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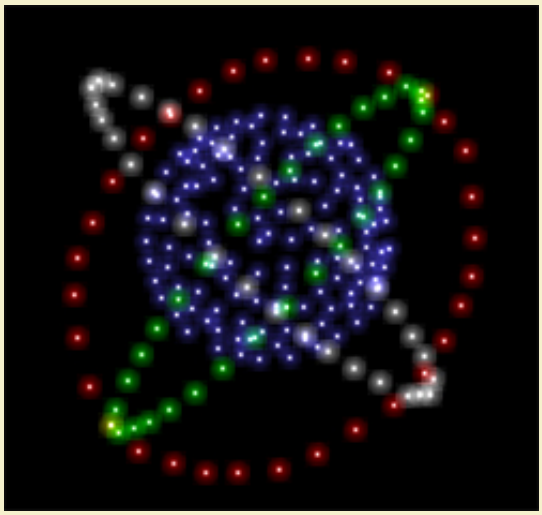
Volume 7, Issue 1

Build This...

6" Atomic Pattern Shell

*by **Jeff Doty***



January, 2007 Issue

Build This:
6" Atomic Pattern Shell

Beginner Project:
Mini Girandola

Technique:
Gummed Tape Ball Shells

Tool Tip:
Gummed Tape Dispenser

Gallery:
4F 2006

Summary:

Jeff Doty is one of the few domestic commercial ball shell builders in the U.S., and his impressive shells often take first place at PGI conventions. This month we are lucky enough to have Jeff reveal his secrets to building what is perhaps the most difficult of all pattern shells: the triple ringed "Atomic" shell. Saturn shells are hard enough to make, but getting three distinct rings on three separate axis to intersect around an inner petal is even harder. The techniques shown here can be used for other types of ring shells and double petal ball shells as well.

Materials:

- (1) set of standard 6" paper hemispheres
- (1) 3" paper or plastic hemisphere w/ 1/2" hole
- 1/4" Clothes line rope (approx. 29 inches)
- Time fuse (2" long)
- 3/8" x 2.5" long Paper tube
- Black Match (approx 4-3/8" long)
- 3/8" Stars: Approx. 34 stars/ring plus 3 oz for the nucleus
- Approx. 1 lb. of KP on Rice Hull burst
- Tissue Paper: 2 pieces 7" x 7"; 1 piece 20" x 20"
- Masking Tape
- Strapping (filament) Tape
- Hot Melt Glue

Tools:

- Wooden Dowel
- Hot Melt Glue Gun
- Felt Tip Marker
- Scissors

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6" Atomic Pattern Shell...

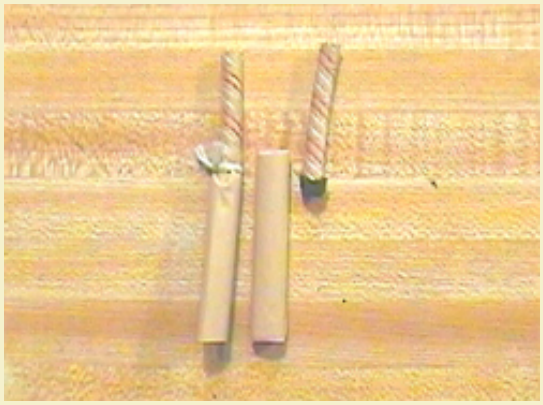

Figure 1: Preparing primed time fuse with an extension pipette.

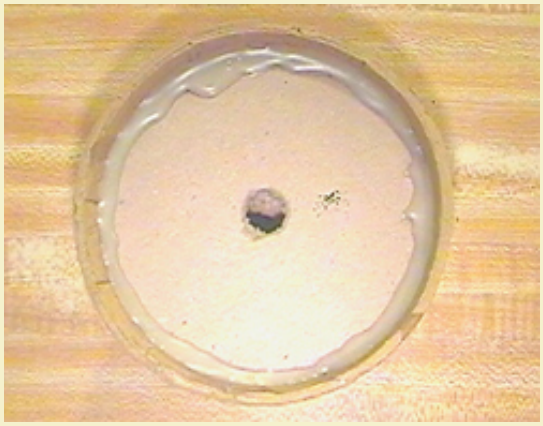

Figure 2: A 3" paper hemi to be used as a cavity former is reinforce with a cardboard disk to prevent warping.

Figure 3: The cavity former is covered with

Introduction

Most displays of fireworks will include a few pattern shells. The more common type of patterns seen are two-dimensional and include Hearts, Smiley Faces, and Spirals. These are relatively easy to make and, as long as they orient properly, receive good crowd reaction. The problem, of course, is that if they don't orient properly, the pattern can look very distorted or even look like a straight line.

Other pattern shells are three-dimensional. These include Hourglass (or Bow tie) in Ring, Saturn Shells, and Atomic Patterns. An Atomic Pattern with Nucleus is probably the most difficult to make. While the Nucleus is just an inner petal and, therefore, straight-forward to make, getting the three orbital rings to align properly with respect to one another, is a challenge. This article will include some tips that will help you meet that challenge. While the article is for making a 6" shell, the techniques are easily transferred to larger shells.

Time fuse

I use a 2" piece of time fuse that has been cut flat and primed on one end. The primed end is then slipped and tied into a paper tube that is about 2.5" long and 3/8" in diameter (Figure 1). A piece of bare match about 4-1/4" long is folded in two and stuffed into the tube to transfer fire from the time fuse to the burst in the center of the shell.

3" Hemi for Nucleus

To form the nucleus, a 3" hemi is used to mold the burst. Strawboard hemispheres are notorious for turning into football-shaped hemis over time. Since this 3" hemi can be used over and over again to make inner petals, it's best to use a plastic hemi that will keep its shape. However, a strawboard hemi can be kept round by hot-melting a disk into it (Figure 2). Since the hemi needs to be slipped over the fuse and extender, a 1/2" hole is drilled in the center of the hemi.

Take a piece of tissue paper, 7" x 7", crumple it up to make it pliable, and wrap it around the 3" hemi, flattening out any wrinkles (Figure 3). This will form the nucleus of the atomic pattern. When working on the fused hemi, you'll need to make a hole in the tissue paper for the fuse extender. Make sure the hole is large so that the tissue won't get caught between the extender and the hemi. If it gets caught, the tissue paper may lift out when you remove the hemi to make the nucleus. Set aside the covered hemi for use later.

Marking the Hemis for the Rings

One ring will go along the rim of the hemi, as in the Saturn shell. The other two will be in the two planes that are 90 degrees from the rim

tissue paper.

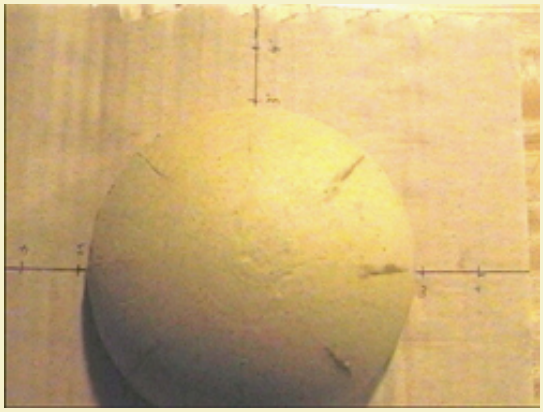

Figure 4: Using a guide to mark the ring quadrants.

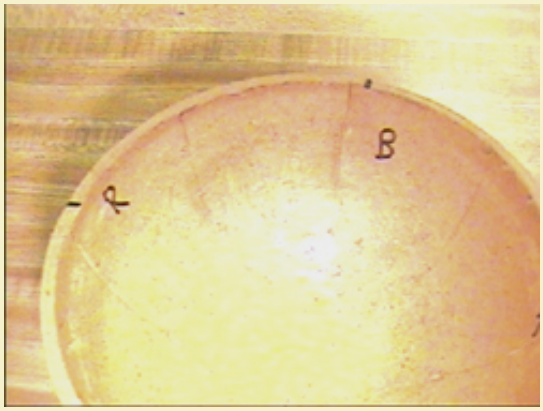

Figure 5: Ring colors are marked inside the hemi.

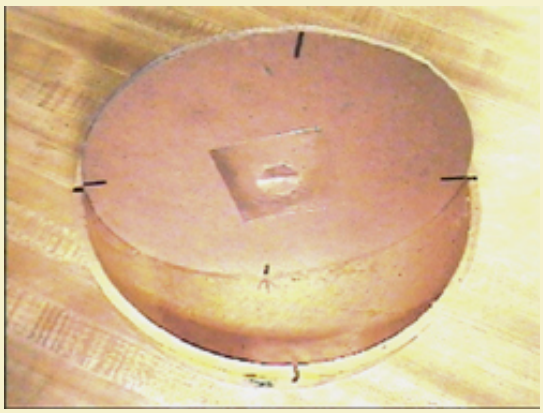

Figure 6: A disk is used to draw a guideline on the inside hemi wall.

and 90 degrees from each other. Place the hemi on a piece of cardboard that has two perpendicular lines drawn on it. These lines are marked at 1 inch intervals to make it easy to center the hemi on the "cross-hairs". (Figure 4). Mark on the hemi where the lines are, thereby separating the hemi into four quadrants. Next, put the two 6" hemis together and transfer the marks to the other hemi. Also, transfer the marks to the rims of the hemis and label inside the hemi what the ring colors will be (Figure 5). These marks layout the planes where two of the rings will go. The third ring will be placed along the rim of the hemi that has the time fuse in it.

Next, take a cardboard circle that has the same diameter as the inside of the hemi. Place it on the cardboard with "cross-hairs" and make four marks on it, splitting it into four equal quadrants. Insert the cardboard disk straight into the hemi such that the disk is at one of the sets of marks that split the hemi into quadrants. Two marks on the disk should be at the rim of the hemi. Make an arrow in the bottom of the hemi where the mark on the disk is (Figure 6). This is on the arc where one of the rings will be placed. Remove the cardboard disk and re-insert it at the two rim marks that are 90 degrees to the first set of rim marks. Line up the disk with the arrow that you just made inside the hemi and draw a line from one rim mark, through the arrow and up to the other rim mark. Also, make a second arrow mark on the hemi where the disk mark is. This will mark the arc for the second ring. Now, re-insert the disk at the first two rim marks, lining up the disk to the second arrow (Figure 7). Draw another line through this arrow outlining where the second ring of stars will go. This procedure will need to be repeated on the other hemi as well.

Next, on the outside of each hemi, mark where the rings are located and label what color star will be in each ring. You will need these markings when you put the two hemis together.

The Rings

There are various ways of inserting the rings of stars. One option is to use hot-melt to glue the stars to the hemi (See Kyle's article 6" Kaleidoscope w/Crossing Rings). This risks having a distorted ring in the sky if you use too much hot melt but, with care, it's easily done and works well.

Another option is to roll the stars in tissue paper and lay the tube of stars into the hemi. The main problem with this approach is that the rings will tend to look disjointed. This happens because the rings cannot be rolled in a single piece of tissue paper. Since the three rings will be intersecting each other, arcs would have to be rolled and then pieced into the shell to form a ring. When the shell breaks open and the stars move outward and away from each other, the tissue paper tends to hold the stars together just enough so that noticeable gaps are formed between the groups of stars in each arc.

A third alternative is to glue pieces of trimming or rope into place and use them as shelves to lay the stars on. For an 8" shell with 1/2" stars, I use braided trimming, obtainable at Wal-Mart or sewing centers. For this 6" shell that uses 3/8" stars, we can use 1/4" clothes line rope instead.

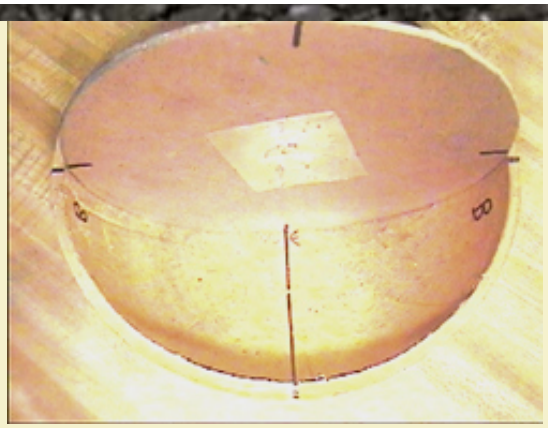

Figure 7: Marking the second, intersecting ring guideline.

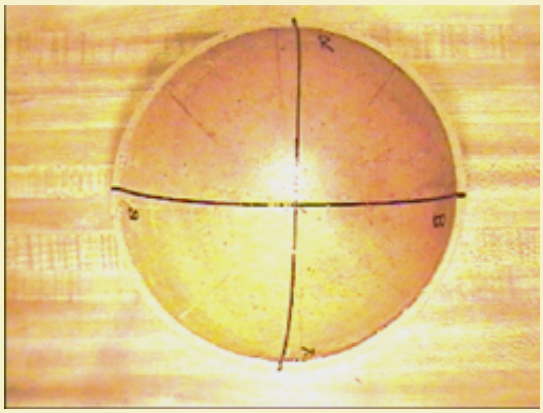

Figure 8: Hemi is marked, labeled and ready to load.

Figure 9: Segments of clothesline rope glued to the hemi as a guide for star placement.

Take the rope and mark it at the following lengths: 7 1/4", 10 1/2", 13 3/4", 21 1/2", 25 1/4", 28 3/4". Wrap a piece of tape around the rope at the markings and then cut the rope. The tape will prevent the rope from unraveling. You should have pieces that are, in order, 7 1/4", two at 3 1/4", one at 7 3/4", one at 3 3/4" and one at 3 1/2". The pieces of rope are then hot-melted into the hemi, offset slightly from the ring lines. The rope needs to be far enough from the ring lines so when the stars are placed on the rope, they will be on the ring line. It may be helpful to lay the rope in place before gluing so that you'll know how they'll fit. If the pieces of rope have a lot of curl to them from being coiled, you can straighten them by soaking them in water and work the pieces until they are straight.

For the hemi that will have the time fuse, hot-melt in place the 7 1/4" piece first, making sure that the ends of the rope are down enough from the rim to allow a ring of stars to be placed above it. Then hot-melt in place the two 3 1/4" pieces for the other ring, again leaving space at the rim for the third ring (Figure 9). Using an awl or a drill, make a hole in the center of the hemi and insert the time fuse w/ extender. Leave about 1.5 cm of fuse poking through the hemi.

For the other hemi, hot-melt in place the 7 3/4" piece of rope first. This should be close to the rim of the hemi, but not over it. The 3 3/4" piece is hot-melted in leaving a gap between it and the long piece of rope so that the stars will fit between them. Then the last piece of rope, 3 1/2" long is glued in to finish the process.

If there is any excess hot-melt between the rope and the line where the stars will go, it will have to be trimmed away so that it doesn't interfere with the placing of the stars. When done, they should look like Figure 10.

More...

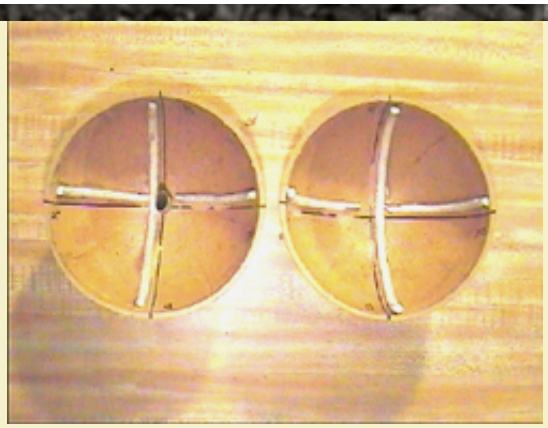

Figure 10: Both hemis prepared with the rope guides for two intersecting rings.

6" Atomic Pattern Shell...

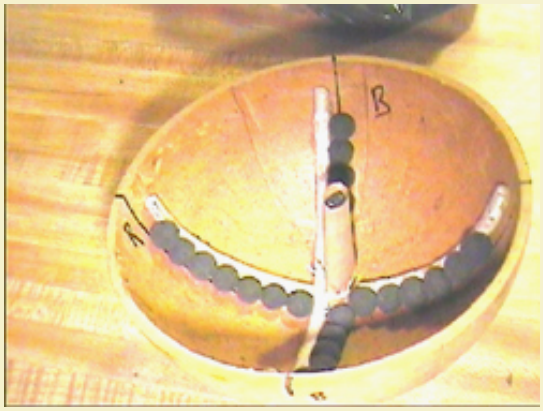

Figure 11: Placing stars along the rope guides.

Figure 12: Partial burst charge loaded on top of ring stars.

Figure 13: Inner petal cavity former is slipped over the time fuse.

Placing the Ring Stars

Next, the stars are placed on the rope. Slightly tilt the hemi on its stand such that when the stars are placed, they will stay on the rope. Place stars only up to 1/2" from the rim. Otherwise, these upper stars tend to roll down into the hemi. Also, in the fused hemi, you'll need to leave sufficient room along the top of the hemi for the final ring (Figure 11). Carefully place 1 cup of burst into the hemi (Figure 12). Center the 3" hemi with tissue paper into the burst, making sure that the rim of the 3" hemi is slightly above the rim of the 6" hemi (Figure 13).

Starting on the low side of the tilted hemi, carefully place the burst charge into the shell. When the burst is near the top, add the last stars to finish the rings. Work your way around the hemi, from the low side to the high side, adding burst and stars until it's filled. Level out the hemi on its stand and add burst to fill it. Since this is the fused hemi, add the stars to make the third ring by carefully pushing them into the burst. While pushing the stars in, roll them towards the hemi so that the burst underneath will be rolled out towards the inner hemi (i.e. the nucleus). Place a piece of cardboard over the hemi and lightly tap on the outside to settle the burst without knocking the stars out of alignment. When tapping, I try to avoid hitting where the rings of stars are located. Remove the cardboard. Add more burst and/or readjust the stars and 3" hemi if necessary. Replace the cardboard and settle the burst again. The hemi should now be filled to the rim (Figure 14).

Forming the Nucleus

While holding the 3" hemi in place, carefully unfold the excess tissue paper and spread the tissue out leaving the hemi clear (Figure 15). Now, the 3" hemi can be removed leaving the tissue paper in place (Figure 16).

Gently place the stars for the nucleus into the indentation left by the hemi, making sure that you don't disturb the burst under the tissue paper. If the stars don't exactly reach the rim of the indentation, it's better to leave them a little bit below the rim than to be too high. If you have properly settled the burst, there won't be much settling when you put the two hemis together. Once the stars are in place (Figure 17), add about ¼ cup of burst to the center. If you have many top stars that are well below the rim, you can raise them while adding the burst, letting some burst go under the top stars. This will help prevent a noticeable gap between the two halves of the nucleus when the shell breaks open (Figure 18).

Carefully gather up the excess tissue paper and fold it over the top of the nucleus. This will help keep the upper part of the nucleus round

Figure 14: Burst charge and ring stars loaded in around the cavity former.

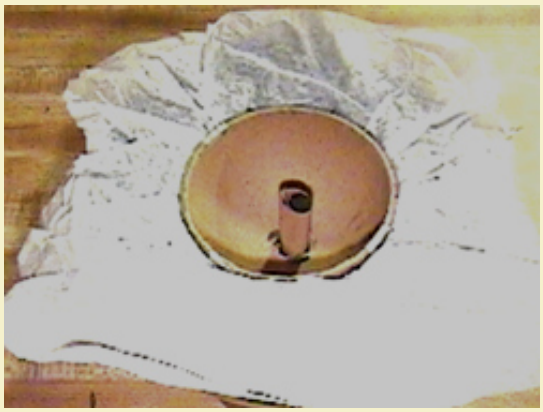

Figure 15: Tissue on cavity former is opened up to remove the former.

Figure 16: The former is removed and the cavity is ready for stars.

when you settle the burst. Once again, place the cardboard on top of the hemi and tap the outside to settle the burst. Remove the cardboard and cut back the excess tissue enough to make sure the fire can easily pass between the hemis. Fold what excess tissue remains, back over the nucleus (Figure 19).

Repeat this whole procedure for the other hemi, with the exception that the third ring won't have to be included. Just slightly overfill with burst before tapping and settling.

Putting the Shell Together

Take a 20" x 20" sheet of tissue paper and fold it in half twice so that it's now 10" x 10". Snip off the corner where the center of the tissue paper is so that there is a hole in the center of the paper. Now, crumple it up to make it pliable. Unfold the paper and wrap it over and around the 6" hemi that doesn't have the time fuse in it. Twist the ends together to make the tissue paper fit snugly without ripping it. You'll have to slightly tear the tissue paper near the rim to expose one of the ring marks so that you can properly align the two hemis (Figure 20).

With one hand holding the twisted tissue paper, place the other hand over the center of the hemi and flip it over. Carefully place the hemi over the fused hemi while aligning the marks, and slide out your hand. There should be only a very small gap between the two hemis. Tap them lightly to bring them together while making sure the ring marks remain aligned. Tear away the tissue paper, leaving it undisturbed inside the shell. I use 3/4" strapping tape at each of the pressed seams of the hemis to hold them together (Figure 21). Then I put one layer of masking tape around the seam where the two hemis came together. Check the time fuse to make sure that you still have at least 5/8" sticking out and hot-melt or glue it to seal the opening from gases. At the top of the shell, tape a piece of string that will be the hoop where your leader is slipped through.

Special Notes

The geometry of the burst charge filler is an important aspect to getting this shell to perform correctly. The standard flakey type of rice hulls commonly available will not work here. The large football shaped hulls seen here were obtained from Riceland Foods, and are similar to what are used in commercial rice hull break charges from China and elsewhere. If the correct type of rice hull can not be found, puffed rice cereal could probably also be substituted with similar performance. The hulls are coated in a ratio of 10.5 pounds of KP to 2.5 pounds of hulls, which is a 4.2 to 1 ratio. The KP charge used was 7 parts potassium perchlorate, 3 parts Service Chemical airfloat charcoal and .5 parts dextrin. The coating process should be done in a star roller or cement mixer so that all the powder is solidly coated onto the hulls, as opposed to the less reliable method of mixing wet hulls with dry powder by hand.

The shell can be pasted in with virgin kraft strips and wheat paste, or gum tapped with a minimum of three layers that overlap 50% (six effective layers). Note that pattern shells such as this often break slightly less hard than a peony or double petal shell of the same size. This is to keep the pattern stars from spreading out to far and thinning out the pattern. Too much distance between ring stars or

Figure 17: Loading stars into the 3" cavity to form the "nucleus" of the atom pattern.

Figure 18: Remainder of space is filled with burst charge.

Figure 19: Tissue is trimmed and folded into the center.

any other type of 2D pattern will make the pattern more difficult to visually recognize.

Figure 20: Piece of tissue placed over one shell half prior to inverting it onto the other half.

Figure 21: The shell seam is held together with pieces of fiber tape after closing the two halves together.