Making inexpensive ejection charges for small to medium sized rockets using minitaure Christmas tree bulbs

A number of factors influence the selection of ejection charge igniters when using electronic deployment of recovery devices:

1. Reliability.	The igniter must ignite the black powder charge, or the recovery device will not eject.
2. Low Current.	The igniter must fire at a low current and voltage to minimize the requirements (and ultimately the weight) of the igniter battery.
3. Size.	The smaller the ejection charge, the easier it is to fit it into the rocket's airframe. Smaller devices also tend to be lighter, which will improve the overall performance of the rocket.
4. Ease of Use.	The ejection charge and igniter should be easy to replace in the field to allow for multiple flights without an excessive amount of preparation time.
5. Cost.	The ejection charge and igniter should be as inexpensive as possible without compromising the above criteria.

This document describes the fabrication of ejection charges and igniters using readily available parts that fit all of the above requirements. They will fire on as little as 2 Volts and 0.2 Amp of current, so the ejection charge battery can be as simple as two "N" alkaline or two to three "1/3AA" NiCad cells in series. A single "N" size 12 Volt type 23 battery can also be used, but has a much lower AmpHour capacity and will need to be replaced more frequently.

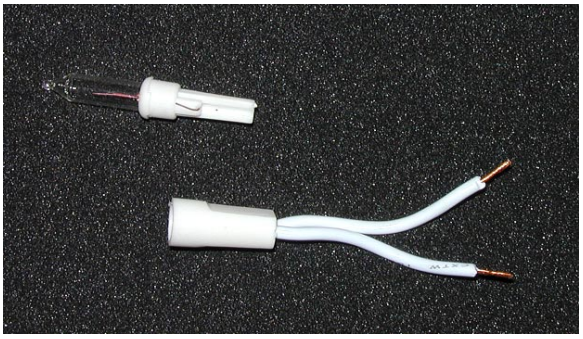
Charges of various sizes can be constucted using this technique, ranging from a 1.5" long, 0.25" diameter version suitable for up to 1.6" airframes and weighing in at under 1 gram to a larger version for up to 3" airframes that measures 1.5" long by 0.38" dia and weighs just over a gram. A simple plug-in socket arrangement allows for easy installation and removal in the field, and only adds a gram or two to the overall weight.

The total cost of each charge including igniter, all materials, and black powder is under $0.25. Fabrication time is approximately one minute per charge and requires no special tools.

Extensive testing has demonstrated superb reliability. Dozens of ground tests and over 80 flights have been logged without a single failure. The low current characteristics of the igniter also allows the use of redundant charges wired in parallel for an even greater degree of confidence.

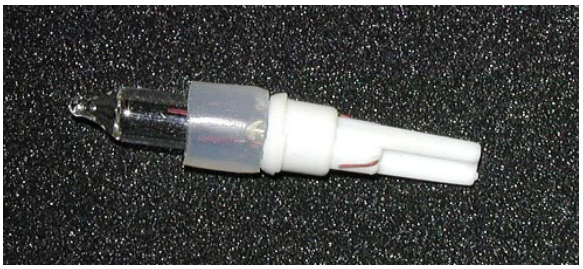
You will need:

1	Miniature Christmas tree bulb (any color, non-blinking)
3/16"	1/8" ID Silicone tube
1"	3/8" diameter (before shrinking) heat shrink tube
	A suitable quantity of FFFFg black powder
1" sq	Non-flammable recovery wadding



The bulb and socket.

Take the bulb and inspect its leads. You will probably find that they are coated with oxidation. Using a knife or piece of sandpaper, remove the oxidation until the leads are bright and shiny. Do not damage the leads.

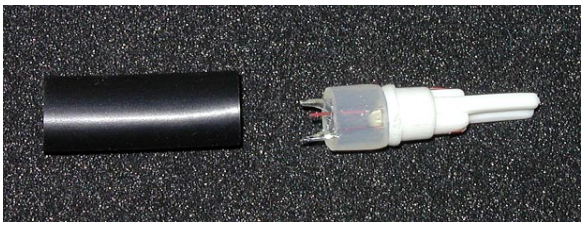


Silicone tube in place.

Cut a ~ 3/16” length of 1/8” ID Silicone tube and slide it along the bulb until it reaches the flange. Most of the filament and leadwires inside the bulb should be covered.

Bulb tip snapped off, filament exposed.

Carefully snap off the end of the bulb with pliers. Do not damage the filament wires inside. Check continuity at this stage. You should get ~2 Ohms.



Ready to install heat shrink tube.

Slip a piece of heat shrink tube over the silicone. Do not allow the heat shrink tube to extend past the bulb flange or the bulb will not fit in its socket.

Heat shrink tube installed and shrunk.

Heat the end of the heat shrink tube that is over the silicone tube to secure it. If you are making a large charge, leave the remaining section of heat shrink unshrunk (full diameter). For smaller charges, shrink the entire length of tubing to the desired size. When the tubing is cool, fill the end with black powder and plug with flameproof wadding.

Left: End view of avionics bay with bulb socket shown. Spent charge below. Ready for a new charge to be inserted (only takes seconds in the field!).

Below: Views of the avionics bay with bulb socket shown from inside and outside. Apply silicone or hot melt glue around the outside of the socket (inside the bay) for added strength and to seal out ejection gasses.

Note: Ejection charge fits in socket with tight friction fit. Due to the low weight of the charges, this is sufficient for most applications. If you expect very high acceleration, you may want to fabricate a clip that holds the charge in place against acceleration/deceleration forces.

Warning! To protect your fingers, always insert/remove live charges with a pair of long nosed pliers. Do not hold charges between your fingers!