



Technique...

Page 1



## Making Black Match

### Introduction:

Many methods of making black match have been published over the years, and most of them work with varying degrees of success. I have tried many methods myself, from things as simple as soaking single strands of cotton string in a dish of slurry and hanging them from nails to dry, or as complex as automated match looms that individually coat multiple strands of string and twist them together as they are fed onto a rotating frame. While the idea of an automated machine that churns out black match unattended is always an appealing goal to the mechanically inclined pyro, I have come to realize that simple methods can be used to create a years supply of high quality match in only a few hours worth of work. Thus, it does not make sense for the hobbyist to expend any time on an elaborate device that consumes valuable shop space to do a task that only costs two hours of time per year!

The problem with most match machine designs, which usually pull strands of cotton string through a bucket of meal powder slurry, is that the slurry does not penetrate to the core of the string. This results in match that does not handle bends very well, and tends to lose its rigidity once bent. This is because the outer coating of powder cracks off and leaves just the exposed inner string. While such flaws are more tolerant in piped match, it will likely cause ignition failure in a non-piped application such as fusing drivers, rockets or inserts. The way to determine the quality of a piece of black match is to cut it in half and examine the cross section. If the cross section is white, then the match is really only suited for piped match. If it is black all the way through and does not become floppy when bent, then you know you have some high quality match that will not likely fail.

The method of making "hand made" match shown here was given to me by a commercial manufacturer who makes all his match this way. It is a very simple method, requiring a minimal amount of tooling, yet is still fast and produces the highest quality match I have seen.



Figure 1: 8 strand cotton string.

### Materials:

The most important thing you need for making good quality match is the right string for the job. High quality match typically incorporates multiple strands of a thin cotton twine into one strand of finished match. The individual strands can not be very thick since you will be using between 4 and 12 of them. Thin cross match typically uses 4 strands, while match that will be piped for shell leaders will use between 8 and 12 strands.

While 100% cotton is said to be the ideal string to use for making match, I have also had good results using the mercerized cotton thread found in art supply stores for use in crochet. The thin cotton thread used in the black match industry has the tendency to break very easily when manipulated as single strands, which makes it frustrating to work with. The crochet thread is very thin yet strong enough to handle the tension placed on it while making match by hand.

The best string to use for the particular method of match making shown here comes already grouped in the number of strands that you wish to use. This string comes in large rolls made from flat bands of parallel strands, as shown in Figure 1. This eliminates the need to buy many separate rolls of thread to



Figure 2: Meal powder and pan of boiling water.

get the number of strands you desire.

The only other material you need for making match is a tub of meal powder with 5% dextrin added. It is highly recommended that the meal powder used be ball milled to a very fine consistency. Using only screened "green mix" can result in slow match that bubbles molten slag as it burns. About 3.5 lbs of meal (1.6 Kg) will make about 400 feet of match. Unlike methods that involve pulling the string through a slurry bucket, this hand method is very efficient with the use of meal slurry, resulting in very little waste.

[More...](#)



## Making Black Match...

Page 2



Figure 3: Winding desired length into a circular bundle.



Figure 4: Bundle is removed and both ends are tied around the bundle.



Figure 5: A third knotted loop helps secure the bundle.

### Procedure:

First you must prepare all the string you will be using to make the match into a circular bundle. This requires you to know about how much match your frame will hold, and also have a way of measuring out the proper amount of string when you make the bundle.

The device I use for rolling up the string, shown in Figure 3, utilizes a piece of wood mounted on top of a "lazy susan" type roller bearing. Four aluminum rods are press fitted into holes on top of the rotating platform, such that at least one of the rods may be easily removed. The string is tied to the removable rod, then a pre determined number of revolutions is made in order to measure out the string. Making the rods 12 inches on center can make the measuring calculations easier, since one turn will then give you roughly four feet.

If you are using separate rolls of string to get the desired number of strands, you will need to gather the ends together and wind them together as one thick band. If your string is on round rolls, it is easiest just to drop them loosely into a bucket on the floor while spooling from them. String cones are best placed on the floor such that you are spooling the string off them from above. Cylindrical rolls of string will have to be placed on rod fixtures that allow the rolls to spin freely as you take string from them.

Once the proper amount of string is transferred to your winding jig, remove the loose pin and tie the starting end of string that was tied around the rod into a loose fitting band around the string bundle, as shown in Figure 4. This band should be loose enough that you can fit your fingers under it without much effort.

Now the string is removed from the winding jig and the remaining loose end is also tied around the bundle as before. Tie a knot in the end of this string so that it will be marked as the end of the roll, which will be the end that gets tied to the frame when you transfer this string onto the match frame.

An optional third band may be tied around the string bundle at this point, as shown in Figure 5. The purpose of the two or three string bands is to prevent the bundle from becoming hopelessly entangled during the meal saturation process. As long as these bands are in place to insure that the strands of the bundle do not cross over on themselves, then entanglement will be prevented.

When preparing the meal slurry, the use of boiling water helps incorporate the already milled ingredients to a still finer level of contact. If you are not using ball milled powder, then the use of boiling water is definitely recommended.

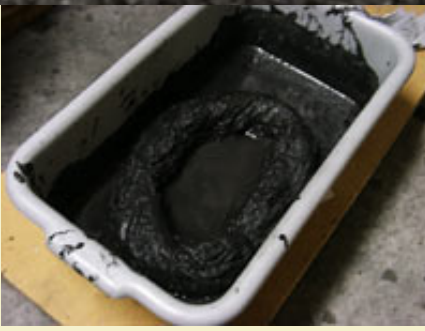


Figure 6: Soaking the string in the meal slurry.

The water should be slowly added to the powder and incorporated with a spatula until a muddy consistency is obtained. This is perhaps the trickiest part of the process, since too much water will result in less powder on the finished match, while too little water will make it difficult to work the slurry into the string. One test for an overly wet batch is to rock the bucket and create a wave that bounces off one side. If the wave bounces off the side and travels back across the full length of the slurry, then it is too wet. The slurry should be thin enough that it runs off your spatula easily, but thick enough to deaden the propagation of any waves created in the slurry.

[More...](#)





## Making Black Match...

Page 3



Figure 7: Saturated string placed over a core to prevent entanglement.



Figure 8: Sizing die used to control diameter of finished match.



Figure 9: Roller board used to keep the string bucket aligned with the frame.

The bundle of string is now placed into the slurry bucket and worked with both hands. This is also a critical step of the process and, if not done correctly, could result in white spots of uncoated string when wound onto the frame. Spread the strands of the bundle apart and scoop the slurry into the inner parts of the bundle. Special attention must be given to the areas under the tie bands, since that part of the bundle can not be spread open.

Continue to work the slurry into the string for several minutes or more. The longer you knead the powder into the core of the strings, the better the match will be. Pick the hoop up and crush it down on its edges while rotating it. Continue this process until no more white string can be found when prying into the inner layers of the bundle.

The saturated string is now removed and placed over a tapered core such as a small bucket or an orange road construction cone. This tapered center piece will allow the string to be unwound without crossing over and getting entangled. It is my experience that once you have an entanglement at this stage, you will most likely not be able to straighten it out and will have to discard the whole mess and start over. As long as there is a central core that the string can not slip under, then entanglement will not occur.

The string and core should be placed in a container to reduce the mess it will create when unwinding the string, as shown in Figure 7. At this point it is safe to cut the three retainer bands that secure the bundle. Locate the knotted string that marks the ending point of your coil and unravel a few feet off the coil so that it will be ready to tie off to the frame.

Before going onto the match frame, the match must pass through a sizing die to shave off any clumps of slurry that would result in irregularities on the surface of the match. A simple sizing die can be made with a length of brass tube and an aluminum plug that fits in one end, as seen in Figure 8. The aluminum plug contains the size hole that is desired, which is 3/16" for the 8 strand match being made in this example. A threaded hole in the side of the die allows different dies to be inserted into the tube and held in place with a set screw. The brass tube should be about five or six inches long so that it can easily be held in one hand as the match passes through it.

Another tool that makes the process easier is the roller board shown in Figure 9. The bucket of wound match sits on this board as it is being wound onto the frame. The wheels under the board, which are fixed position casters, allow the match bucket to easily slide side to side when winding the match onto the frame. One foot can then be used to keep the bucket in line with the frame as the match works its way across the frame width.

[More...](#)





## Making Black Match...

Page 4



Figure 10: Fuse runs through die and onto frame.

The end of the match is first passed through the sizing die, then tied off to one corner of the [match making frame](#), as seen in Figure 10. One hand is used to hold the sizing die and guide the match onto the frame, while the other hand slowly rotates the frame (see Figure 10). Try to keep enough tension on the match to keep it from shifting out of place as the frame rotates. The match should be spaced onto the frame with at least a half inch between parallel strands in order to avoid strands from contacting each other and sticking together.

The match bucket should be positioned close enough to the frame so that any slurry that drops out of the sizing die will land in the bucket. The sliding platform previously mentioned helps the operator keep the bucket under the sizing die during the whole process.



Figure 11: Match frame fully loaded.

Once the match frame is fully loaded, a C-clamp can be used to hold it upright and keep it from spinning. The match is allowed to dry on the frame for several days before removing it. Snip a small piece from the end and check the core for dryness before removing all the match from the frame.

Be sure to examine and test your match for integrity before putting it into use. There should be no large crystals of nitrate visible, no white string exposed and the match should not bend easily. Ideally there should be a thick enough coating of powder on the string so that the individual strands of string are not easily noticeable.

The match can be tested by selecting a sample from the thinnest looking strand in the batch and running it all the way through a hole drilled in a thick piece of wood. The match should take fire easily and maintain a consistent burn rate through the hole and out the other side.

Burn rate should also be tested by igniting one foot long pieces of match in open air. If the match sputters along, occasionally stops and then restarts, then the coating of powder on the string is not thick enough. The most common mistakes when learning to make match is to use a slurry that is too thin or failing to work the powder into the core of the string.



Figure 12: Finished match, bundled and ready for storage.

Once the match is completely dry and tested, remove it from the frame by first cutting all the ends at the bottom with an anvil cutter. Then the match is cut from the top while using one hand to prevent them from dropping to the floor. Try to avoid bending the match at this point. It is best to remove small handfuls of match at a time and lay them out flat on a long table.

Once all the match is removed from the frame, it is bundled together using bands made from strips of paper. This will keep all the pieces in a secure bundle, making it possible to move the bundle without bending any match. The bundle should not be so tight that individual sticks of match can not be

slid out for use. Many hobbyists store their finished match in long tubes of paper or PVC with removable caps at both ends. 🔥

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