Non-Standard Three-Inch Cylinder Shell Construction with Rising Whistle

by Jim Biersach

My first pyro project was the construction of three inch cylinder shells. Richard Bland taught me the basics of this method, and over the years it has evolved. I have used this technique at PGI conventions and done well in competition. I have taught it as a class at WPAG shoots and have had great success. If you are a traditional Italian shell aficionado, please move on. This is not for you. If you are ready, let's begin.

The first thing to do is to roll the paper casing that will form the body of the shell. You can use 60 or 70 pound kraft paper if you have it. If not, a paper grocery bag will work quite well. Cut a piece 18 inches long, by 8 to 10 inches wide. Whoa! Now we need a case former. Oh, you have one in the refrigerator. Get a 12 ounce beverage can that is not opened. Mix up some Elmer's glue and water in a 50/50 ratio. Roll the can with one wrap of paper, apply glue to the remaining paper, and roll it up. Brush the outside of the paper with some of the glue mix, and slide the can out, and let the paper cylinder you just rolled dry. See photos 1-3 for this sequence.

Now we need to make the rising whistle that also serves as a time fuse. I use a three inch piece of 1/2 inch inside diameter rocket tube. The tubes are available at Hobby Horse*. You will also need 2 1/2 inch end disks with an 11/16 hole in them. They are available from Wolter Pyro Tools†.

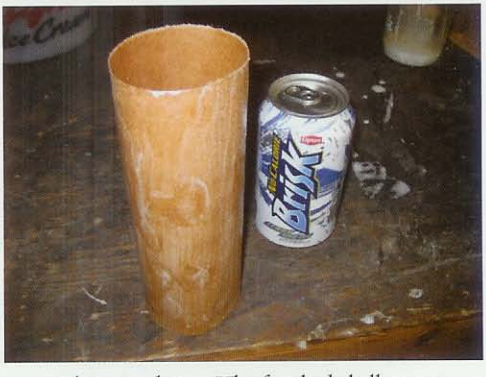
I use a 70/30/1 Benzoate-based whistle mix for this application:

Potassium perchlorate	70%
Sodium benzoate	30%
Red iron oxide or copper oxychloride	+1%

*www.hobbyhorse.com (800-604-6229)
†www.wolterpyrotools.com (608-297-9402)

Photograph 1 – The case former and paper for the shell case.

Photograph 2 – Rolling the case.



Photograph 3 – The finished shell case.

I press§ one inch of whistle mix into the tube so that there is 1/4 inch of empty tube on the end that will go on the inside of the shell and a 1 3/4 inch space that will be on the out-

§ Note – whistle compositions should be made with a press using adequate safety precautions, shields, etc. and not hand rammed with a mallet.

side of the shell (see picture 4 for the tools to do this). This is what takes the fire, and produces the whistle. I have found that a one inch column of my whistle mix gives me a three second burn. This is what I want for a three inch shell. Test your whistle to make sure you get a three second burn time. Hey, it's fun to test!

On the end of the whistle that will go in the inside of the shell, glue two turns of 20 or 30 pound kraft so that it extends out two inches past the end of the tube. This is called a nosing. When this dries, insert a three or four inch piece of black match, and then tie the paper nosing around the match with a clove hitch. Now put the nosed whistle assembly halfway through one of the end disks, and glue it on both sides with some hot melt glue. Your now have a completed fused end disk. See Photographs 4 – 6 for this sequence.

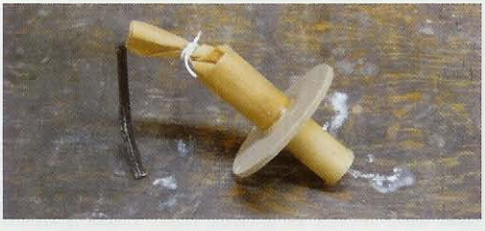
Now we need a work jig to facilitate attaching the fused end disk to the paper cylinder we rolled. I use a piece of PVC pipe, but anything that holds the paper cylinder and allows the attachment of the fused end disk can be used. Slide the paper cylinder on the assembly jig and insert the fused end disk so that the black match is on the inside of the cylinder. Position the end disk in about $^1/_2$ inch from the end of the cylinder and smear straight Elmer's glue around the inside. Now pleat the ends in. Apply glue to the pleated end, and apply masking tape to hold the outer end disk in place. See Photographs 7 – 9 for this sequence. This assembly can then be set aside to dry. That wasn't too hard, was it?

I am assuming that you have stars, polverone, 4FA and 2FA grade commercial black powder, and some quickmatch.

Drill a $^3/_4$ inch hole in a 2 × 4 and use this as a work surface for your shell (Photograph 10). Put the fused end of the shell into the hole in the 2 × 4 to hold it during assembly. Now cut a thin cardboard liner to go inside.

Photograph 4 – Note the ramming base with a riser to leave a 0.25 inch recess in one end.

Photograph 5 – The nosed whistle-time fuse.



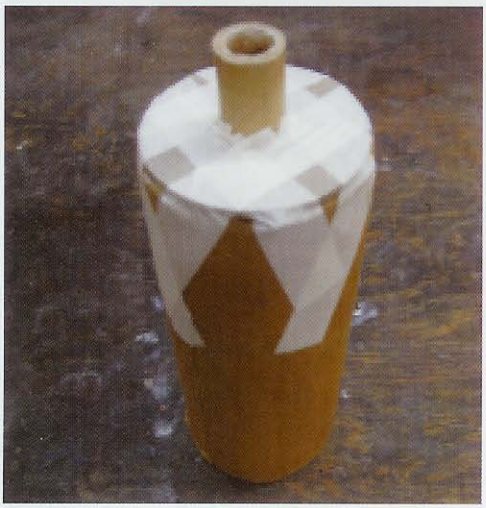
Photograph 6 – The completed fused end disk assembly.

The liner needs to be nine inches long and three or four inches wide. The width will determine the height of your shell. If you are using inserts this may be a factor in determining this dimension.

So what are you going to use as a liner? Well, I use the cardboard carton that the case former came in. Yup, a soft drink carton. You can use other thin cardboard too. So roll it up, and put it all the way down in there so it is resting on the fused end disk and back-spin

Photograph 7 – Fused end disk in the paper can.

Photograph 8 – Pleating the overhanging paper over the end disk.



Photograph 9 – The attached fused end disk.

Photograph 10 – Preparing a work surface.

Photograph 11 – Thin cardboard liner inside the shell casing.

Photograph 12 – Trimming the case to one-inch above the liner.

it against the inside of the case (see Photograph 11). Now trim the shell case so that it is one inch longer than the liner (Photograph 12).

Next we need a "canulle" or tube to form the central burst charge of 4FA. I use a piece of 1/2 or 3/4 inch copper water pipe. Place the canulle over the black match inside the shell. Now, holding the canulle tube in place, add some stars around it – about 1/4 of the way up is good (Photograph 13). I like to put a piece of masking tape over the top of the canulle to prevent stars from falling in. Next add a small handful of polverone (Photograph 14). Grab a stick and tamp the sides of the shell firmly to settle the polverone in around the

Photograph 13 –
Adding stars around the canulle.

Photograph 14 – Adding polverone.

stars. Settling the stars and polverone is an important step and is required for the shell to have enough structural integrity to withstand the lift charge. Now add more stars and more polverone and settle them until you have almost reached the top of the cardboard liner (Photograph 15).

Now put about a tablespoon of 4FA in the canulle (Photograph 16). Slowly twist it and pull it out trying not to disturb the arrangement of the stars. Now fill in with stars and polverone until you are level with the top of the liner (Photograph 17). You can tamp on it a bit to settle it in. You don't have to be too careful. If it won't take a little tamping, it won't take the thump of the lift charge. Now put a solid end disk down on the stars.

Photograph 15 –
Casing filled with stars and polverone.

Photograph 16 –
Adding the 4FA burst charge to the canulle.

Photograph 17 –
Stars and polverone up to the cardboard liner.

Photograph 18 – Gluing-in the end disk.

Photograph 19 – Overhanging paper pleated down.

Photograph 20 – Adding two disks.

Photograph 21 – Taping the two end disks in place.

Photograph 22 – The shell wrapped with masking tape.

Slobber some white glue around in there and pleat the overhanging paper over the disk (Photographs 18 and 19). Now take two end disks and tape them over the pleated end to hold them in place (Photographs 20 and 21). When I started this I only used one end disk on the outside. I had an occasional "flowerpot" (where the shell bursts in the mortar). A friend told me to use two disks and I have never had a flowerpot since.

So, it's starting to take shape. Take some wider masking tape, and wrap the shell around the circumference (Photograph 22).

Now comes the magic part: "Spiking" or wrapping the shell with string. I am always amazed at how doing this makes the shell rock hard. The design considerations in spiking are to make the shell strong enough to withstand the lift charge. It also has to be strong enough to hold the shell together while all of the stuff inside lights, yet weak enough to break at the right time – not too soon causing a weak break, nor too late causing a hard break where stars might not light.

Take some string. What string? Well that's a good question. Yes, you can get some of that snappy flax or jute like they sell at the PGI convention. That is what I use. But I have used a lot of other stuff too. Wal-Mart has some flax string in the beading department. I am sure that other craft and bead stores have something too. I have used kite

Photograph 23 –
Tying the string to the whistle-fuse for spiking.

Photograph 24 –
Winding on the vertical spiking.

string in a pinch. But some of it has to be doubled or tripled up to be strong enough to do the job.

Start by taking about 30 feet of string and tie it to a solid object. I use a cleat mounted on the side of a shed. Pull the string tight, and tie a clove hitch around the whistle tube (Photograph 23). Now pull it tight, and rotate the shell around and have the string go down the side, across the bottom, up the other side 180 degrees from the first pass, and up to the tube. You should be pulling as tight as you can, without breaking the string. Now go around the tube, and turn the shell 90 degrees and do it again. Now we have the spiking dividing the shell into quarters. We have to keep going until it is divided into sixteenths (Photographs 24 and 25).

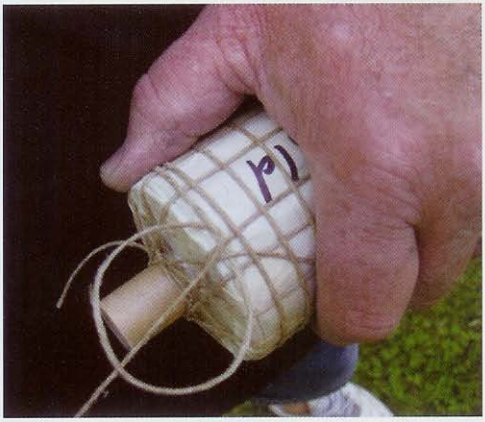
After it is spiked so that you have 16 segments you need to pull it real tight into the top and start working your way down to the bottom. When you get the string spiraled down to the bottom you need to keep pulling, and spiral it up to the top (Photograph 26). Try to make little squares on the side of the shell (Photograph 27). When you get up to the top (Photograph 28) go to the string that starts the spiral down. Cut the string with about 6 inches past that spiral string. You need to work it under that string and tie it off

Photograph 25 – A top view of the shell with vertical spiking completed

Photograph 26 – Winding down to the bottom to begin the horizontal spiking.

Photograph 27 – Winding on the horizontal spiking to form squares.

Photograph 28 – Reaching the top of the horizontal spiking.



Photograph 29 – Tying-off the horizontal spiking.

with an overhand knot (Photograph 29). The reason that you want to use that string is to keep it from unraveling. Refer to the pictures for clarification. Whew! Your hand should hurt from all of the pulling if you did it right. It should be rock hard now. Slobber white glue on the whole outside of the shell and carefully rub it in with your hands. Do not rub the strings too hard and have them come undone.

Next comes the lift charge. Take a small plastic bag and put 35 grams of 2FA in it. Put one end of a three foot long piece of quick match leader in the bag, and tape it together (Photograph 30). Hold the lift and leader up next to the shell, and guestamate where the leader will need some of the paper removed

Photograph 30 – The lift charge and leader ready to be attached to the shell.

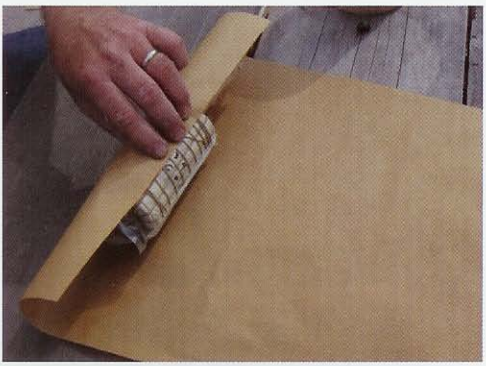
Photograph 31 – Estimating where the leader needs to be bared to light the whistle.

Photograph 32 – Inserting the bared section of the leader into the whistle.

so it can be inserted into the whistle tube. This bared section of match should touch the whistle mix (Photographs 31 and 32).

Tie a clove hitch around the whistle tube and the quickmatch leader that goes into the tube and also the quickmatch that goes out of

Photograph 33 – Tying the quick match leader into the whistle.



Photograph 35 – Wrapping the shell with paper.

Photograph 34 – Securing the leader-passfire to the shell.

Photograph 36 – The wrapped shell before trimming the excess paper and application of the label.

Photograph 37 – The finished shell with label.

the tube (Photograph 33). We need to tie it securely. You do need enough quickmatch for the passfire to go to the bottom where the lift bag should be. Now take an 18 inch piece of fiber tape, and go lengthwise around the shell. Our objective here is to tape the lift to the bottom of the shell, and tape the leader to the shell before it gets to the whistle tube. The reason for this is that everyone picks a shell up by the leader, and we don't want it ripped out of the whistle tube (Photograph 34).

Now get a piece of 20 or 30 pound Kraft paper, or if you are really proud of this shell, get some gift wrap that looks nice. Put a turn or two around the shell (Photograph 35) Put one clove hitch at the bottom, and trim the excess paper off so that the shell will fit down in the gun, and put two clove hitches around the top (Photograph 36). This again is to keep the leader from coming off. Now label it so you know what it should do (Photograph 37). Put a piece of visco in the leader, and a safety cap, and you are ready to trot off to the "B" line to see your creation paint the sky.

Have fun, and do it safe.

JIM BIERSACH
jimpyro@hobbyhorse.com