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Beginner Project... **Page 1**

1-1/4" Microstar Gerbs

Figure 1: 10-20m titanium turnings and micro stars.

Figure 2: Rolling the casing from poster board.

Materials:

- (1) 44" long x 7" wide poster board
- (1) 11" long x 7" wide 30lb kraft
- (1) 11" long x 5" wide 30lb kraft
- (1) 3" long visco or black match
- fire clay (bentonite)
- gerb composition

Introduction:

Gerbs, also known as fountains, are simple tubes of pyrotechnic composition that spray a plume of sparks from a hole in one end. They are among the simplest firework devices to construct, thus they make a good starting point for beginners. The gerb shown here is actually a bit more advanced than a typical gerb, due to its larger size and microstar requirement, but the same technique applies to all gerbs.

Most gerb compositions utilize some type of metal particles in the mixture in order to obtain good spark height. While coarse charcoal can be used to create a larger plume when making a gold fountain, the light weight of charcoal particles does not allow the pieces to be thrown as far as will metal particles. A better choice for a gold gerb is to use steel filings or iron turnings. Filings are generally granular type particles, like sand, while turnings are fragmented strips of metal that usually result from lathe or milling operations. If you have access to a machine shop, you may find all sorts of metal turnings for the taking just sitting in the catch trough under a lathe. Some people have also successfully used brake turnings obtained from auto repair or brake shops.

The most common metals used in gerbs are steel/iron, titanium and aluminum. The larger the metal particles are, the higher they will be thrown and the longer they will burn. Steel and iron produce a gold branching type of spark that is a brighter yellowish color than charcoal sparks. Titanium produces bright white sparks with good duration, and is the metal of choice for silver gerbs. Aluminum also produces bright white sparks, but tend not to go as high as titanium and also seems to have a shorter burn time. Larger sized flake aluminum is ideal for creating a fire-fly effect when used in a charcoal-intense base formula.

Microstars are tiny bits of color burning composition that are mixed in with the gerb formula in order to produce colored sparks, since metal particles can only produce shades of gold and silver. Since star compositions burn faster than metal particles, the microstars are substantially larger than the tiny metal particles. Thus the colored sparks created by micostars are less dense than the gold or silver sparks produced by metals.

Figure 3: Sanding the inside edge to a taper.


Figure 4: Coating one side with 50/50 white glue/water.


Figure 5: The final two turns of 30lb kraft.

The gerb described here is a bit on the large side compared with consumer gerbs, but I figure if you are going to build your own fireworks then you might as well make them bigger and better than anything you could just buy in the store. This gerb will shoot silver sparks and microstars up to about 30 feet, with a burn time of around 16 seconds. The gerb also has enough thrust to make it a unique driver for wheels and other revolving set pieces.

Rolling the Case

A strong casing with an inside diameter (I.D.) of 1-1/4" with at least a 3/16" wall thickness is required to build this gerb. The length of the casing can vary depending on how long of a burn time you want. The case used here has a length of seven inches, which should give you a duration of about sixteen seconds.

Since good quality tubes in larger sizes can be hard to find or expensive when you do find them, it is often easier just to roll your own unless you need a lot of them. A very strong casing can be made from two strips of poster board paper that are 7" wide and 22" long, with the paper grain running along the width. Figure 2 shows the components required to roll your case, which include a 10" long x 1-1/4" wooden dowel rod, the poster board strips, an 11" long x 7" wide finish wrap of 30 lb kraft and a mixture of 50/50 white glue and water.

Before rolling the first strip, the edge is prepped by sanding it to a taper as seen in Figure 3. This is done to prevent the thick paper from leaving an air gap that runs the length of the tube, which can cause sparks to skip down the side of the powder column and blow the gerb up. The edge is beveled so that it will lay flat inside the case when rolled.

The first turn of paper is rolled dry around the case former and held in place while the remainder of the paper is painted with the 50/50 glue mixture as seen in Figure 4. After the first strip is almost completely rolled up, the second strip is overlapped slightly onto the first and painted with the glue mixture as before. The second strip is then rolled up and the final kraft outer wrap is overlapped, glued and rolled up to finish the casing. Using the thin kraft for the last two turns helps hold the tube together so that the thicker paper can not unravel.

The finished case is put aside to dry completely before proceeding.

The Composition

The formula for most gerbs involves a black powder base with additional charcoal added to regulate burn rate, then the addition of metal dust according to the desired effect. The formula used here uses 60% ball milled meal made with home-made spruce charcoal. The fine milling and spruce charcoal creates a fiercer burning fuel than if commercial air-float is used, and an additional 10% commercial air-float is added to slow the mix down some. If you make your meal from commercial air-float, ball mill it less or just end up with a weaker meal than usual, you can decrease the amount of additional charcoal added.

There are three spark producing ingredients added for effect only.

Figure 6: Wooden dowel rods used as rammers.

Figure 7: The plug forming rammer has a rounded tip.

Figure 8: Making the clay plug.

These are the coarse charcoal, the titanium flakes and the microstars. The coarse charcoal is not really necessary when making a titanium gerb, since you won't be able to see the orange sparks against the bright white sparks, but I just add it anyway so that if you want to make a good fire-fly formula then all you need to do is substitute the titanium flakes with aluminum flakes.

The microstars should be less than 3/16" in size, either rolled or cut. It is easier to make microstars by rolling small cores in a star roller, or even use the core-less method of making them described here. The stars shown in Figure 1 were made from husked millet as the rolling core, which is a very small seed that does not consume much volume compared with other core types. I prefer to use perchlorate/ magnalium type star formulas for their brightness and longer burn time, which helps make the microstars stand out more even when surrounded by bright white sparks. Since the microstars will be embedded in the gerb driver composition, there is no need to prime them.

Loading the Case

The only tools needed to load this gerb are two 10" long rammers that can be easily made from 1-1/4" diameter wooded dowel rods. Oak dowels are preferred, since you will be beating on them pretty hard with a hammer. I like to apply several turns of fiber reinforced tape around the ramming end to help keep the ends from splitting as they mushroom out over time. The rammer used to drive the clay plug has a rounded end, which produces a curved surface on the inside end of the plug. This curve is necessary to guide the microstars out of the vent hole during display, which is especially important if the gerb will be fired from a horizontal position. I used to make these gerbs with just a flat ended rammer for the clay plug, and could never figure out why the microstars disappeared when the gerbs were used as horizontal drivers on wheels. When fired straight up they worked fine, but when fired horizontally the microstars just disappeared! It turns out that without the curved inner plug surface, the stars get trapped inside and never make it out if the gerb is fired on it's side!

No special nipple is required to load this gerb. The vent plug is rammed first, and is flush with the end of the gerb tube. Three level table spoons of powdered clay are required when using the rounded plug rammer. If you opt for a flat ended plug rammer, then only two level table spoons are required. Figure 8 shows the clay being loaded into the tube with a funnel.

Once the plug is rammed, the gerb composition is rammed in increments of one heaping table spoon. Figure 9 shows how just how much heap I use here. Each increment must be rammed pretty hard due to the large diameter of the rammer. The larger the diameter is, the less compression you get with each whack of the hammer, since the force is being distributed over a larger surface area. The increments are rammed one at a time until the powder column reaches about an inch from the top of the tube. The bottom end plug is then rammed from two table spoons of powdered clay to finish off the gerb.

The exhaust hole is now drilled in the first clay plug that you

Figure 9: Ramming the driver composition.

Figure 10: The top (left) and bottom (right) plugs.

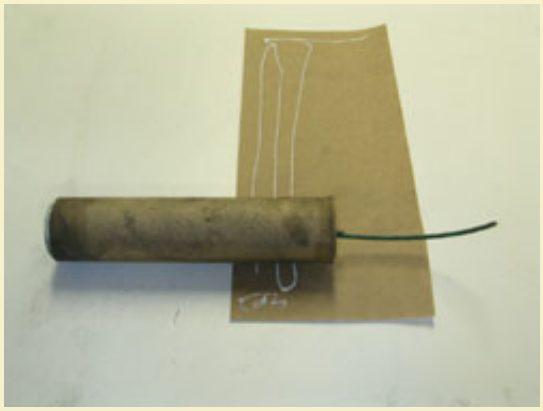

Figure 11: Fusing and nosing the finished gerb.

rammed, as seen in Figure 10. This hole should be 1/4" diameter and run only deep enough to just expose the powder inside. Because the gerb composition contains metal, DO NOT use a power drill to make this hole. The best way is to hand twist the hole in a drill press by pulling down on the press with one hand while twisting the chuck with the other. Note that a special base nipple could be fabricated so that this hole is automatically formed when the end plug is rammed. To keep the tooling simple for the beginner, this hand drilling method will work just fine.

Fusing and Finishing

The gerb is finished by fusing the hole with a doubled-up stick of black match or Visco type safety fuse. It is important that the fuse wedges tightly into the hole so that it will not easily pull out. Two turns of light-weight craft paper is wrapped around the fuse end and onto the fuse as seen in Figure 11, a process which is referred to as "nosing."

This gerb generates a respectable amount of thrust, thus it must be securely anchored when fired. One method is to tie pointed sticks to the side and stake them into the ground. Holes can also be bored through plywood platforms so that the gerb can be inserted and glued in place.

The photograph above shows a group of three gerbs being fired in competition during the Florida Fireworks Festival of 2003. These gerbs contain crackle stars as the microstars, which can be seen as the bright flashes scattered throughout the spark plume.

Figure 12: The finished gerb.