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Volume 3, Issue 6

Build This...

4" Lampara Shell

by Liquid Gold

Summary:
The lampara shell is simply a salute charge atop a container of flammable liquid. The effect, in its most common form, is a rolling orange fireball with black smoke. This makes for an ideal daytime as well as nighttime effect. Colored, somewhat translucent fireballs such as red or green are possible, using methanol and various metallic salts as coloring agents. But that's for another installment; here we will concentrate on the most common form in the four inch size.

4" Lampare Shell

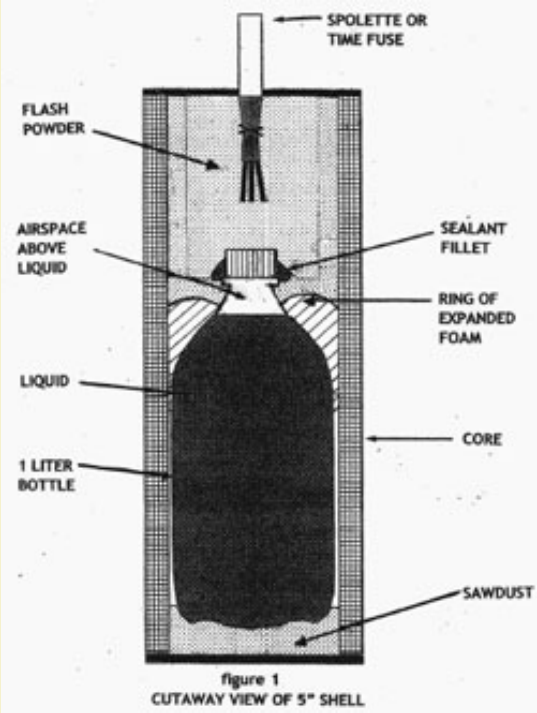

Figure 1: Lampara cross section.

Figure 2: Foam seal around the 1 Liter bottle.

"Idle tubing is the pyro's playground"
- Kurt Medlin

My first encounter with the lampara effect was at the 1997 PGI convention in Amana, Iowa, where it was a signature effect in the display presented by Heartland Pyrotechnics Association. Having apprenticed under some of their master craftsmen, I began developing some techniques and methods to create a 4" lampara shell. The product of that development process is the successful design presented here as shown in the cross-section view in Figure 1.

A lampara shell is essentially a pyrotechnic form of a fuel air explosive in which a container of flammable liquid is ignited by a salute charge. The resultant effect is a 'heavy report' and a rolling orange fireball surrounded by clouds of thick black smoke. The combination of sound from the flash powder salute and the vibrant color patterns created by the combustion of the petroleum based fuel makes the lampara shell an ideal effect for both day and nighttime displays.

Although the word 'lampare' is generally used to describe shells of this nature, the term lampara is more technically correct; lampare is the plural form (Swisher, 1999.)

Related effects are the "Fire Flower Lampara," a chrysanthemum style shell with a lampara pistil (as displayed by James Denny and Patti Roman of the Michigan Pyrotechnics Arts Guild) and naphthalene based lampare.

BEFORE ATTEMPTING LAMPARA CONSTRUCTION ONE SHOULD POSSESS A THOROUGH UNDERSTANDING AND EXPERIENCE WITH CANISTER SHELL CONSTRUCTION. RESEARCH AND UNDERSTAND THE SAFETY ASPECTS AND MANIPULATIONS OF FLASH POWDER. WORK SAFE!

Materials Needed:

Case
For a 4" lampara shell, a 3.5" OD spiral wound tube with a minimum wall thickness of 1/8" to 5/32" will be the case. It provides the strength and integrity necessary to stabilize the container of flammable liquid during transport and from the force and pressure of the lift charge. The exact length of the tube required will depend on the height of the container and the amount of flash powder in the salute charge. In this example, the tube is 12" long.

Paper tubes that have been used for plastic shrink-wrap are an excellent 'free' source of casing material though they are also commercially available from pyro community suppliers such as Platte River Fireworks.

Cardboard End Disks
Two sets of 1/4" end disks will be needed for a 4" lampara. One set of 1/4" end disks will be used for the spolette/time fuse assembly and a second 'double set' of end disks will be sealed to one end of the tube that will become the bottom of the case. Depending on the exact OD of the tubes that you use for a case, your stock 3.5" end disks may be slightly over- or under-sized. Be sure there is sufficient wall thickness for the end disk to bond to. Resinous wood glues, such as Tite Bond Premium, give superior strength and moisture resistance over Elmer's or similar glues that would normally be used in standard canister shell construction.

More...

4" Lampare Shell

Figure 3: Pleated paper over bottom of the can.

Figure 4: Piston made with wadding between two solid disks.

Container (bottle)
The ideal container is a plastic bottle made of High Density Polyethylene (HDPE). HDPE will not degrade or dissolve from exposure to the various petroleum fuels that may be used to create the lampara effect. While 16 or 20 ounce soda/pop bottles work well, the most compact and suitable container for a 4" lampara is the 20 ounce Gatorade bottle. Its size and shape provides the highest volume in as compact a container as possible while still leaving room for the required sealants and the salute charge. The 24 ounce bottle of Pepsi Products is about the maximum size for a 4" lampara shell.

Note: Most brands of plastic soda/pop bottles are made of PETE (Polyethylene Terepthalate) plastic and can deteriorate from long term exposure to petroleum distillate fuels, particularly gasoline. If in doubt, test your bottle/fuel combination for at least 3 months for signs of discoloration, brittleness or softening of the plastic.

HDPE bottles are available in various sizes and shapes from container/packaging manufacturers and suppliers and from Pyrosupplies.com.

Expanding Insulating Foam
Expanding polyurethane insulating foam, such as Great Stuff (Figure 2), is used to secure the container within the case.

Flash Powder
The standard 70:30 flash powder mixture of KClO4/dark aluminum is all that's required for the salute charge. For a 4" lampara, 6 ounces of flash powder is a minimum amount, larger amounts to taste. Due to the different densities of dark pyro aluminums, the amount you squeeze in will vary.

Fuel
Standard diesel fuel creates a nice orange fireball with lots of black smoke. Undiluted kerosene is a close second although almost any flammable liquid will have some effect. White gas (Coleman fuel), fuel oil, and used motor oil are also good candidates. A 50:50 or 70:30 mixture of gasoline and diesel, Kerosene, or motor oil will thin the mixture and maximize its dispersal in the air thus optimizing its ignitability and enhancing the effect though there will be some minor differences in the duration of the fireball and the amount of smoke produced.

When filling the bottle with fuel, leave approximately one inch of space above the liquid to allow for expansion due to temperature changes. Any leak or seepage from an over-pressurized container


Figure 5: Loading the saetines.

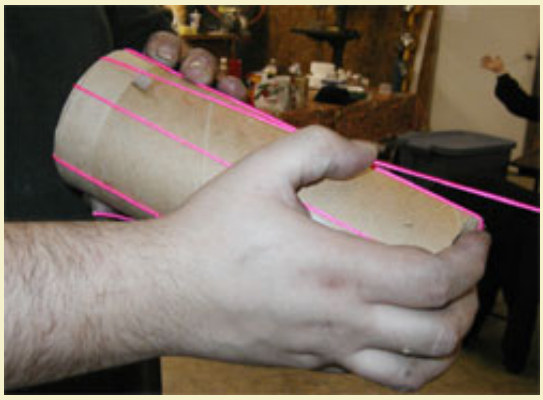
Figure 6: Horizontal spiking process.

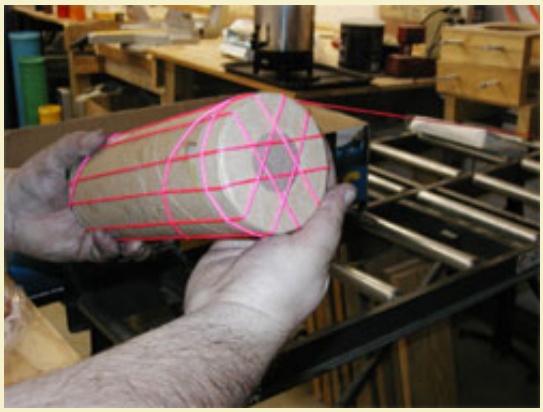
Figure 7: Masons twine used to illustrate pattern. Do not spike with this kind of twine!

could dampen the salute charge, dampen the spolette assembly or weaken the case and cause the shell to malfunction in the mortar and become a flaming ground bomb.

Colored fireballs in blue, red or green are also possible using methanol and various metallic salts as coloring agents.

Sawdust
Sawdust is used to fill in the space between the bottom disk and the irregular bottom of the bottle used. One inch of fill should be all that's necessary.

Sealant
A critical component of a lampara shell is the seal on the fuel container. It is essential that the sealant used be impervious to the fuel (or combinations of fuel) used. The leakage of even the smallest amount of fuel will likely have disastrous, not to mention embarrassing, consequences.

Permatex Form-A-Gasket No. 1 has proven to be a reliable sealant for this application. It adheres readily to HDPE, is easy to use, and is unaffected by petroleum fuels.

Solvent based urethane caulks are another practical option and have recently become more commonly available at home improvement stores.

Tests of latex caulk and RTV silicone adhesive for use as sealants were disappointing. Latex caulk was not fuel proof and did not provide a strong seal. RTV sealant is fuel proof, however, its major drawback is that when cured it readily peels from away from the smooth plastic cap (although this is not serious problem once the fuel container is secured in the case.)

Tape
1" - 1 1/2" wide gummed paper tape.

Time fuse/spolette

Although Japanese or Chinese time fuse could also be used, this design uses a spolette for the time delay. A 3-second time delay should be considered the minimum for a 4" lampara. To maximize the transfer of fire, use good quality stiff match and expose a good portion to the flash. With time fuse additional strands of blackmatch can be tied to the crossmatch. This may appear to be a bit of 'crossmatch overkill,' however, flash powders may sometimes be difficult to ignite; this is no place for shortcuts so it is vital to have plenty of blackmatch in direct contact with the salute charge. Whichever fuse option you choose for the delay, timing tests for a given length are crucial for safety and consistency.

Kurt Medlin's article on spolette construction (1999) is an excellent source of information on the art and craft of making hand rammed spolettes. Accompanied by numerous photographs, the article provides detailed step-by-step instructions that outline a practical method for making consistent and reliable spolettes.

A technical history of the Brock spolette is in Myke Stanbridge's article (1997).

More...

4" Lampare Shell

Assembly:
Note: While relatively easy to construct, a lampara shell is not a "beginner" project. A lampara shell is as dangerous, if not more so, as any salute shell. The use of a flammable liquid in combination with flash powder significantly increases the potential for serious consequences. A thorough understanding of and experience with both canister shell construction and the safe use of flash powder should be considered as minimum requirements before beginning construction of a lampara shell. The Fulcanelli articles (1984, 1987) on traditional cylinder shell construction are a definitive source.

1. Prepare two sets of 1/4" end discs; one set of discs with a nosed spolette/time fuse assembly and a second set of doubled end disks that will be sealed to one end of a tube to form the case.

2. Fill the container with fuel to within 1" of the top of the bottle. Apply a thick bead of sealant to the threads inside the bottle cap and screw the cap onto the bottle. Apply enough sealant to completely cover the outside of cap where it connects to the neck of the bottle.

3. Seal the set of doubled end disks to one end of the tube with resinous wood glue.

4. Pour in enough sawdust to make a 1" layer in the bottom of the case.

5. Place the sealed, filled container in the case allowing the sawdust to fill any gaps between the bottom of the bottle and the end disc.

6. Apply a bead or two of expanding insulation foam around the upper third of the bottle as shown in Figure 2. Monitor this process closely - expanding foam may swell into the cavity for the salute charge or get underneath the bottle and lift it out of its seated position in the sawdust. While the foam is still tacky, trim back any excess that goes past the bottle cap. When cured, the foam will anchor the bottle in the case and form a sealed cavity for the salute charge.

Note: Butane is used as the propellant for expanding foam insulation products. The process of applying the bead(s) of expanding foam inside the case may create a pocket or concentration of highly flammable butane fumes. The application process should be done outdoors and away from any open flames or other ignition sources.

7. When the foam has cured (about 12 hours), fill the space above the bottle with the flash powder mix.

8. Glue the end disc with the nosed and crossmatched spolette/time fuse assembly in place with resinous wood glue.

9. When the glue has set, apply two turns of gummed paper tape, half of the width of the tape, to the areas where the end disks and case meet as in Figure 4. The excess is snipped, pleated, and glued to the end disk as in Figure 5.

10. Spike the shell with 16 vertical wraps of cotton or flax twine as shown in Figure 6. A partially spiked shell is shown in Figure 7. Note that fluorescent masons twine is used in Figures 6 and 7 for the purposes of making the twine more visible. Masons twine is a poor choice for spiking and is only used here for illustrations purposes.

11. The shell is pasted in with 4 turns of 70 # Kraft paper in two steps of two turns each. When the first layer is dry, the final two turns can be applied.

12. Dry the shell.

13. Lift and leader the shell with the fuse up. Use the general lift rule of one ounce of 2FA black powder per pound of shell weight. With experience you'll learn to control the altitude at which the shell breaks using shell weight vs. lift charge and timing to dial in a desired burst height.

Temperature extremes should be avoided in prolonged storage. The safest storage practice for competed lampara shells is to keep them in an upright position.

Such long and potentially heavy cylinder shells can generate greater lift pressures than standard single break shells. Avoid the practice of securing mortar plugs with wire staples, which often leaves the plug very vulnerable to the increased lift pressures of a lampara shell which can result in a blown plug. Plugs secured with nails or bolts installed across the grain of the wood plug are preferred as drywall screws may lack sufficient shear strength. For the lampara shell weighing 3 - 5 pounds, HDPE is the safest choice being sturdier than the traditional cardboard mortar. Your mortar should be well plugged (perhaps a double or even triple thick plug) and buried 75% of its length. Larger lampara shells weighing more than 6 pounds should be treated as a multibreak shell and shot from a steel mortar. The steel tube should be buried 100% of its length and the shell fired by e-match or a long length of visco safety fuse.

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Resources

Tom Backes
End disks, tubing for lampara casings
TJB@aol.com (563) 556-0219

Mike Korbylo, ATF Fireworks
quality HDPE mortars and firing systems
http://www.atf-us.com

PyroSupplies.com
HDPE containers
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