I was using Swedish perchlorate. I simply don't beleive this sound can be reproduced without a good grade perchlorate.

Catalyst

You could also use copperoxichloride for the catalyst instead of iron oxide which will improve the burn rate of the fuel and make it hotter. You will be surprised how this catalyst improves the performance of benzoate whistle mix. I've only made a few thousand whistle rockets in the past 15 years so I know what I'm talking about.
Titanium dioxide use as a catalyst in whistle mix actually slows down the burn rate as compared to iron oxide or copperoxichloride. The only use I found for this catalyst is when I make long winded screamer rockets and use it mixed in the sodium benzoate fuel as the catalyst. It works quite well in this capacity.
If you want to try making your benzoate mix burn hotter, try using copperoxichloride for the catalist. It will also make the salicylate mix burn hotter also. I asume you are using iron oxide right now. I found when using this catalist with either mix, you get a hotter or faster burning mix. It seems to work better with the benzoate than with the salicylate or just affect the benzoate mix more.

Difference between salyclate and benzoate whistle

Salyclate whistle used in rocket fuel is the best for power. Benzoate whistle has it's uses in rocket fuel also, but not if you are making a rocket that you want to lift a heavy payload. You could use a benzoate rocket to lift a heavy payload, but the dimensions would have to be larger than the salyclate rocket.

Salicylate burns faster than benzoate no matter what ratio you mix it or what catalist you use. For end burn configuration, I've found salicylate to be the loudest. For core burn configuration, the main difference between the two is the raspyness is greater with the benzoate.
I can only say that if you make a rocket using the same tooling and use benzoate whistle in one and salicylate in the other mixed to the same ratio, with no heading, the salicylate rocket will go almost twice as high as the benzoate rocket.
You can increase the altitude of the rocket by increasing the increments of salicylate one at a time until the rocket blows. Then back off one and that is the max amount of salicylate mix you can press into the rocket before switching to the benzoate mix.

Others

No whistle on take off is a sign of using a poor grade of potassium perchlorate.

Increment size for a 2 lb. LWS should be about 10-12 grams, no bigger.

Testing 4lb. whistle rockets could be a problem because they make so much noise. You can hear them 3-4 miles away.

HYBRID ROCKET USING THE UNIVERSAL HYBRID SPINDLE

Introduction

Since I first came up with this rocket, I've expanded this spindle to make 4 different motors with it and now call it my new universal spindle. Five different rockets can be made using the universal hybrid spindle.

1. Black powder motor
2. Strobe rocket
3. Long winded screamer
4. Hybrid motor
5. Colored tail rocket

So with this one spindle you can make kick-ass rocket motors. The black powder and hybrid motor are the only two that use a nozzle. I use no clay choke above the fuel in my motors except in hybrid motors when lifting heavy payloads because a short delay is built into the rocket which needs added strength to withstand blow through. This rocket is a high performance rocket motor when made in all the different types. You won't be able to hand ram any of these motors if you decide to make them so I hope you have a means to press them. The number # 1 hybrid mix doesn't give a tail to the rocket when fired. So to get a tail, this is where I use the # 2 hybrid fuel.

Hybrid # 1 Mix

The hybrid tooling is designed to use hybrid fuel and a slower burning black powder fuel above the hybrid fuel. First, there is a clay nozzel, then 4 - 7 increments of the hybrid fuel is pressed in, then the rocket is finished with black powder to 1 increment above the spindle, then as blukhead any fuel can be pressed into the motor to give a colored tail or whatever you want it to look like as it's returning to earth. The maximum number of hybrid increments used in the rocket before they blow up is 7. You can make this motor any power you want up to power level 7. All of the rockets I have designed around that spindle are on the red line already which means if you change any of the increment numbers, you might have a cato with your rockets. This can all vary with the way you make your whistle fuel also. Even using iron oxide or copper oxichloride for the catalist makes a noticeable difference in the performance of the rocket. You must use a rocket tool designed to make these rockets. The loading pressure I use is 8500-9000 psi. The fuel I use in the motors can be used in all the sizes of the different size motors. So once you make up the fuel, you can make any size rocket that you may have.

HYBRID # 1 MIX:

The hybrid #1 fuel I use in these rockets is made using:

76	potassium perchlorate
23	sodium salicylate
1	iron(III)-oxid
2.5	vasoline (2.5 bis 3)
10	charcoal, ballmilled to a very fine powder
	lacquer thinner

The hybrid fuel is the whistle mix with added charcoal, 10 parts, and it’s ballmilled very fine. Use ballmilled charcoal, not just airfloat. After all the ingredients are sieved through a 40 mesh screen, then add the charcoal to the rest of the mix and screen through a gravy strainer. Then melt the vasoline and add lacquer thinner, approximately 20 grams to a 100 grams of fuel. Mix this through out the fuel until you have a very damp mix and then force it through a window screen and spread it out to dry.

Black powder # 7 mix:

60	potassium nitrate
30	charcoal, ballmilled
10	sulfur
5	dextrin, water & alcohol

The black powder used is riced with water and alcohol.

Hybrid # 2 Mix

I now have another fuel that can be used in place ot the hybrid fuel. With this method, you do combine the two fuels together and use this as the only fuel in the rocket. With this method, the rocket truly looks like a black powder rocket but it isn't and it has kick ass power like the original hybrid #1.

HYBRID MIX # 2

60 %	Whistle mix # 2
76	potassium perchlorate
23	sodium salicylate
1	iron(III)-oxid
2.5	vasoline (2.5 bis 3)
	lacquer thinner
40 %	Black powder mix # 1
75	potassium nitratet
15	charcoal, ballmilled
15	charcoal, 40 - 36 mesh
10	sulfur
2.5	soluble gluttinus rich starch, water & alcohol
100 %	total

First you make a batch of straight whistle mix. Then you make a batch of black powder. These two mixes are made up seperately and then blended together. I don't use 5 parts dextrin anymore. I use soluable gluttinus rich starch and use only 2.5 parts. Make sure you ballmill one of the 15 parts of charcoal and get it real fine. I usually ballmill mine for 12 hours overnight. The 36-40 mesh charcoal gives the rocket a nice tail. The black powder has to be riced with water an alcohol and then dried. By ricing the fuel, you mix in the water and alcohol to wet the black powder and then force it through 20 mesh screen, spread it out and let it dry. You do the same with the whistle mix, only you are adding lacquer thinner and dissolved vasoline to the whistle mix. Then screen it with the same mesh size screen, spread it out and let it dry good. The whistle mix is usually pretty soft once it is completely dry, so I put this through the screen also.
After these mixes are made up, I always run them through a gravy strainer one more time after they are dried to get them pretty fine. What I have been doing with my black powder is to get it pretty wet in the first stage of ricing it. Then I spread it out and dry it for about 25 minutes in the sun and before it is very dry, I rice it one more time before it gets to hard. This makes a nice grain for blending it into the whistle mix. Then you blend them together at a rate 60 % whistle mix and 40 % black powder by weight. You want a good blend without too many big chunks of either fuel in the mixed blend for better results. Press this blended fuel all the way to the top of the spindle with one extra increment above the spindle, then decide what you want for a tail and press that in. I believe this fuel can be made to be as powerful as the original hybrid fuel. Using the blend method of the two fuels together is the only way to get a good tail using whistle mix. I've tried adding charcoal to whistle mix alone and it just wouldn't burn with a tail.
To regulate the power of the hybrid rocket change the number of increments of hybrid fuel or change the intensity of the whistle mix. You get a weaker mix if you use sodium benzoate as the

fuel as compared to sodium salicylate. Salicylate out performs benzoate if mixed to the same ratio. You also can regulate the power of this fuel by adding more or less black powder. Change the black powder content to 60 % instead of 40 % and get more tail and less thrust. You can play with this ratio until you get your motors to cato if you are using a good grade of perchlorate to make your whistle mix.

Flight Preformance of the Hybrid Rocket

These rockets can lift very heavy payloads. At the convention in Wi. in 2001 I lifted a 6'' diameter ballshell with a 1'' motor to a good height. Remember, the ¾” rocket loaded to power level 3 had 49.8 lbs. of thrust. With a well made, ¾” version of the hybrid rocket, you can push a 4'' ball shell higher than what it should go. So to tweek the rocket, use only as many increments of the hybrid fuel in the rocket that you need to lift it to a proper height. And anyone who has seen my rockets fly with just a salute heading on them, I always let them come back down a 1000 feet or more so when they finally go off, you can still hear them.

Hybrid rocket tooling dimensions

I use a 950 series bronze to make my rocket spindles. First, the spindle is 20% shorter than a standard black powder spindle. The nozzel diameter is larger than the standard black powder spindle. For example, a 3/4'' or one lb. rocket motor, the diameter. of the base of the spindle is 0.430” and the length is 4.2 '' long. Scale this up or down to get other size spindles. The base has the 30 degree taper which is typical of a black powder spindle and this dimension is included in 4.30 inch length. The taper on the spindle is 1-1/2 degrees. The tool set also needs 3 rammers with holes and 1 solid rammer. The black powder motor you build with this spindle will be as good as any black powder rocket you can make.

3/4" WHISTLE ASSISTED COLORED TAILED ROCKET

Whistle rocket fuels

WHISTLE MIX # 2

76	potassium perchlorate
23	sodium salicylate
1	iron(III)-oxid
2.5	vasoline (2.5 to 3)
	lacquer thinner

Making whistle assisted colored tailed rocket

There is no nozzle used in this rocket. For the colored tail rocket, press in three increments of #2 whistle mix, then press the color of your choice to about 1 inch above the spindle. Most colored fuels burn not too fast so 1 inch above the spindle is a starting point. Vary the amount above the spindle to get the required delay. If the colored fuel burns real slow, just add and extra increment of whistle to the rocket before starting the colored fuel.

If using the hybrid spindle to make these rockets, without a nozzle, press in three increments of the fastest whistle mix you can make, using sodium salycilate. This will take up about one inch of the spindle length. (¾"size rocket: 3 increments = 1 inch). Use only 7 grams for each increment in a ¾" size rocket. Total 21 grams of whistle mix, then finish with black powder or use a colored fuel for a colored tailed rocket, like the magnesium red, Steinberg formula to about ¾" above the spindle. Loading pressure on these rockets is around 8500 psi. These will be kick ass rockets because of the long spindle, but you don't need to use this long of a spindle to make red tailed rockets. These things take off so fast, you don't even know that the first few increments pressed into them is whistle mix. This is what gives the rocket it's boost on takeoff. And the red color is there at the same time. You can even make a red tailed rocket using a shorter spindle such as the standard whistle rocket spindle which is about 2-1/4 inch long by using the same technique, whistle and then the red formula.

This is the formula I use for my red tailed rockets only I use -200 mesh magnesium and 5 parts potassium dichromate. I then bind with NC and acetone. The parlon makes it pretty sticky when ricing but this works good when used in all my rockets where you see a red tail. This formula was the original chuffer formula that you gave in your post that Doc Steinberg used at my house back in 2001. He didn't use any potassium dichromate or acetone and NC lacquer. Shelf life on this is pretty good also. The last batch I made is over 2 years old and still works good.

The hybrid tooing you have is perfect for what you want. Just take either the red or green magnesium composition you have already, and start with 3 or 4 increments of the salyclate whistle comp on the instruction sheet, then finish your rocket with either color comp. What you will have is a very fast flying green or red rocket. Try it before you consider another spindle and see what you decide. So the loading steps would be: press in 3 increments of whistle first, then press in the remaining space in the rocket with the color comp. Once you have about 5/8 inch above the color that you chose first, then you could use the other color above that so the change goes from red to green or green to red. Or, make the increments 1/4 inch thick above the spindle and press in red, green and back to red or just the opposite so you have a three color change.

LONG WINDED SCREAMER ROCKET

Whistle rocket fuels

WHISTLE MIX # 2

76	potassium perchlorate
23	sodium salicylate
1	iron(III)-oxid
2.5	vasoline (2.5 to 3)
	lacquer thinner

WHISTLE MIX # 3

64	potassium perchlorate
32	sodium benzoate
1	iron(III)-oxid
5	vasoline
	lacquer thinner

Making Long Winded Screamer Rockets (LWS)

There is no nozzle used in this rocket. 4 increments of whistle mix #2. Then whistle mix #3 all the way to the top of the rocket tube. Leave enough space to grab the motor with a vice grip to pull it off the spindle after inserting the solid rammer into it. On the increments above the spindle, I always add flake titanium in each scoop before I press it in.

Pressing Long Winded Screamer Rockets (LWS)

I have used loading pressures on LWS anywhere from 7000 to 9500 psi. If it works at 7500 psi, don't use any more pressure. I've always used New England tubes so I know what kind of pressures these tubes can take. Just remember when you start pressing the first few increments, don't go up to the calculated pressure right away. Start at least 1000 psi less than what you finish the rocket with. And as you press up the spindle, increase the pressure gradually until you reach the calculated number. As you can see, on the first press, you are only pressing on the fuel around the spindle so you aren't pressing on the full diameter of the tube. If you start right at 4'500 pounds of force, the actual loading pressure will be around 11'130 psi. Don't worry about maxing out your Pressure Force Gauge. It can take it.

I also found that using benzoate whistle that is used above the salycilate whistle mix in the LWS rocket, if it is catalized using copper oxichloride, this will also cause a cato. So if making a LWS rocket, use only iron oxide in the mix. Using copper oxichloride makes it burn to hot. When ever I make these rockets, I always use at least 9000 psi loading pressure, and sometimes I accidently bump it up to a lot more. And I've found that more is better than not enough. What I also do with a finished rocket is to place the plastic bag into a ice cream bucket with a good fitting lid for extra protectio

Better screaming

Using a good grade potassium perchlorate for whistle mix is the answer to very loud, screaming rockets. I have used just about every kind of perchlorate there is available and found that the two best potassium perchlorates to use are #1, Swedish potassium perchlorate and #2, Taiwanese. These two potassium perchlorates give the best sound. Also, use copperoxichloride for the catalyst instead of red iron oxide. I know Swedish is not available anymore and have starting using. The longer the core into the fuel that is made, the louder the scream also. There is no need to recess the fuel into the nozzel end. When using a good grade fuel, it will scream damn good without the recess. I suspect the perchlorate you are using is a cheap, chinese grade and you never will get

that stuff to whistle very loud. Make sure you know what type of perchlorate you are buying because it has a most profound effect on the whistling character of the mix.

Flight time

There is only one straight whistle rocket, the Long winded Screemer on that sheet of instructions, and if you don't do it exactly the way it says on the sheet, good luck. Just make sure you use a long fuse on the rocket. There isn't to much latitude on making up that rocket, but when made with properly made fuel, you will be amaized how well it flys. 15-18 second flights will be average before the heading activates and the rocket will still be up a long way.

ENDBURNING ROCKET

Making endburning rockets using hybrid mix # 2

I now use the # 2 hybrid fuel exclusively in my endburn motors. Making Estes motors has been a lifetime passion of mine. I make a special spindle that looks similar to Estes nozzles. It is oil hardened to stand up to the pressures that it takes to press these motors. Also, the first rammer is made from aluminum with an insert of the same material that the spindle is made from. The endburn spindles are not stainless steel. They are made from 4041 alloy steel and will rust in you let them, so keep them oiled when not in use. I use 4140, alloy steel and oil harden each one before I use it. You can't touch it with a file. I don't know what the hardness is, but I do know that it is some where above 60 rockwell.
And I only use New England paper tubes to make these motors because they are the only kind that will work consistantly. The fuel that can be used is straight black powder made to burn as fast as possible. The other fuel that can be used is what I call # 2 hybrid fuel, which is a blend of whistle and black powder. You need costly equipment to make them, meaning a good hydraulic press with capabilities of measuring loading pressure.
Once the rocket has burned off 3/4 of it's fuel, then the speed gets pretty high if you don't have a very heavy heading on it.

HYBRID MIX # 2

60 %	Whistle mix # 2
76	potassium perchlorate
23	sodium salicylate
1	iron(III)-oxid
2.5	vasoline (2.5 bis 3)
	lacquer thinner
40 %	Black powder mix # 1
75	potassium nitratet
15	charcoal, ballmilled
15	charcoal, 40 - 36 mesh
10	sulfur
2.5	soluble gluttinus rich starch, water & alcohol
100 %	total

To increase the power of end burning rockets, add whistle mix (Hybrid #2)

The best way to increase the power of your black powder would be to add whistle mix to it instead of making black powder using potassium perchlorate alone as the oxidiser. For maximum power in an endburn motor with a good tail to boot, I use, what I call my Hybrid #2 fuel. What's nice about using the Hybrid #2 fuel in endburners or the hybrid rocket, you can change the ratio of BP to whistle mix and play with it to get any power you want. It doesn't matter what kind of perchlorate you use with this, because you can vary the strength by varing the two ratios. Change the black powder content to 60 % instead of 40 % and get more tail and less thrust. With this mix, I've won a few trophys at the PGI in my endburn rockets. The fuel burns very fast and the extra course charcoal gives off a nice tail. And the most important thing to do when making these rocket engines is to use a sleeve on the tube and press them to at least 8000 psi or they will just blow apart. I use around 9000-9500 psi. And the next most important thing is to use only New England, virgin kraft tubes. You cannot make an endburn rocket longer than 2-1/2 to 3 inches if using cheap tubes before you get a burn through in the sidewalls of the tube. If you don't have New England tubes, then the whole task becomes real difficult and I wouldn't even try to make them. I found that the burn rate for this fuel is about 1 inch per second or slightly less.

The endburn rocket I won competition

The endburn rocket I won competition with was a 3/16 wall, I inch ID rocket made with New England Papter Tubes (NEPT). It was pressed to 9000 psi. The fuel consisted of 50 % whistle mix mixed to a ratio of 76-23-1-2.5 which is potassium perchlorate, sodium salicylate, copperoxichloride and vasoline respectively. The other 50 % of the fuel was 75-15-15-10-2.5 black powder that was wetted and riced and dried. The ratio was potassium nitrate, ballmilled charcoal, 36-40 mesh chaocoal, sulfur, and soluable glutenous rice starch respectively. The ratio of fuel was measured by volumn, not weight. You can regulate the power of this fuel by varying the black powder percentage in the mix. Only by making the two fuels seperately and then mixing together after dried can you get the charcoal tail that this fuel gives to the rocket. You can regulate the power output of the fuel and it give a nice tail. You could always increase the amount of salicylate in the mix also to slow it down but I never did it this way. It won't be difficult to control the burn rate because all you have to do is add more black powder to the mix, say a 60-40 ratio with the 60 being black powder. I like the power of whistle mix for endburners. They out perform black powder for the obvious reason and don't require the high loading pressures the black powder does.

Endburning rocket made from commercial black powder

I have made endburn motors using straight black powder, using commercial made 3fg and 4fg but the loading pressures to remove all the little grains into a solid mass goes up to about 15,000 psi. I had to use a solid sleeve made from steel in order to do this. I have pressed some of the New England tubes to a loading pressure of 30,000 psi without destroying the tube. Until I polished the inside of the sleeve to a bright, mirror finish, I couldn't even push the tube out of the sleeve after it was finished. By the way, the 30,000 psi loading pressures I did was on a .100 thick walled tube. When there isn't much wall to crush, you don't have these problems with smashing down the tube. Just use small increments as you press.

If I would have used meal powder instead of 3fg, You might be able to reduce the loading pressure by a few thousand psi. If you use black powder only to make your rockets, you will have to wet it and rice it, "push it through a Screen" and dry it. If you don't do this, the powder will burn much slower than "riced powder". After ricing the powder, you have a nice flowable, dustless fuel that is much easier to work with also. Ballmilling the fuel over night would improve the burn rate and get it to burn as fast as possible. I also used willow charcoal but any charcoal will work. I was never satisfied using straight BP to make my endburn rockets though. You get so much more power when you add whistle mix to the BP.

Another way to use your whistle mix in an endburn configuration would be to add ballmilled charcoal to you straight whistle mix. Start out by adding 5 parts to a 100 gram batch of whistle mix. Add the charcoal right along with the other chemicals before you add the vasoline or whatever you using. This is what I call my hybrid #1 mix which I use in a core burn rocket. The added charcoal slows down the fuel just enough to prevent catoing. If the motor catoes, add 10 parts charcoal to each 100 gram batch. Just keep adding charcoal until the rocket stops catoing. Remember to add ballmilled charcoal, the finer the better.

New England Paper Tubes

I disected a New England Paper Tube (NEPT) and found there are 4 layers of paper glued together. Then, these four layers are rolled together to form the tube. I would love to see just how this operation is performed. This must be a trade secret because no other company in the USA makes these kind of tubes. The best wall thickness to use is 1/8 inch walls. I can press a rocket 7 inches long without burn through. And use a good fitting sleeve on all your tubes.

Nozzle diameters for endburn rockets

To give you a heads up on nozzle diameters for endburn rockets, I use for a 1/2" rocket a diameter of .120 thousands. For a 5/8 dia. 0.140, a 3/4" rocket 0.165, a 7/8" dia. rocket 0.180 and the 1" id rocket at 0.220. I just made my first 4 LB. endburn and made it to 0.340 and tested the fuel I use in all the other ones and it seemed to work pretty good. Have the first rammer tapered on the end to

about 80 degress included angle or 40 degrees on a side and the exit part of you nozzel tapered to 30 degrees included angle or 15 degrees on a side. This angle is what Estes uses on the motors they make. If it's good enough for them, it's good enough for me also.

Nozzle Erosion

What you could do to allow for the nozzle erosion as it burns farther up the grain, press a hotter fuel into the motor. I've done this before on the longer motors that I've built. Since the nozzle is slightly enlarged, it could use a faster fuel burn without a cato. Just a thought.

STINGER MISSILE

Making stinger missile using hybrid mix # 2

What I use for fuel in these short spindled rockets is my hybrid #2 fuel. This fuel gives a nice tail and very powerful and less likely to cato then straight whistle mix. Press a clay nozzle. Then use the # 2 hybrid fuel all the way to the top of the spindle and then finish the rocket with anything you want for a bulkhead. With the stinger tool set, you will be able to make a pretty powerful core burning rocket also.

HYBRID MIX # 2

60 %	Whistle mix # 2
76	potassium perchlorate
23	sodium salicylate
1	iron(III)-oxid
2.5	vasoline (2.5 bis 3)
	lacquer thinner
40 %	Black powder mix # 1
75	potassium nitratet
15	charcoal, ballmilled
15	charcoal, 40 - 36 mesh
10	sulfur
2.5	soluble gluttinus rich starch, water & alcohol
100 %	total

The main factor when using a stinger spindle is to make sure the side vent drilled into the side goes through clay before it hits fuel. A special rammer make for the first increment of clay rammed into the rocket should be made first with a longer than normal taper to accomplish this. With the exhaust from the small hole going through clay first, erosion will be minimal.

Several factors determine how well your rocket will perform. First, an increment of fuel pressed into the tube shouldn't be more than 2/3rds. the diameter of the tube. Second, the loading pressure should be around 6500 psi. If they still blow after doing this, add an extra hole to bottom of the rocket, exactly opposite the the first one. If they still blow, add another hole to the bottom of the rocket and space them 120 degrees apart. I use two side vents in each motor and they really buzz on take off. Very impressive little rockets. Start with 3/16 holes on each side and make them smaller until you get a cato. Maybe you won't have to downsize the holes at all. These will be the best sounding hummers you ever heard.

Making stinger missile using whistle mix #2

Also, this spindle would make a very powerful whistle rocket by using straight whistle all the way up. There is no nozzle used in this rocket. It should work with a mix of 76-23-1-3 salycilate or benzoate mix. If it blows, then use a 70-3-1-3 mix instead. They have to be pressed using 9000 psi loading pressure. If using #2 hybrid, don't forget the nozzle.

WHISTLE MIX # 2

76	potassium perchlorate
23	sodium salicylate
1	iron(III)-oxid
2.5	vasoline (2.5 to 3)
	lacquer thinner

STROBE ROCKET

Making strobe rockets

There is no nozzle used in this rocket. Start with 4 increments of whistle mix #2 and then strobe mix #4 to 1/8" above the spindle, then finish with 2 - 3 more increments of whistle mix #2 for a bulk head.

WHISTLE MIX # 2

76	potassium perchlorate
23	sodium salicylate
1	iron(III)-oxid
2.5	vasoline (2.5 to 3)
	lacquer thinner

STROBE MIX # 4

60	ammonium perchlorate
25	magnalium, 50-50, -200 mesh
15	barium sulfate
5	potassium dichromate
	NC lacquer & acetone, about 10% mix of NC lacquer

Just make sure the increments for each press is not more than 3/4" high after you press it into the tube. The only thing that will cause either of these rockets to cato is too much salycilate whistle mix pressed in first.

Preparing strobe mix

What I suggest you do is once you have all the chems to make your strobe mix, start with the smallest batch you can make up and test it first for strobe rate while it's burning. You can make a strobe rocket with any strobe rate that it burns with, but to make a good, keep climbing type of rocket, the strobe rate should be pretty fast. You have to start some where so this is what I suggest, and what I use for my strobe fuel: 60 AP, 25 magnalium, 200 mesh, 15 barium sulfate, 5 potassium dichromate. Wet with NC lacquer dilluted to 10% with acetone. It doesn't matter what % you use, really. Mix it in good and get the mix pretty wet. Then rice it through a gravy strainer or whatever you have available. While it is still wet, pinch a tiny pyramid of comp and set it aside to dry for 15 minutes. What you want is a small pellet that is firm and solid to test. With a lighted match, test how it takes fire and watch it burn and note the strobe pulse. To increase the strobe pulse, you can do this two different ways. Reduce the mesh size of the magnalium or introduce straight magnesium powder into the mix, keeping the metal content as 25 parts. I have found that substituting 1-1/2 parts of magnesium into the mix increases the strobe rate. It will vary according to the mesh size of the magnesium. I suggest using the finest magnesium you have. The 2 micron atomized magnesium works good. I mostly used 400 mesh granular magnesium. If you go the other way and change the mesh size of your magnalium alone, it will take some expermenting. Just change the ratios of the mesh sizes you mix together. If you still have a slow strobe burn rate, then I suggest you use and combine both methods together. By making small batches and testing first, you won't have a whole bunch of almost usless strobe mix laying around. As for the suggestion to substitute the barium sulfate with strontium sulfate, this is what I use to make my red strobe mix with. The formula I use here is a slightly modified Simizu formula: 48 AP----22 atomized magnesium-100-150 mesh----6 parts granular magnesium-400 mesh---19 strontium sulfate----5 P. dichromate. Bind with NC lacquer and rice. I should mention that I use 90 micron AP in both mixes. Any more questions and I'd be happy to ramble on.

NC Solution

I've used 25 % premade NCL and used up over a pound of smokeless powder to make my own NCL. It doesn't matter what the concentration of NCL you use to make strobe mix for rockets. All I

do is mix about 2 tablespoons of smokeless powder in a quart jar with acetone filled to 1/2 inch of the top and let it dissolve for about 3 or 4 days. Shake it up every day until it's dissolved and then use about 2 tablespoons of this mix added to a 6 ounce cup and dilute it within a 1/2 inch of the top with acetone. Stir it up and it's ready to use. This is about enough to moisten a kilo of strobe mix. I get it wet enough before I rice it and spread it out and dry. While I am mixing it in, if it doesn't get wet enough, I add only acetone to the strobe mix. I've done it enough times and never measured it, but I usually get it pretty wet with the acetone wetted NCL. It's like a syrup before I add the acetone to the mix. I think I used about 3 tablespoons of smokeless powder once when I was making up a batch in a quart jar and it was so thick, I poured half into another jar and added acetone to each jar to fill it up. It still was heavy enough before dillution. The smokeless powder I used was a single base powder also. Made sure that's what you use to make your NC lacquer.

Strobe rocket mix - strobe rate

If it still strobes to the ground then your strobe is burning way to slow and probably your whistle mix is way to weak also. If you can't make your strobe mix strobe fast enough then your barium sulfate is the culprate. This chemical is probably the most biggest reason people have problems with they're strobe rockets. Get a different batch of barium sulfate or add the finest granular magnesium you can find at about 2-3 parts per 100 gram batch and leave out the same number of grams of magnalium. You have to have the right strobe rate to the mix or the rocket just doesn't fly high enough. Also, if the whistle mix is fast enough, you lose height also.

Increase the strobe pulses per second

I also found that barium sulfate, when used in the strobe formula that I use for strobe rockets, can be blamed for a slow strobing pulse rate if it is not pure. I have no way of testing barium sulfate for purity because I am not a chemist but have narrowed it down to this chemical as causing all the problems I have encountered with strobe mix. The strobe rate should be just right to make a good strobe rocket but there are ways that I have found to tweek the mix if your barium sulfate is tainted with impurities. I've always wondered where I could get pure barium sulfate to test my suspicion of this chemical being the culprit of crappy strobe mix. And what I mean by crappy is that the strobe rate is very slow when burned. The best way to increase the strobe pulses per second is to substitute a few parts of very fine, granular magnesium in place of the magnalium in the mix. Whenever someone asks me how to make strobe mix, I always tell them to make a tiny batch first to test and see if you have good barium sulfate. Almost always, the mix has to be tweeked to get the right strobe rate before it can be used in a strobe rocket.

Strobe rocket mix - sensitivity of formula

I don't think there is a more sensitive mix than strobe mix. When you test this stuff on a steel anvil or on concrete both in friction and pounding on it, it scares me every time I do the test to show someone how sensitive it is. Yet, I've never had an accident when making strobe rockets. Strobe mix can explode, when two metals come in contact with each other with a small amount of fuel between the metal. It won't happen every time because I've proved that. But I heard of one guy that let his buddy press up a few strobe rockets and one of them blew in the process. What he did was use the solid rammer to soon and pressed down onto the tip of the spindle. The guy got hurt but not to serious. So remember that when you are pressing up rockets, don't let your concentration wander. That's the biggest problem I find when pressing rockets for a few hours at a time. And don't be in a hurry when pressing them either. Your thoughts cannot wonder during this time.

Pressing strobe mix - Danger

Adding titanium to a whistle mix just makes it more sensitive when pressing. I know of one incident where, while pressing a small comet using strobe mix, the operater let the comet sit under pressure for a few moments. He turned away and took a few steps and it went off. Since then, I never let the pressure sit on any kind of mix I'm pressing. I've always told anybody that presses whistle mix, don't let the pressure well on the mix. Release it immediately. Although I never press

whistle rockets with titanium in the core, I do use it in the delay portion of the rocket. In the tens of thousands of whistle rockets that have been pressed in the past without incident, it proves it can happen. I still think the titanium played a big part in your mishap, but we will never really know for sure.

Store strobe rockets

Why did they blow up. That's a good question. Probably the most important factor in making these rockets work in the first place is loading pressure. Second, was the fuel completely dry when they were pressed up ? Third, were they kept dry since they were pressed ? Storing these kind of rockets, ones with whistle mix and strobe fuel for more than a few months, in an environment where the temps are up and down affects the performance of these rockets. If the rockets were stored in a air tight containers, and the fuel wasn't completely dry when pressed, good luck. There are a whole bunch of things to consider if you plan on storing these kind of rockets motors for any length of time. Even if the tubes you were using had be exposed to a lot of humidity before they were pressed can affect a stored rocket motor. It all boils down to moisture. Whistle fuels and strobe mix don't like moisture. If you can keep this out of the picture, then a lot of problems would be solved.
What I suggest you do is press up a few using at least 8500 psi loading pressure and then place them in a double plastic bag with a dessicant bag also, and let them sit for a few months. Just make sure the fuel is absolutely dry. Then test fire one right after you press it to make sure you haven't screwed something else up.

PRESSING ROCKETS

Hose clamps on sleeve

Over the past 16 years, I gotten used to using PVC split sleeves. It takes me around 2 hours to make a sleeve from PVC to fit the 1-1/4" new england tube sold by Jim B. You have to start with 2" PVC and get it down to fit a 1-3/4" tube. I prefer PVC sleeves, because they're just easier to make and still work good, in my opinion.
First, get your sleeve to fit without being completely closed around the tube when the clamps are on and tight. If you didn't have a gap in the sleeve, the tube would be loose in the sleeve, or slightly not tight. Second, just make sure you support the sleeve with as many hose clamps as you can put on it. A lot of people leave to much room between hose clamps, when they press rockets and this leads to problems. Place them as close together as you can get them and right up to the top of the rocket casing. When I'm using a long sleeve to make a rocket, I use a powered screw driver to remove the clamps. The PVC sleeves work on all sizes and is easiest to make.
One thing that's important when removing the spindle from the motor, do this only after it's removed from the sleeve. This allows the motor to relax slightly, and the spindle will come out easier. Otherwise the sleeve has a tighter grip on the internal portion of the motor and after the sleeve is removed, the spindle will be slightly relieved.

BP loading pressure

A rule of thumb that I use for loading pressure is 6500 psi. If you use this pressure on all your rockets, the burn rate of the black powder can be pretty fast. Whatever the ratio you are using right now and your rockets are working good, increase the Nitrate content by 5% increments and stop when your rockets begin to blow up. Then use the last mix you made where they worked. You will be suprized by the increase in performance of you rockets by pressing them instead of pounding them. By the way, my loading pressure that I use on any rocket I make is around 8500 psi.

You need less pressure force for the first increments

The first increment is pressed to a lot more loading pressure that what is calculated for the entire diameter of the rocket tube. And with the increment being on the extreme end of the rocket, it burns up pretty fast and never has really given me any problems.
Just remember when you start pressing the first few increments, don't go up to the calculated pressure right away. Start at least 1000 psi less than what you finish the rocket with. And as you press up the spindle, increase the pressure gradually until you reach the calculated number. As you can see, on the first press, you are only pressing on the fuel around the spindle so you aren't pressing on the full diameter of the tube. If you start right at 4'500 pounds of force, the actual loading pressure will be around 11'130 psi.
Calculate the area of your spindle at the bottom and the top. Notice the difference and then calculate what force change you would have to make to keep the loading pressure the same all the way to the top of the spindle. If your spindle doesn't have much taper to begin with, just keep the force the same all the way and don't worry about it. I use around 9000-10,000 psi on all my rockets I press.

Pressure Force Gauge Converter

It's easy to confuse the two terms of pressure and force. Force is the actual weight that is put upon the rammer, like putting a car on top of the rammer. Pressure is the amount of weight on a given area. All gauges are calibrated in psi. And yes, the pressure force (PF) gauge has a piston inside that is 1 square inch in area. So when a force is applied to it, it reads out in psi and since it's applied to one square inch of area, it also reads out the actual force applied also. In order to calculate loading pressure, you have to know the weight applied to the rammer. The pressure force gauge tells you that right away. Divide the reading by the tube area to get loading pressure. Example: The area of a ¾ inch tube is 0.442 square inches. Divide 2'873 pounds by 0.442 and you get 6'500 psi. Divide 3'757 pounds by 0.442 and you get 8'500 psi. Harold Bentley was the first to use this idea a few years ago.

The tube wall stretches and the paper tears apart from high loading pressure.

I use only New England high quality tubes to make all my rockets motors. If you use a thick wall tube made with a cheaper grade paper, then you really can't use a high loading pressure such as I do. When using a high loading pressure with thick walled tubes, the tube wall can become compressed outward and downward and what happenes then is the tube wall stretches and the paper actually tears apart and the wall becomes very weak. This can happen with the more expensive New England tubes also. Thats why I say 6500 psi should work good. Any pressure higher on a thick walled tube could start to tear the paper fiber and weaken the tube.
On all my endburner rocket motors, I use a thin walled New England tube with only a 1/8 inch wall. These motors are pressed to 9000 psi and still maintain there wall integrity because there isn't so much paper to compress. Of course, the internal pressure isn't present during firing as you would have in a core burner.
The wall thickness on my tubes that I use to make hybrid motors are 3/16 inch but I still press them to 8500 psi. Press up a motor using 8500 on a thick walled tube and then cut it apart and tell me what you found. There will be tear lines going up the tube that will be at least one half or three quarters deep in the wall of the tube. And you wonder why the rocket blows when you fire it. There isn't any tube wall left to support the internal pressue generated. So I suggest using a good grade tube to start with.

Increments

An increment, after it's pressed into the rocket, shouldn't take up more than 2/3rds the diameter of the tube itself. As long as the increment doesn't take up more than 2/3 the diameter of the tube your are pressing, this is just about right. My increments are probably closer than 1/2 the diameter of the tube. Small increments are better that larger ones.

With a ¾" tool set, 7 grams is about maximum for an increment. This is about one scoop, or one slightly rounded teaspoon. And in a 1/2" endburner is about a level 1/2 teaspoon. That's probably around 4 grams.

The old tale of an increment should be equal to the diameter of the tube just won't work on the more powerful, high energy fuels being used today, including black powder. I don't think rockets were pressed, using a hydraulic press when that statement was rule of thumb. A modern day black powder rocket out performs the old black powder rockets that were made by pounding years ago. Buy the way, the black powder rockets I press today are pressed to 8500 psi without any problems.

To large Increments

To large of an increment will cause those rings around the tube. Also that's why the ram is sticking. For some reason, when using the same amount of fuel for an increment, volume wise, black powder will do this. You can hear the creaking or snaping sound as you press on the increment in the higher pressure stage. This is your tube crushing downward and causing those lines in the tube. Just use less of an increment for each press. You may still get some lines in the tube, but don't worry to much about it. I would have also said your sleeve doesn't fit tight either. Use as many clamps on the sleeve as you can get and as close as possible to each other. The reason you didn't get those lines on your old tubes is because the cohesion of the paper in those cheaper tubes gives more easily on the inside of the tube and doesn't extend to the outside, where you can see it. I get those lines on most all of the rockets I make, but some are more visable than others.

Spacers to reduce travel of the hydraulic press

When ever I made a larger rocket using longer tooling, I place spacers under the tooling. I only use 1 inch of travel in my hydraulic press. I just insert or remove spacers under the tooling I'm using. The farther you extend the ram on any kind of hydraulic device, the more wobbly it becomes and introduces an unstable condition. Figure out a way to place spacers under you tooling to raise and lower the height of your pressing needs. I have a bunch on 1/2 inch thick plastic pucks, some thicker, that I machined flat and use those under my tooling. I also have some pieces of steel pipe about 3 and 8 inches long, with a plate on top to set the pucks onto for large distance changes.

When pressing small endburners, I use the 8 inch pipe spacer and a plate on top with a bunch of 1/2 inch spacers on top of that and remove the 1/2'' spacers as I press up the motor. All these spacers have to be perfectly square, including the pipe. I machined them in a lathe to make sure. And last, if your press isn't perfectly square with what you are pressing, with all the spacers in place, it's junk. So just make sure everthing is square and very rigid. If you get any sideways flexing, fix so it doesn't do this.

Misalignment in the press

Any misalignment in the press will bending your spindle. But why: When pressing with a long spindle, you will note as your pressing progresses up the spindle, that your spindle is no longer in the center of the tube when you look down into the tube. That's caused by not pressing evenly. And if the comp isn't perfectly level before you press the increment, this will only amplify the problem as you press up the spindle. Woody had this problem at the convention this year and I showed him how to correct this problem. Take a skinny dowel or a welding rod long enough to reach to the bottom of the increment just dropped into the tube and swirl it around until you level it off before pressing. Do this with each increment until you can visually see each increment that you put in, and note each increment to see if it is level before pressing.

On the bent spindle, make sure the hole in the rammer is clean also. If composition was filling up the hole, then you are pressing against a dead head inside the rammer. It is absolutly imperative not to allow fuel to become built up on the inside of your rammers. This is a problem that can lead to bad consequences. Always look into the rammers before each use and check to see if any fuel is built up inside. This reduces the size of the hole and it will jam on the spindle before it reaches the line scribed on the rammer. At least I hope there is some kind of marker on the rammer to show where this will happen. At least, put a piece of tape on the rammer to show the jam line. After you are finished with each rammer, clean it out before setting it down and going to the next rammer. I use a jackknife to scrape out any build up of comp inside my rammers with a very gentle motion, trying not to scrape any metal out. My rammers last forever. After 10 rockets, I put my rammers in my lathe and polish out the bores with Mother's Mag-Aluminum polish to a bright, shiny finish. This keeps the comp from sticking tight to the rammer for awhile. What you could do is get a small dowel or drill bit and wrap tissue around it and put a dab of polishing cream on it and run it inside the bore to clean it up. Use a hand drill to spin the dowel.

Remove an jammed rammer

I once had to remove a jammed rammer from one of my new customers spindle. What I do is cut off the tube and remove all the fuel from around the spindle. Then I place the base in a vice and try removing the rammer by any means first. If it won't move, I then heat around the rammer with a propane torch to expand the aluminum. After a few seconds of heating, bang! The rammer flew off the spindle and hit me in the hand. That tells me there was comp inside the rammer. I learned my lesson also. I don't know if the rammer was close to the jam line on the rammer or not but there was fuel composition inside the rammer. Don't let this happen to your rammers.
Make sure everthing is removed from the tooling and you just have the bare tooling with the stuck rammer sitting on the spindle. Place the base of the tooling in a vise and tighten is up so it can't move horizontaly. Take a vise grip pliers and snap it onto the rammer near the end of the rammer. Then take a propane torch and heat up around the entire circumference of the rammer with out getting any heat on the spindle for about 6 or seven seconds. Don't stand in front of the rammer, the direction it is going to come off the spindle. You might have a little comp inside the rammer that will ignite when you heat it and it will come off the spindle very quick. After heating it, twist and pull on the vice grip to loosen the grip of the rammer. If it doesn't move at first, heat it some more and give it another try. It should come off after heating it up and expanding the rammer slightly. If it doesn't come off, cool the entire set up in a cold pail of water and try again. You may have to get aggressive on the vice grip this time. This method has worked for me ever time.

ROCKET ENGINE CASINGS

Motor casings soaked in wood hardner

I've soaked some of my 3/4 inch NPT motor casings in wood hardner. It really seems to increase the wall strength of the tube. What I was interested in doing was to make the ends of the tube itself stronger. That way, an epoxy used to glue in the bulk head would hold better. With a paper tube, the only holding strength you have is only as deep as the next layer of paper and glue. By using the wood hardener, and soaking the tube for an hour, the hardener would soak deep into the paper and make it one solid thickness. This is what you need to make a composite motor, one solid chunk of tubing. This would also hold the nozzel intact.

Tube loading pressure test

Don't let wall thickness of a tube gives you a lot of strength to the tube. It does if you are hand ramming a tube but when you begin to press rockets, wall thickness doesn't mean poop. Why do you think Estes model rockets are made from such thin tubes ? The wall thickness on the D engines is only 0.100 thick. These motors are pressed to at least 15'000 psi or maybe more. What happenes to the wall of the tube when subject to that kind of pressure ? It compresses down and outward or gets thinner. What happenes to a thick walled tube if you squeeze it down with 15'000 psi. It does the same thing but more so because the wall is so thick because of all the paper. What happenes then ? The wall actually stretches so much outward and downward, the paper tears itself and leaves you with a breeched tube. You can't see it from the outside but if you cut open the tube, you will find tears along the walls going up the tube. Now the wall is only 1/16 inch thick that isn't broken. What's left is a 1/4 inch walled tube with probably a wall thickness of 3/16 left and it's split more than half way through. If you don't believe me, I have proof of this. Even a good NEPT will do this if too much loading pressure is used. These two operations of making rockets by pressing or pounding will vary the result, depending on the condition or type of tube you are using. You can only make an endburner from NEPT tubes more than 5'' long before it burns through the side wall of the tube. I know some guys make them longer for drivers on wheels and girandolas, but they wouldn't fly by themselves and go 4000 ft. high. I'm talking about high power rockets that use a fast burning fuel and that need at least 8000 psi loading pressure. And the whole idea here is pressing the motors using thick walled tubes and using high loading pressures. It just can't be done using a cheaper, thick walled tube.

A good, strong, hard wound tube with a thin wall is better than a thick walled, softer wound tube

A good, strong, hard wound tube with a thin wall is better than a thick walled, softer wound tube for making rockets or any other kind of device that requires pounding or pressing of the composition into it. The simple reason for this is because of the wall thickness of a tube will determine how much it will distort during the pounding or compressing that you give it. It also depends on the type of paper the tube is made from. I've seen some pretty good tubes made from a good grade kraft paper and some tubes made from a thick paper board with thick walls that weren't worth for making rockets. And since I believe in using extreme forces to press rockets, the wall thickness is very important in determining the strength of the finished product. What really determines the quality of a rocket is what type of tube you make if from. That's why I use New England paper tubes made with virgin kraft with walls no thicker than 3/16 inches. The end burn rockets I make have a 1/8'' thick wall and the heavyer tubes have a 3/16'' wall. If the wall thickness is greater than 3/16'', the paper will compress and stretch more than a thinner tube because there is just more there to do so. Because of this, each type tube has a certain amount of pressure that can be applied to it before this becomes detramental to the strength of the tube. Once this pressure becomes enough to start stretching and tearing the fibers of the tube, then the strength of the tube is lost. Imagine a tube inside a sleeve, being pressed with a composition. If the tube has a thick wall, at a certain pressure, the paper starts to compress downward and outward. And what happenes at this point, the tube starts to tear the paper fibers and the strength is lost. Take the same tube made with the same paper with only 1/2 the wall thickness. Using the same pressure

exerted on the tube, there is less volume of paper to be compressed or to give when pressed. The affect on the walls of the tube is not as severe as it was with the thicker walled tube. The damage to the tube walls is less. Every tube has a certain amount of pressure that can be exerted to it before this damage occurs. And this damage will occur sooner to a thick wall tube than a thin wall tube. I do use rocket tubes other than New England tubes but for purposes where the strength is not so important. I've made some pretty impressive long winded screamer rockets using a thin walled, and cheap tube in my opinion from Impulse Reactions. I also made a hybrid rocket using a thin walled, grey type of paper tube and it worked very good. If I would attempt to make the hybrid rocket with a thick walled tube of the same paper quality, I don't think it would work. I now have New England tube in every size up to 1-1/4 inch and as small as 1/2'' diameter. I'm sold on these tubes and use them exclusively.

A thick walled tube isn't required when using the New England tube

A thick walled tube isn't required when using the New England tube. The 3/4 inch version tube offered by Jim B. at only 1/8 inch wall will work for an endburner made to 7'' long without burn through. I also have 7/8'' tubes in 1/8 wall thickness that I have made 7-1/2 inch long endburners and no burn through. I press these in a solid sleeve and use 6860 lbs. of force or 11,433 psi. and they still don't burn through. I would say you could have a wall thickness of 3/16 using the 6 lb. rocket tube and make this work without any burn through. The percieved thought that thicker is better but that is simply not the case. The thicker the wall, the more paper there is to give under high pressure. And this is where the destruction begins in a rocket tube. Using a thick walled tube, especially one of those cheaper tubes, the more you compress, the more it stretches and tears the fibers of the wall and the weaker it becomes. I have over pressed the 3/16 walled tube also. I simply used to much loading pressure on the rocket and for some reason I cut it open and found fractures running up and down the tube that were about 1-1/2 inches long and went half way through the wall thickness but could not be seen on the outside. One of the most important items to prevent the tube from expanding while pressing is to use an extremely close fitting, unforgiving sleeve that won't give under compression. If using a plastic sleeve, this has compressability or give to the walls. Since this is the easiest material to use, I use it. But with my solid sleeves, they are made from solid steel and don't give one bit. I hope you see the concept. Rich Wolter makes sleeves out of aluminum that close onto the tube being pressed. These work probably the best of all of any sleeve I've seen. There is no way the outside of the tube can expand beyond the OD. of the tube as it's being pressed. Of course, the OD. expands once you take it out of the sleeve. This is understandable. The tube bulges slightly more than the original dimensions, but not while it's inside the sleeve. Once I press out the finished rocket from one of my solid sleeves, there is no way I could get it back inside the sleeve. I have this theory, which I call the relaxation theory. Once this tube is taken out of the sleeve, you can fire the rocket and it will work perfect. Let this rocket sit for 24 hours and fire it, it will explode. Why ? First, the tube hasn't relaxed to nutralize the pressures exerted onto it. During this period of relaxation, the grains must crack and change internally and this is what causes it to explode 24 hours later after it's made. Also, if this rocket was pressed with fuel that puts it on the red line in the first place, the event of catoing will happen also. Firing this rocket right after it's made, these events haven't had time to present itself. I once made 3 rockets and fired them right after I made then and they all worked perfect. So, I made up ten more to bring to a shoot a week later. Every one blew up on launch. Another possibility is the fibers in the tube are slowly opening up and tearing open at a very slow rate. The tube finally stops this self destruction after a few hours but by this time, it's to far gone to work any more and it will cato. So using to much pressure to press your rockets can do damage also, especially with thick walled tubes. So, this is my theory.

OTHERS

N.C. laquer

For the past 16 years I've been using mostly homemade NC laquer made from single base smokeless powder and used it in many of my different mixes. I experimented and used it to bind a lot of different mixes that I use in my rockets. I even used it to bind black powder and thought it would give more power output just because it was in the fuel. Can't really say it did what I expected. I use it to bind the intensely bright red formula used for the red tailed rockets. And I first used it to bind strobe mix. To use double based smokeless powder could be dangerous. I guess there hasn't been much experimenting with double based smokeless powder. I find that using NC lacquer to bind a lot of different mixes is a lot faster then using water and alcohol for drying purposes and most all these mixes I use are for delay trains in my rockets for colored tails.

Mineral Oil in BP Rockets will reduce the thrust sinificantly

To be honest, I have never added oil to black powder to slow it down. Why? There is an easier way to slow the burn rate of black powder without adding anything else to the powder. Just use unballmilled fuel or change the ratio of ingredients. For every 1% oil you add to the fuel, you reduce the amount of thrust about 12%. How do I know this? Our Friend Nicolas Guerin ran a thrust test on end burn motors and added from 1 to 4% minerial oil to ballmilled black powder. On each rocket engine tested, the thrust was reduced by approximately 12% on each engine as the oil was increased. If this happens with endburn motors, the same will happen with core burners. So to slow the fuel down, try unballmilled fuel first. If they still blow, just change the fuel ratio until you get one that works. By ricing the fuel with water and alcohol, and drying, this will hold down the dust problem.

Make Charcoal From Shavings to Eliminate the Grinding Step

When making charcoal, use any wood that's been sawed up or shavings because this will eliminate the grinding step involved. If using cut up pieces or chunks of wood to make charcoal, then the next step is to grind it up into a finer mix, then into the ballmill or whatever. If using sawdust to start with, you eliminate this step altogether.

Balsa wood to make Rocket Sticks

Balsa wood logs makes good charcoal and excellent rocket sticks, nice and light and straight. I made 5/16 inch sticks 36 inches long out of a small piece after it was dry and got about 80 perfect sticks out of it.

Sticks for Rockets

Length and thickness of rockets sticks:

1/2" I.D.	20" x 1/4"
3/4" I.D.	32" x 5/16"
1" I.D.	38" x 3/8"
1-1/4" I.D.	60" x 1/2"

As for sticks, I never balance mine. For 1/2 inch rockets, I never use any sticks longer than 30 inches. On my 3 lb. rockets with a 6 inch ball shell on top, my stick is about 5/8 inch square and 4 feet long and never had a problem yet. PS: You may get different numbers from somebody else. If the numbers call for longer sticks, don't beleive them. Why waste lumber.
I have found the best wood to make sticks from is nice, straight grained cedar. Use only soft wood like pine or spruce or cedar is my favorite, with “NO” knots in the wood. Any kind of softwood will work. The lighter the wood, the better. You don't need a heavy wood to make sticks, as long as it doesn't have any knots. Make sure you don't have any knots. That is a weak spot. Check each

stick you've made and bend it slightly in all directions and check for a weak spot. If there is one, it will break. Better to break in your hand that in the air 50 feet up.

End burn motors definately need a longer stick. Why, I don't know but I make them longer than the ones I make for a regular rocket.

Fins for rockets

Just trying to build rocket motors that work was my intention 40 years ago. I started out in model rocktry. Since then, I've kind of evolved towards pyro rockets but have mastered the model rocket engine. Just to see them fly, I put a stick on them and let them fly. When you talk of stability in flight, it amazes me the different paths that a rocket takes in it's upward journey. Out of maybe 10 rockets, maybe only two or three will fly straight and true. I know the rockets would fly much straighter and more stable, when you put fins on the rocket. I have done this in the past, just to see how they would fly. It really does improve the flight of the rocket. I make my own engines to lift my model rockets, similar to the Estes motors that you can buy. The rocket always flys as straight as an arrow. It would be really nice to have every rocket fly that true with a stick attached to it. No more worries about where it's going to go. That ain't no fun either.

Fusing rockets

I fuse all my rockets right at the very beginning of the fuel train. With a rocket with a nozzle, just up inside past the clay nozzel. If you can fuse your rockets farther up into the core and they don't blow up, all this means is the fuel you are using is kind of weak or the spindle is pretty short. The longer the spindle, the more power the rocket will have until you get to the maximum length that the core can be made and then you start to cato.

I'm very specific on where to fuse all my rockets on the videos on my rockets and it's good to question this step. Since all these rockets are on the verge or I've heard some one say on the red line, it's very important to insert the primed fuse into the rockets that have nozzles, black powder and the hybrid motor just far enough to touch the powder beyond the clay. Then insert a piece of tissue balled up and press it into the nozzel hole far up enough to hold the fuse tight against the powder train. For the LWS and the strobe rocket, the primed fuse is taped to the stick as close to the bottom of the rocket as you can get with the prime blob just touching the fuel grain. That's all there is to it. One more thing, when using chinese fuse, the kind that burns completly away, wrap two layers of masking tape around the fuse first. Otherwise, as soon as the fuse burns past the tape that is holding it onto the stick, it will fall away and fail to light the rocket. Not every time , but this will happen just when you have five guys waiting to use the launch tube you are using. After you have the tape on the fuse, then tape it on the same as you would the American visco which this doesn't happen using this kind of fuse. The prime I use is to dip it into nc lacquer and then some fine black powder like ground up lift powder or even whistle mix, but I always use 3fg slightly ground up. Meal would work great.

Launching rockets

For a launch tube, use a 1 inch diameter piece of pvc pipe and take a steel rod about a foot long and sharpen it on one end and duct tape this on one end of the pvc tube very firmly. Jab the point of the steel rod into the ground to set your launch tube. Drop the stick into the tube and let the fuse hang out over the edge of the pipe. Launch. Don't launch anymore rockets from a leaning saw horse. Also, you angle of launch was too much on the rocket in you demo. I seldom ever worry about about the wind. A good flying rocket will go rigth through a good wind.
Now take some gummed tape and roll a tube over a sample of your rocket tube. Use this tube to make a heading tube and put some silver powder in it and, if you had some of my special endcaps, glue one into the top of the heading tube first, then insert the banger fuel, put a little glue around the heading tube on the inside, and slide it over the finished rocket motor. Put your stick on and fuse the rocket and you are ready to go.

Delay fuse

For the delayed fuse, get a piece of cotton rope about 3/8" diameter, the kind that is used for sashing and pull out the inner nylon section used to reinforce the rope. Make the piece about 3 inches long and then after the nylon is removed, slide the hollowed out end over the visco and pull it tight to snug up the rope. You should have about 2-1/2 inches hanging from the visco. Fluff up the rope and light it with a cigarette or cigar lighter that doesn't have much light. You probably have at least 15 minutes before the visco lights and you can be sitting on your porch watching in saftey.

Staged rockets

I've only made 2 stage rockets and they go so high, you loose site of them, except at night. The biggest concern when making these rockets is the delay between each stage. The delay in a rocket is the portion of fuel that's left burning in the rocket after it stops producing thrust. In order to keep the first stage from blowing through, a bulkhead has to be pressed into the rocket thick enough to prevent this. And since the delay has to be short enough before the rocket starts to lean over before it lights the upper stage, a clay plug has to be pressed into the motor to prevent blow through. This clay plug has to have a passfire hole through which to transfer fire to the next stage. This is where it can become tricky. From this passfire hole, you could put a loose layer of grainy black powder or a piece of black match leading up into the next stage. If your upper stage rocket uses a pretty strong fuel, you may get a cato at this point. If not, the fire will transfer to the next stage. I only taped the stages together. And the staging rockets I made were using endburn motors, not core burners. On an end burner motor, you don't even need a delay and fire tranfer is easy because you don't even need a clay choke. To get more info on the staging of these motors, I'd talk to the guys that did the three stage motors at the convention this year. I saw these rockets and was quite impressed with they're performance. I wondered how they didn't blow from stage to stage myself. They had to use a weaker fuel that what I use in my rockets.

What I do to attach a booster to another rocket is roll a tube right over the upper stage rocket motor, using gummed tape. This tube is cut down to about 2 inches long and glued onto the lower portion of the upper stage rocket and extends 1 inch below the bottom of the rocket motor. Then, slide the booster inside the protruding 1 inch that extends below the upper stage. The fit is slightly adjusted, using masking tape on the booster engine so it fits slightly firm. When you fasten the stick onto the arrangement, tape only the upper stage to the stick and leave the booster hang. As soon as the booster is finished burning, it will blow off the stick. There is some tuning of the booster rocket motor though that you will have to so you don't have a long delay between stages. You want a very short delay between the stages so what you have to do to the booster stage is use only about enough delay above the spindle to to get the delay you need. And here is where the tuning comes into play. A very short delay increment above the spindle will not prevent the rocket from blowing through the top of the booster stage. So what you have to do is press enought fuel above the spindle, then add a clay plug to get the extra holding strength that is required to prevent blow through. Then you have to drill a passfire hole through the plug to get the next stage going. What I do then is firmly press into the passfire hole a little whistle mix to transfer the fire to the upper stage. I haven't made a whole lot of staged rockets but I'm sure Dan T. could give you his version of staging. I kind of interested myself how the staging of whistle motors works that I've seen fly at a few shoots I've been to. Because I make my motors on the "Red Line" most of the time, a blast of fire going into the next stage would usually result in a cato of the upper stage. So I'm interested in other methods also. I've mostly staged only endburn motors, and here I glue in a short, fast burning fuse that I scavaged from a festival ball shell, cut it about 3/8 inch long, and drop in a blob of NC lacquer into the nozzle end of the upper stage motor, then insert the fuse, and prime it with some meal pwd. In an endburn motor, you don't need to press in any delay at all in the booster engine. So as soon as the booster burns out, fire is right there to ignite the fuse going into the upper stage. There is a slight delay but so short, you can't even see it happen because the rocket is pretty high already. We can all wait until we hear from Dan and see what he does.

Nozzle

For nozzel material, you should have bought a supply of the cheapest cat litter you can find. The fine granual type is what I use. Then, smash up some flower pots, the reddish collered type and

screen it through a window mesh size screen and use whatever falls through the screen. I mix this about 50-50 together and use this without any other additives to make my nozzels. Some times I add powdered graphite to the mix also. This allows somewhat less friction between the granuales when pressing. About a 15-20 to one amount. You can buy catlitter at about 100 times cheaper than bentonite clay from any supplier and that's what cat litter is, bentonite clay. Just don't buy the kind that has any perfumed mix added to it or all those little blue crystals.
When using graphite in the clay nozzel material, it acts like a lubricant and allows the clay-grog mix to consolidate to a tight, compact nozzel easier than if it wasn't used in the first place. Use it in place of oil or wax that's usually added to the clay. I never add oil or wax to my clay. I did find out that removing the first rammer used to press in the clay nozzel into a rocket came out easier if graphite was present in the clay.
I have run some simple tests using the type of clay I press into some of my rockets where graphite is present in the mix and clay without it. By using around 3-4% graphite in the clay, the mixture presses tighter and to a more compact plug than without the graphite. The same occurs with whistle mix or any other type of fuel you compact into a casing whether pounding or pressing when vasoling is added.

To light payload

If one launches a fast, high speed rocket without a heading to slow it down somewhat, it reaches a speed that causes it to become very unstable because of the aerodynamics of the rocket. Something isn't just right on the rocket and causes it to whip and go goofy and this is what breaks off the stick also. This was a big concern at our shoots in the past where our rockets were going in the opposite direction. The problem was happening with all long winded screamer, strobe and hybrid rockets using a light payload, except with the black powder version rocket. It would only happen if a light payload was used on the rocket, because with a light payload, the rockets would shoot off the launch pad like a bullet and reach a speed that would affect the rocket. If a heavyer payload is used on the rocket, this critical speed can not be achieved to cause this unbalanced flight characteristic. Every rocket will have a different speed before this imbalance is reached. After making many of these rockets myself, I know just about how heavy the payload should be to prevent this eradic flight. Only when the rocket is made where the stick is in the slip stream of air that can hit it, this will become a problem. A wide and big heading placed on a rocket usually covers up the stick hanging out on one side anyway, so this won't affect the flight.
If you hold a rocket, with the stick pointing away from you and you sight down the rocket, what you see is what the air acts against while it is in flight. What you see is the top of the rocket with the square of the stick on one side. During flight, air acting on the area from the stick cause a breaking action on one side of the rocket and in turn, the rocket would fly in that direction, if the air drag becomes to great. The speed of the rocket determines how much this angle backwards will be and the size of the cross section area of the flight stick. And it usually is opposite the direction in which the rocket is pointed.
So to balance out the drag caused by the main flight stick, add a second stick with the same corss sectional area 180 degrees opposite the flight stick. This second stick only has to be 3 inches long with the same cross section area as the longer main flight stick. This extra stick placed opposite the main flight stick is just there to balance out the drag caused by the main flight stick. This is the method I have come up with to stabilize the light-headed, fast take off rocket by using the extra stick. So if you make a super, fast take off rocket, put enough weight on the rocket heading or use the extra stick on the lighter rockets.
I know this subject hasn't been discussed before but the problem never came up until the speed of these rockets became so great. We had this problem last year at our club shoots and it was my duty to find out why our rockets were not going where they were suppose to go. And this is the solution to the problem so far, putting the extra stick on the rocket. It's a new problem but then we have rockets like they never had 20 years ago either.
Any knots in a rocket stick will cause the rocket to fly as you described. Don't use lumber to make your sticks if there are any knots present. I suggest you get some clear cedar and cut your sticks from that.

4" and 5" shell making

I don't make many shells but my 4'' and 6'' shells break with great precision. I don't even glue the joints. What I use for break is H-3 on rice hulls to a ratio of about 10 to 1, using ballmilled willow charcoal. Then I place about 1 rounded teaspoon of benzoate whistle in each half near the center of each hemi before I close it up. Then I spike it in using 1'' wide strapping tape, with one complete layer around the entire shell. I start with a stripe from the fuse to just beyond the bottom portion of the shell. Once I have on 8 verticle strips, I put 1-1/4 layer around the joint horizontially. Then I fill in the gaps vertically. This is for a 6 inch shell. Most of my shells are lauched on top of a rocket but I have fired probably 15 shells from mortors and never had a failier. The only difference between each shell is how they are fused. For the rocket launch, I just use a hand rolled tube going into the center of the shell with black match up the the center and with the mortor launch shell, I use Jap time fuse. It would be difficult to see any difference between my shells and a comercially built paper shell. It took a while to tweak the break of these shells but this is how I make them. For a little harder break, add slightly more whistle to each half. With the 4 inch shell, I use the same spiking technique with slightly less whistle mix.
It may seem like I am using way too much H-3 but I weighed out the amount one time and used a 8-1 ratio and coated the rice hulls and found that the break was slightly weak. Having never weighed out the amount before, I assume this 10-1 ratio is what I was using, because the rice hulls didn't look as dark when I used the weighed out proportion. And the weighed out proportion was rolled onto the rice hulls where the H-3 that had the better breaks was made using the method of mixing wet hulls with the H-3 throwen into a plastic bowl with a cover and shaken up until I couldn't see any rice hulls anymore. The next batch I make will be weighed out and rolled onto rice hulls using a 10-1 ratio to see if this isn't closer to what I had before I weighed out the mix.