

## Making Your First Cylindrical and Spherical Shells

Aerial shells are an integral part of today's fireworks displays, being the preferred method of aerial effects delivery of the majority of pyrotechnists (occasionally some will opt for rockets). It is therefore a good idea to gain some experience in the field of shell-making.

### Classes of shells

There are two main classes of shells: spherical or round shells, and cylindrical shells. Spherical shells allow for symmetrical shell breaks and star patterns, whilst cylindrical shells open the doors for more stylized effects and burst patterns. I suggest that the beginning shell maker start off with cylindrical shells, and then, once confidence has built up, to move on to spherical shells. I say this because not only do spherical shells take more experience to make than cylindrical shells, they are very difficult if not impossible to perfect, and this may discourage the budding amateur.

### Making Cylindrical Shells

To make a beginner's cylindrical shell, the things you need are:

- a) stars (Dan Williams' page has some excellent info on making cut stars);
- b) an ordinary toilet paper tube;
- c) burst charge (I use whistle mix; flash obscures the initial star trails and BP is generally too slow);
- d) 2 end discs;
- e) some wood glue;
- f) some 70lb Kraft paper;
- g) rough jute or hemp twine;
- h) flour or starch paste;
- i) length of time fuse

The T.P. tube on its own is not nearly strong enough to function as a shell casing. Therefore, you must reinforce it. First, thin the wood glue with water. Use a ratio of two parts wood glue to three parts water. Cut four or five 1 foot lengths of 70lb Kraft paper, making the width of the Kraft equal to the height of the T.P. tube. Apply the thinned wood glue liberally to the strips, and roll them around the T.P. tube. Set this aside to dry.

While you're waiting for the tube to dry, cut off a 1 1/4" length of time fuse with a razor blade (scissors will crush the powder core). Take a 1/8" diameter drill bit, and drill a hole thru the center of the powder core of the time fuse, about 1/4" in from one end. Take a drill armed with a 1/4" bit, and drill a hole directly thru the exact center of one of the end discs (leave the other disc alone for now). Insert the length of time fuse into this hole, allowing only 1/2" of the fuse to protrude from the outer side of the end disc, and glue this on using hot or wood glue. Next, take a 1 1/2" length of black match which has been dusted with meal BP before it had dried (it is dry now), and insert this into the hole in the

time fuse. This is the crossmatch, which takes fire and ignites the otherwise hard-to-light powder core of the time fuse. Paste around the crossmatch with a little BP paste, to hold it in, and then dust this with a bit more meal powder. Prime the other side of the time fuse with BP paste and dust it with meal powder. Allow the primings to dry. Glue this end disc (1/2" crossmatched side on the outside, of course) onto the tube, using full-strength wood glue (not thinned). Now it is time to fill with the burst charge and the stars.

Before the burst charge can be added, you must make a composition retainer. This is basically a very thin walled kraft tube that is 1/3rd (or occasionally 1/2) of the ID of the shell casing, and of the same length. It is placed in the exact center of the shell casing, and it is filled completely with burst charge. Next, we must fill the remainder of the shell with stars. I recommend that beginners use charcoal streamer type stars in their first shells, as they are easy to make and require little or no priming. An example of a composition of this type is Andy W's "Super Simple Star Formula," which is composed of:

70% Meal BP

30% Charcoal (mixed coarse and fines)

This composition is moistened with a 25% Methanol/75% Water mixture, allowed to dry, bound with NC lacquer, and primed with a dusting of meal BP.

Ok, now that I've finished that particular tangeant, let's get back to the topic of shell construction. In the cavity that still remains in the shell, place all of the stars you can manage WITHOUT packing them. Then, pour BP into all of the crevices between the stars (do NOT do this if you are using a chlorate-based burst or star formula in the shell!). Now you may pack the stars down, but only lightly. I recommend prodding them with a pencil.

Now this is an important bit: leave AS LITTLE empty space in the shell as possible. If you do, then the stars etc. may move out of alignment, and you'll get a bad burst pattern, which is a discouraging thing to get in your first shell.

Now that your shell is full of burst and stars, you may remove the burst composition retainer. Now all there is to it is to glue the top end disc on. And complete the outer shell wrappings. And string the shell. And attach the lift. Man, this'll take a while.

Ok, glue the other end disc on using the same technique you used to glue the first disc on. Now on to the shell wrappings. To wrap the shell, take about half a meter of 70lb kraft, which has a width twice the height of the shell, place the shell in the middle of one of the ends of the kraft, and simply glue the kraft on (with the thinned glue). For the parts of the kraft that go over the ends of the shell, simply crimp them down over the end discs, making sure to use a little bit of full-strength wood glue to aid adhesion. If you've done things correctly up to this point, the shell should look something like this:

Now for the stringing. This step is probably the hardest to master, although once you learn how to do it, you never forget (well, unless you suffer a severe concussion or CO

inhalation or something). Whip up a batch of wheat/starch paste, having the consistency of ordinary white glue. Next, take a length of nice, rough twine or cotton cord, and saturate the little bugger with wheat paste. This always aids things because when the wheat paste dries, the string will shrink, giving a tighter wrap than is possible by simple hand wrapping means. Now that you've got that done, wrap the shell. To wrap the shell, tie one end of the string to the time fuse (which I hope you've glued in properly), and then wrap the string around the shell as tight as you can get it, and tie it off, yes, at the fuse. If all went well, the shell should now look like this:

Next, "counterwrap" the shell. This will be a bit trickier than the first act of stringing. To start off this string wrap, I recommend you use a slipknot (who doesn't know how to tie these, honesty?) to attach it to the shell. Here's a tip: try to wrap the shell so that the stringing, when looked upon from one side, looks like it forms diamond or cube patterns. If you didn't screw up, the shell should now look like this:

Now all that is left is to attach the lift. First, make a cone with the same circular base size as the shell's end discs, using some kraft and some wood glue. Then, fill it with the appropriate amount of 2FA BP lift (I'll eventually put a chart of the proper lift amounts up here). Insert a length of quickmatch, or an e-match, into the BP in the lift cone, place the shell time fuse end-first into the lift, and simply tape the cone to the shell with some masking tape. You're done! Now place your shell in a mortar, set the quickmatch afire, and watch your shell ascend to the heavens.

## Making Spherical Shells

Making spherical shells is a bit more difficult. To make a nice beginner's spherical shell, you'll need:

- a) stars;
- b) Shell Hemispheres
- c) burst charge (I use whistle mix);
- d) some PS glue (see the composite hemi section);
- e) some cotton cloth;
- f) length of time fuse (or spoulette, or whatever).

We'll start with filling the hemi which is not meant to be fused. First, you need to put the stars into the hemis. This is done by taking stars and placing them into the inner section of the hemi, so as to form a "layer" of stars, which blankets the inner section of the hemi, but with NO overlapping stars. Then, sprinkle some meal BP (for small shells) or meal-coated rice hulls (for larger shells) onto the stars so as to fill all of the possible gaps between the stars (note: do NOT do this if you are using chlorate based stars; and, anyways, if you're not an experienced shellmaker yet, then why the hell would you be

using chlorate stars?). Then, take a piece of Kleenex or similar, place it onto the stars etc, push it down so that it takes the shape of its container, and then cut off the excess.