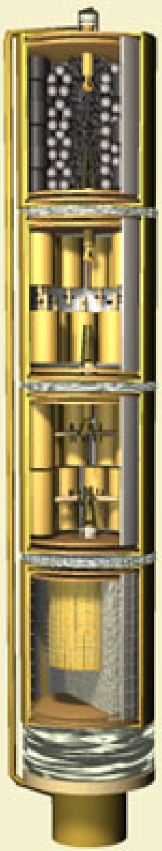
Volume 4, Issue 1

Build This...

6" Compartment Shell

Color Break w/Inserts, Reports & Bottom Shot



Summary:
If you've ever seen a shell break that seems to release more effects than could possibly fit in one break, you have probably seen a compartment shell in action. Compartment shells are constructed like multi-break shells, only the breaks have hollow spolettes between them to allow gasses from the first break to spread to all breaks instantly and break them all at once. The illusion is one single break, even though several separate shells are actually breaking at the same time.

The compartment shell detailed here uses the Maltese shell construction method to produce a symmetrical central comet break with color pistil, followed by a ring of color insert shells, then a ring of reports before ending with a large bottom shot.

Perquisite Reading: Maltese Multi-break Shells
Maltese 6" 3-Break w/Bottom Shot
Maltese Shell Roller
Multi-Break Shell Press
1-1/2" Insert Shells

6" Compartment Shell...

Figure 1: Two pass-through spolettes and one charged spolette.

Figure 2: The top compartment, a standard Maltese color break with a 3.5sec spolette.

Introduction:

The more components that are loaded into a single break of a canister shell, the longer the shell case must be to accommodate them. Unfortunately, the ability of a canister shell to resist splitting under the lift forces before leaving the mortar decreases as the case length increases. Longer shells are subject to more compression, and this can lead to side splitting and subsequent flower potting.

It is important not to confuse case length with shell length here. Case length is the length of one single break within the shell, whereas shell length is the sum total length of all individual cases stacked on top of each other. Flowerpot risks also increase as the shell length increases, but not as dramatically as when individual case lengths increase. A long shell made of several smaller breaks has more structural integrity than a long shell made with fewer but longer breaks. Each break adds a "bulkhead" to the structure of the overall shell, providing zones within the column that are not susceptible to bulging or buckling under pressure.

Dividing a single break into several compartmentalized breaks not only increases shell integrity, it increases the amount of components that can be thrown out in the same plane at the same instant. This is useful when you wish to have many concentric rings of effects breaking at different times as they spread out across the sky. Typical compartment shells contain a color break in conjunction with some combination of insert effects that display at calculated intervals.

The only difference between a compartment shell and a multi-break shell is that the spolettes between compartments are just hollow tubes with a few strands of black match running through them. This allows the gasses from the first break to pass into the next breaks in rapid succession, with all breaks appearing to burst at the same time from the perspective of the viewer. This effect sometimes occurs unintentionally when multi-break shells employ poorly made spolettes that can not hold their powder charge against the internal burst pressure of the shell, a phenomenon known as "blow-through."

Construction:

Because this is a larger caliber shell consisting of multiple breaks, the Maltese method of construction is used. Start by preparing four 6" cans using 10" wide strips of poster board that are 36" long (multiple pieces can be added together to get this length). Use 1-1/2" tabs to close in the top disk, which will give you a good 8-1/2" inches of useable can for loading the break contents. It is better to have a can that is too long than too short, since you can always trim the excess when closing the can.


Figure 3: Loading the first ring of insert shells in the second compartment.


Figure 4: Loading the second ring of insert shells after filling in with rough powder.


Figure 5: The second ring of 9 inserts wedged in place.

You will need the following disks to make the cans:
8 - 6" disks with 1/4" center hole
6 - 6" disks with 3/4" center hole
2 - 6" solid disks
2 - 4" disks with 1/4" center hole
2 - 4" solid disks

The bottom shot is made as described here, so it is not covered in this article. The spolette for the bottom shot will need to have a 6.5 second delay on it.

The spolette for the first break needs to have a 3.5 second delay, which is about the amount of time it takes for a shell of this size to slowly rotate so that the plane of break is at the optimum viewing angle for the audience (determined by watching many similar shells on video). The spolettes for the top break and bottom shot are rolled from manila file folder paper as described here, except the O.D. only needs to be 1/2" instead of 5/8". This allows the spolette to be made from only one sheet of manila while still being strong enough to withstand very hard ramming. The other two spolette tubes are 4" long and not charged. Figure 1 shows the top spolette along with the two hollow spolettes. Two pieces of black match are fed through the hollow tubes and T'd at the bottom to prevent them from pulling out after being installed in the shell. This match is probably not even necessary, but I include it as an extra precaution to insure that the fire train is not broken.

Loading the Cans:
The first break shown in Figure 2 is loaded as a standard Maltese comet break with color pistil, as described here. I prefer to use streamer type comets for a shell like this so that the central break remains visible as the rings of insert effects surround it. Glitter, flitter, willow and charcoal streamers are all good choices for this break.

The second break is loaded with 18 color insert shells in two rows. The insert shells are constructed as shown here, except they are made to be 2" tall instead of 2-1/2" as shown in the referenced article. These will break 2 seconds after the shell opens, which means the time fuse for them should be cross matched about 1" between centers.

Figure 3 shows how the insert shells are loaded using wedges instead of packing with sawdust behind them. This method is much faster and gives the same results. The idea is to make sure the shells are held firmly in a ring, such that they do not fall out if the can is turned upside down. This is much easier to do using thin wooden wedges than ramming sawdust between each insert.

After the first ring of inserts is installed, 1/4" rough powder is used to fill the center space and the spaces behind the shells. Be sure to plug the bottom hole with a removable plug first. A simple section of 5/8" I.D. tube with a wad of paper tamped into it makes an adequate plug. The rough powder is filled until it reaches the top of the time fuses, as seen in Figure 4.

The second row of insert shells is now installed, placing the fuse end

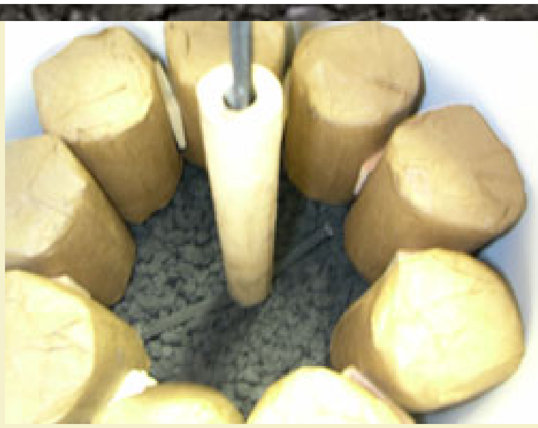


Figure 6: A pass-through spolette put in place before filling with rough powder.

Figure 7: Rough powder is filled around the spolette and all other empty spaces to finish off the second compartment.

down and wiggling it into the rough powder so that the shell seats on the powder bed. Wedges are again used to lock the ring in, as seen in Figure 5.

One of the pass-through spolettes is now placed on the powder bed as seen in Figure 6, then the remainder of the empty space is filled with rough powder. Be sure to tamp the case while filling so that the powder settles into all the voids.

More...

6" Compartment Shell...

Figure 8: A tray of 20 side fused reports ready for loading.

Figure 9: Third compartment is loaded with two rings of 10 reports.

Figure 10: All three cans are closed using the Maltese method.

The third compartment is loaded with 20 reports that are timed to go 3.5 seconds after the shell breaks. This will be 1.5 seconds after the ring of insert shells break, giving a big ring of noise before the final bottom shot goes 1.5 seconds later.

The reports used for this shell can be made in one of many ways, but it is better if they are side fused as shown rather than top fused as the insert shells were. Not only do side fused inserts take up less space in the shell, they are less susceptible to having the setback forces drive the fuse into the shell and damage the gas tight seal, which can cause them to break when the shell breaks. If any one report leaks and goes off when the shell breaks, it will set off all the reports at once and just make one loud boom. In shells that contain the reports within the same break as the stars, this type of failure will destroy the stars as well. In a compartment shell, however, the color break can actually survive the detonation of the report break, thus preserving at least part of your hard labor!

The reports shown here were made from spiral wound tube cores that measure 2-5/8" long x 1-1/4" O.D. with a 1/8" wall. The time fuse holes were first drilled in the sides, then covered with a piece of masking tape. A chipboard disk was then glued to the end of each one and allowed to dry. The tubes were then loaded with an increment of sawdust, then filled with flash, then topped with more sawdust. The sawdust is just there to act as a secondary gas leak barrier. An end disk is glued in place after loading and allowed to dry. Spiking the salutes with a good linen flax twine will make a noticeable increase in loudness. After spiking, the salute cases are pasted in with two turns of 30lb recycled kraft. The recycled kraft lays down much easier, shrinks more and makes a better gas tight seal than virgin kraft, which is why I prefer it for all final outer shell wraps.

Once the salutes are dry, you will still be able to see where the pre-drilled fuse holes are. A pencil is now used to punch through the thin paper and tape barrier so that you can insert your time fuse. The time fuses are cut at an angle on the end that goes into the salute. The angled cut exposes a little more powder core and increases the amount of flame transfer, which is important since there is no way to cross match the inside end of the time fuse when side fusing like this. A distance of 1-5/8" is measured between the cut end of the time fuse and the cross match hole, giving you the desired 3.5 sec delay (assumes a 2.2sec per inch burn rate on your time fuse).

The cross matched time fuses are inserted as far as they will go, then hot melt glue is used to seal around the base. White glue may be used, but it will have to be applied in two coats in order to deal with the problem of air-bubble gaps that form when the first

Figure 11: Spiking with linen twine: 24 verticals and wide horizontal spacing on the insert compartments.

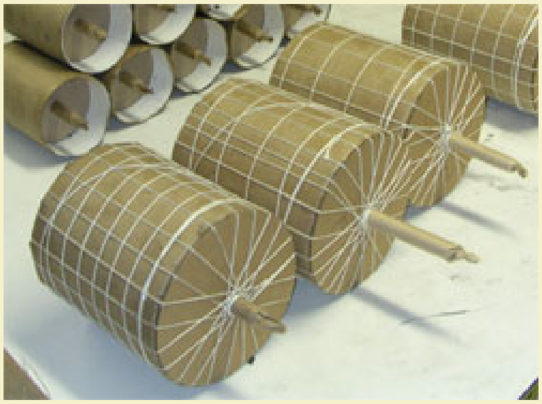


Figure 12: All three compartments spiked. Note the closer spacing horizontal spiking on the color break.

Figure 13: Stacking the breaks on the shell press.

application dries. So a second application must be applied after the first one dries. Hot melt glue is really much better than white glue when making critical gas barriers like this because of the air gap problem that occurs with white glue.

The completed salutes are shimmed into place just like the insert shells were, as seen in Figure 9. Both rows of salutes can be installed at once as seen in Figure 9, although it is probably best to fill in around the first row with rough powder before installing the second row.

The salute compartment is finished off with a hollow spolette just as the second compartment was.

Finishing the Breaks:
With all three cans loaded, a disk is placed over the spolette on each one as shown in Figure 10. The overhanging case is then slit and folded down as described here.

The spiking for this shell was done with the linen flax twine sold by Pyrosupplies. A strong twine of consistent thickness is important for getting good symmetrical breaks out of any canister shell, and the 8 strand variety used here actually allows less than the conventionally prescribed number of verticals to be used. Only 24 verticals was used as opposed to the 32 traditionally recommended for 6" canister shells. Figure 11 shows the wider horizontal spiking used for the two shells containing inserts.

While a traditional Maltese comet break requires a solid layer of spiking using a special jute twine as shown here, I have found that this tedious spiking method can actually be replaced by the Italian style spiking when using a good flax twine. The lower left shell in Figure 12 shows the spiking used on the comet break, the results of which can be seen in the photo at the end of this article.

The three breaks (along with the bottom shot not shown) are now pasted in with two turns of 30lb recycled kraft as described here. Note the use of protective covers over the black match that protrudes from the two hollow spolettes.

Finishing the Shell:
At this point the shell is assembled and finished just like any other Maltese multibreak shell, which is detailed here. Figure 13 shows one of the compartments with the hollow spolette mating with the break above it. Figure 14 shows all four shells being squeezed together on the shell press, with newspaper rammed tightly between the breaks. Note that the paper is not rammed all the way flush with the outside of the casing. This gap allows room for the cotton twine applied in Figure 15 to squeeze down on the six verticals that wrap the shells length. Strong tension on the outer vertical spiking helps keep the shell rigid and strong for storage, handling and of course when coming out of the gun.

The finished shell weighs in at about 18 lbs and is lifted with 250g of rough powder passing through a 1/8" screen. 

Figure 14: Newspaper rammed in place while press aligns shells tightly together.

Figure 15: Eight verticals hold shells together, with cotton twine wrapped tightly between breaks to tighten vertical twine.