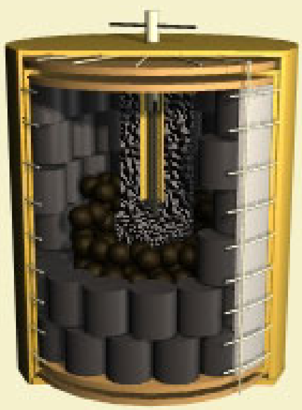
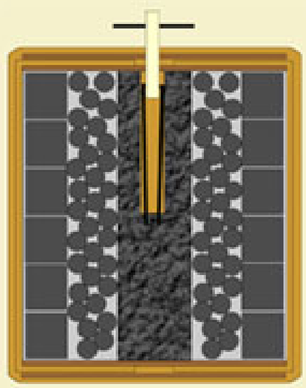
Build This...

5" Charcoal Comet Shell with Color Pistil





February, 2002 Issue

Build This:
5" Charcoal Comet Shell.

Design Notes:
Round Stars, Part I.

Autopsy:
Elephant Pattern Shell.

Class C Corner:
Air-Borne Art

Summary:
This shell breaks with big, bushy charcoal comets as a low intensity backdrop for a splash of vibrant color pistil stars. This is also referred to as a "double-ring" effect, although there really aren't any distinctly noticeable ring patterns. Making the comets will consume the majority of time spent building this shell, but the results are worth the effort.

Prerequisite: 4" Single Break Color Shell

Formulas: Tiger Tail, Blue, Red, Green, Purple

Materials:

- (3) strips 24" long x (comet height x row count) + 3-3/4" wide 70lb virgin kraft, grain short (case)
- (1) 23" long x (comet height x row count)+1/4" wide chipboard, grain short (liner)
- (3) 24" long x (comet height x row count)+6" wide strips 70lb virgin kraft, grain short (paste wrap)
- (1) 36" long x (comet height x row count)+10-3/4" strip of 30lb kraft, grain short (outer wrap)
- (4) 4-1/2" kraft or chipboard end disks, 1/8" thick
- (1) 2" piece of time fuse (2.2 ft/sec)
- (1) 3/8" ID x 2-1/2" long pipette (2-3 turns of 70lb kraft)
- (1) 5-1/2"" of 4 strand cross match
- (1) 1" piece of 4 strand cross match
- (1) 17" piece of 8 strand black match
- (1) 30" quickmatch leader
- (75 or 90) 3/4" comets

Tools:

- 4-1/2" dia. case former
- Rubber mallet
- 1-5/8" OD dowel or pipe
- Cross match punch
- 7/32" drill bit
- Hot glue gun
- 3/4" comet pump
- Brass hammer or 2 ton arbor press
- Scissors
- Anvil cutters

Unmeasured Materials:
3/8" stars(round or cut), flax twine, 2FA black powder, white glue or wood glue, masking tape, wheat paste

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Figure 1: The comet shell built for this article.

Figure 2: A pair of commercial comet shells with large flitter comets.

Introduction:
Comet shells employ large, cylinder shaped stars which are formed by compressing damp composition in a sleeve using a plunger under high pressure. The size of the comets used in a five inch shell can range from 3/4" to 1-1/8" in diameter, depending on the effect that is desired. Larger comets are used to create long, drooping streamers due to the extended burn time of such large stars. Smaller comets allow more of them to fit inside the shell, and also leave extra room for other types of inserts that may form a second ring inside the comet ring.

For this shell, the comets will be 3/4" diameter, allowing 15 of them to fit snugly in each ring with no shimming required. When designing comet shells, you can use the Insert Calculator to see how many will fit inside the space you have to work with. The space required by the chipboard liner must be accounted for when using this tool, making the shell ID slightly less than the case former diameter.

This shell uses six rings of 15 comets, requiring a total of 90 comets. The comet composition used for this project is Shimizu's Tiger Tail, which is a slower burning charcoal streamer composition. The ingredients are not screened together, rather they are ball milled until a fine gray powder is obtained. Ball milling is necessary to achieve the fine tailed, bushy effect desired here. If the mixture is just screened together in the standard way, the comet tail will not appear as soft and dense.

Ball milling the comet mix also results in stronger comets after they are pressed. The larger the charcoal particles are, the weaker the comet will be. You should not be able to break the finished comets in half with your hands when they are dry, otherwise they will shatter when the shell bursts.

The comets used for this shell are 7/8" tall, resulting in about 156 comets per 1000g of Tiger Tail comp. You will get more or less depending on height differences between comet pumps. But while you are making comets, you might as well make enough for two or three shells. You weren't going to make just one were you?

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Figure 3: Arbor press, comet pump, comp bucket and drying screen.

Figure 4: Keep pin 1/2" - 3/4" above sleeve when loading.

Figure 5: Pressing the comet.

Making the Comets:

The Tiger Tail composition should first be dampened 15% by weight with a mixture of water and 14% alcohol. Note that if you are using isopropyl rubbing alcohol, it is typically only 70% alcohol, thus you must use 20% in order to get the actual 14% alcohol/water solution. The alcohol helps speed the drying of the comets, and also lowers the surface tension of the water, which helps the water disburse into the composition with less effort.

The composition must be thoroughly kneaded with the hands after the water/alcohol mixture is added. The water will tend to form clumps that are over saturated with water, and these must be broken up continuously in order for the water to disperse evenly throughout all the powder. Some builders will run the composition through a coarse screen several times during mixing to help break up the clumps, which speeds up the mixing process. Another method involves compressing the damp comp down into a solid cake, then let it set for several minutes to allow capillary action to distribute the water evenly. Note that this later method should not be used when there is risk of an aluminum-nitrate reaction, as the solid block of comp will retain heat and accelerate the reaction.

Once the composition is properly dampened, an amount squeezed in the palm of your hand should form a clump that easily breaks in half when crushed with your thumb. It should not crumble back into powder, but it should not deform like clay either. Once this consistency has been reached, the dampened comp should be placed in a container with a lid to prevent the alcohol from evaporating until it is ready for use.

There are two varieties of single comet pumps that are commonly used to make comets. The simplest involves a short tube with a plunger that fits inside. The plunger is marked with a line at one end, which is used as a gauge to keep all comets the same size. The second type of comet pump has a slotted sleeve to accommodate a plunger fitted with a pin, as seen in Figure 4. This pin is used to gauge the length of the comet, as well as preventing the plunger from dropping through the sleeve when the comet is ejected.

The pump is first loaded by holding the plunger so that the pin (or line) is about 5/8" above the end of the sleeve as shown in Figure 4, then repeatedly rammed into the damp comp until no more will pack into the sleeve.

Once loaded, the composition is consolidated by placing the pump on a hard surface and applying force to the plunger. This can be done with a brass hammer, hard plastic mallet or a 2 ton arbor press. The arbor press makes the work go slightly faster, produces considerably less noise and requires less effort. The arbor press shown in Figure 3 features a ratchet lever with a plunger wheel that allows the user to quickly position the plunger on top of

Figure 6: Push pin down to sleeve and cut off excess comet.

Figure 7: 250 comets ready for drying.

the pump so that the pull lever is always at an angle of optimum leverage.

When using the pin type pumps, it is important to make sure the pin is always aligned above the slot in the sleeve, as shown in Figure 5. Failure to do this can result in the pin being sheared off or bent, with possible damage to the sleeve. If the pump was loaded properly, the pin will stop short of the sleeve when the comp is fully compressed. If the pin enters into the slot after pressing, then the comet will be too short and must be scrapped back into the comp bucket.

After pressing, the plunger is rotated so that the pin is no longer over the slot, as shown in Figure 6. The plunger is then pressed until the pin contacts the sleeve. For pinless pumps, the plunger is pressed until the engraved line is aligned with the edge of the sleeve. A thin blade is then used to shave off any part of the comet that extends beyond the bottom of the sleeve. This step is important for insuring that all comets are the same height.

Finally the plunger is rotated so that the pin is aligned with the slot again, then the comet is ejected onto a drying screen. The comet should be reasonably strong at this point, such that it won't easily crumble if squeezed between the fingers. If the comet is dropped onto a hard surface from a height of three to four feet, it should not break apart into many pieces. Should this happen, then the comet comp needs more water.

Once you get the hang of it, you should be able to pump out about 100 comets per hour. Figure 7 shows several hours worth of work ready for drying.

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Figure 8: Loading in the first row of comets.

Figure 9: All comets tightly packed into six rings.

Figure 10: Center filled with break charge and round color stars.

Loading the Shell:
Before you start cutting any paper, you need to determine the height of the inside of the shell by placing five or six comets (depending on how many rows you want in the shell) end to end and measuring their length. The height of the chipboard liner should equal this distance plus an additional 1/4 inch. The following table shows how all the material sizes can be calculated from the height of the comets you are using.

Layer	Paper Dimensions
Case	H + 3-1/4" x 24" long (three strips)
Chipboard	H x 23" long (23" will vary slightly)
Paste wrap	H + 5-3/4" x 24" long (three strips)
Finish wrap	H + 10-1/2"" x 36" long

H = comet height x number of rows + 1/4"

The former used for 5" shells should be 4-1/2" diameter and about 12" long. Roll up the three kraft strips and pleat in a fused disk as described in the 4" Color Break Shell article. Allow 1-5/8" of paper to extend beyond the end of the case former before inserting the end disk and pleating.

The key to building this shell is to insure that the comet rings fit as snugly as possible up against the wall of the shell. In order to achieve this, it is necessary to calibrate the inside diameter of the shell by adjusting the length of the chipboard liner. Start with two full turns of chipboard and insert a single row of comets as shown in Figure 8. The last comet should be difficult to squeeze into place, and the comets should remain wedged in place when the shell is inverted. If you are not able to insert the last comet, remove the chipboard liner and trim a few inches off its length. Refit the comets again to see if the 15th comet can be wedged into place. Continue trimming the liner until the ring can be completed.

An alternative to this method of fitting the comets involves rolling a turn of chipboard around the former before rolling the case over it. This will slightly enlarge the diameter of the case, allowing the liner to consist of two full turns of chipboard. While trying to determine how much chipboard to roll around the former, you can let the case overhang enough to test fit a small liner and a single row of comets while the case is still on the former. This way you can determine the fit without having to pleat in a disk.

Another method of keeping the comet rings tight without customizing the inside diameter of the shell is to wedge small shims of wood between the comets. When the last star won't fit, the empty space is divided around the ring such that small wedges of wood can be used to make the ring tight. Anywhere from one to four wedges may be required, depending on the size of the wedges and the space to be filled. Some builders also use crushed

Figure 11: Remaining space filled with rough powder.

Figure 12: Spiked and ready for pasting.

tubes wedged into the cavity to lock in the ring.

It is common when loading larger comets to pack sawdust down into the small spaces between the comets and the shell wall. This process can be tedious, but results in a more symmetrical spread of the comets when the shell breaks. However, as seen in Figure 1, omitting the sawdust still results in an acceptable break when the comets are packed tight enough. The symmetry requirement that warrants the use of sawdust becomes more important when single rings of large comets or inserts are used.

After the comet fitting trial and error is complete, the rest of the comets may be loaded into the shell. Each new row of comets should be offset from the previous row by 1/2 a comet diameter, so that the comets stack like bricks in a wall. Figure 9 shows the shell fully loaded with comets.

The 3/8" stars that are to be loaded between the comets and the burst core are most effective if they exhibit pure colors with a lower amount of light output. This is so that they do not overpower the charcoal streamers, which do not put off much light. Any of the formulas given on the materials page will work well here.

There are a few ways you can load the inner ring of stars and burst charge. The traditional method involves inserting a thin-walled metal pipe known as a "canulle" into the center of the shell and pouring the stars around the outside of it. The burst is poured into the canulle pipe, after which it is slowly removed.

I find the tendancy for the canulle to get stuck by the binding action of the stars makes this method rather difficult at times. My own method involves creating a thin walled burst bag from two turns of thin tissue paper rolled around a length of 1-5/8" O.D. PVC pipe. The tissue is folded around the bottom of the pipe, which is then inserted over the time fuse and pushed to the bottom of the case. The pipe is slowly removed and the bag is filled to the height of the comets with 2FA burst charge. The tissue bag should extend about an inch above the powder charge so that it may be folded over when filled. The stars are then poured around this cylindrical burst core until they reach the level of the comets, as shown in Figure 10.

The space between the comets and the top of the chipboard liner is filled with rough powder, which is made by granulating damp meal powder (with 5% dextrin added) through a coarse screen. The purpose of this gravel-like filler is to provide non-compressible structural support between the bottom of the case and the rest of the contents. If the contents of any canister shell do not provide a continuous line of structural integrity, there is the risk that the shell could compress slightly under the large forces exerted on the casing when it is fired from the mortar. This compression would cause the shell walls to split open and flowerpot immediately.

This shell is closed and finished in the same way described in the 4" Color Break Shell article. The only difference is that it is spiked with 24 vertical strands of twine instead of the 16 used for 4" shells. The paste wrap also requires three 24" long strips instead of two. The easiest way to determine the width of the paste wrap is to use a long, thin strip of paper to measure the distance from the time fuse, down the side of the case and around to just beyond the center of the bottom disk.

Depending on the type of stars and number of comets used, this shell will weigh around 1500 grams. Using the ounce per pound rule for calculating the lift charge would require 93 grams of 2FA.