**THE COLOR AND REPORT ROCKET**

by Kurt Medlin

"Idle tubing is the pyro's playground"

Inspiration can come from the most unlikely places. The color and report rocket described here was born out of such an experience.

After successfully learning to make black powder rockets in the one-pound size (3/4" bore), I decided to go up to the two-pound black powder rocket (7/8" bore). At that time in the mid-1980’s, the only vendor selling 7/8" ID tubes was Triple G Tube Supply,* so I ordered a supply from them and began making two-pound rockets with a set of newly acquired 2 lb. rocket tooling. The story would have ended there if it were not for something unique about the size of these particular tubes relative to the tooling. However, before I continue the story, some background is necessary on the prevailing rocket sizing convention currently in use in the United States.

In the U.S., an unofficial “standard” has emerged for the dimensions of core-burning black powder rocket motor tubes and their corresponding tooling. Specifically, this standard sets the rocket tube length at ten times its internal diameter (ID), and the spindle length at seven times the tube ID.† This is not a hard and fast rule, but a “standard” that has emerged by virtue of the fact that most, if not all of the U.S. pyro tool and tube suppliers offer rocket tooling and tubes conforming to these dimensions.

Every pyro supplier except Triple G and their two-pound rocket tube, that is.

While all of Triple G’s other rocket tubes followed the “standard,” mentioned above, their two pound tube was much longer. Instead of being 8¾ inches long (10 x 7/8" = 8¾”), Triple G’s two-pound tube was a full 10 inches long. Since my spindle conformed to the “standard” and only occupied seven ID’s of the tube (6½”), I ended up with a little over two inches of empty tube after pressing the motor - even with a one-ID tall increment of composition above the spindle and a one-ID tall increment of clay above that. Except for an inconsequential amount of additional weight, this extra bit of tube is not inherently a problem. But somehow it seemed a shame not to put this unused portion of the tube to good use – preferably in a way that was “pyrotechnically enhancing” to the effect of the rocket. My solution to putting this unused space to good pyrotechnic use was to develop the Color and Report Rocket described below.

The “Pyrotechnically Enhanced” Rocket Effect and Design

The effect of a color and report rocket is just as its name implies, a burst of color (or any type of star effect) followed by a report. As you can see from the diagram below, the rocket carries a heading on top as it normally would (in this example, a traditional diamond-like shape used in the past), and the unused portion of the engine tube above the propellant is used as the report casing (see Figure 1). The sequence of events is as follows: When the engine reaches the last of the rocket composition at the end of the rocket’s coasting phase, it ignites a piece of quickmatch that leads outside the engine and up the side of the tube into the heading. This sets off the color portion of the effect while simultaneously lighting a piece of time fuse leading into the report portion of the engine tube. The time fuse provides a 2–3 second delay for the stars in the color burst to start burning out before igniting the report.

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* No longer in business, 1999.
† For more details on this “standard” see Mike Swisher’s article, “Dimensions for Black Powder Rocket Spindles,” in PGI Bulletin No. 114 (June, 1999).
Besides the aesthetic effect the report adds to the rocket’s display, there is a small additional benefit to this design with regard to safety. When the report goes off, it does one of two things to the rocket tube: it either splits it into more than one piece, thus minimizing the size and weight of the fallout; or it remains more-or-less in one piece, but is splayed open like a peeled banana, providing air resistance as it falls, thus slowing its descent. One of the often-sited objections to using rockets in public displays in this country (right after the objection about using an untethered, self-propelled firework in a public display at all), is the fallout danger from the rapidly falling engine casing and attached stick after the rocket has finished its display.*

This design doesn’t propose to solve the issue of fallout associated with rockets completely, but it does offer some additional safety benefit.

One aspect of this design which some may consider a drawback is the inherent limitation in the options for constructing the heading case to be used as the ‘color’ portion of the effect. The end of the ‘color’ heading case that attaches to the motor needs to fit over the outside of the motor tube to accommodate the black match coming up the side of the motor as well as the time fuse sticking out of the top of the motor. Unless some creative techniques are used, this pretty much precludes one common approach to making headings - that of making a round or canister shell separately (substituting black match for time fuse) and attaching it to the top of a completed motor. Despite this limitation, I believe very pretty and effective rocket effects can be had with this design.†

A Step-by-step Pictorial of Making a One-Pound Color and Report Rocket

Since Triple G is no longer in business, the options for obtaining an extra-long rocket tube are to roll the tubes yourself, or to find a supplier that carries tubes of the appropriate length.†

* This “problem” may be more cultural than technical, since rockets are used in large numbers by pyrotechnists in Latin America and parts of Europe, where this supposed hazard results in little reported injury or loss. The American propensity to file frivolous lawsuits and the consequent ‘gunshyness’ of insurance carriers is proverbial.

† As an adjunct to this article, in a future PGI Bulletin I will present some simple designs for making headings that can be used with this design, including the heading shape in Figure 1.
ate size. The exact extra length of tube is not critical, it just needs to be long enough to hold an adequate amount of flash powder and allow enough space to insert the end plug with the time fuse. A length equal to two tube ID’s can be used as a rough guideline for determining the minimum amount of extra tube needed. There is no maximum extra tube length to which one must adhere in this design, but as a practical matter, you will want to avoid tubes exceeding the length your rammers can accommodate, unless you plan on making special rammers for the purpose.

Below are step-by-step instructions with pictures for making a color and report rocket in the one-pound size using 3⁄4” ID by 9” long gerbe tube from Precocious Pyrotechnics.

Step One: Prepare the Report Delay
Prepare the report delay by gluing a piece of time fuse into the middle of a 3⁄4” end plug. Leave most of the fuse on the side of the plug that will be sticking up into the color heading. The time fuse should have about 3⁄4” – 1” between the cross matching for 2–3 seconds of delay. The exact amount of time is a matter of choice – I like the report to go off just as the effects in the heading are burning out, that way it serves to punctuate the end of the effect. Photograph No. 1 illustrates cross-matched time fuse glued into a 3⁄4” end plug.

Step Two: Mark Rammers to Account for the Additional Tube Length
After rolling or buying a sufficiently long tube, it will be necessary to mark new change points on your rammers to account for the additional tube length. Anyone who has ever ruined a spindle by not changing rammers at the proper time will attest to this very important step!

Step Three: Pre-drill Hole for the Passfire
The next step is to pre-drill a hole in the appropriate position for the passfire. This could be done after the engine has been pressed, but I prefer to avoid drilling into composition, even when it is a relatively benign one made from hand-sifted potassium nitrate, charcoal, and sulfur. The proper height at which the hole should be drilled depends on how much time you prefer before the color heading ignites, and will generally correspond to where you would normally start the clay plug in a non-color and report rocket. In my experience, the rule of thumb of one ID of powder above the spindle works well and provides the appropriate amount of delay (in this example, that would be a 3⁄4” thick solid increment of composition above the central cavity left by the spindle). If you prefer more or less timing before the heading goes off, measure appropriately above central cavity left by the spindle, bearing in mind the amount of time needed to display both the color and report safely above the ground. Photograph No. 2 illustrates the position of the passfire hole relative to the tip of the spindle. When drilling the hole, a dowel should be placed inside the tube to support it and to ensure a clean cut.

Step Four: Press Rocket and Attach the Passfire
Press the rocket as you would normally, up to the point where the rocket composition has been rammed to just below the passfire hole (I keep a piece of tape over the passfire hole during the pressing process to keep the charcoal dust from blowing out). Next slide a

Photograph 1 - End plug/time fuse assembly. This one was made with 3⁄4” between the cross matching on the time fuse for approximately two seconds of delay. To add strength to the end cap, I like to fill in the area between the time fuse and the edge of the end cap with a 1⁄4” thick layer of hot glue or some such filler. This should be done prior to gluing the assembly into the report chamber of the motor tube.

Photograph 2 - Pre-drilled hole for the passfire. Notice where the passfire hole is relative to the spindle - one ID, or 3⁄4” in this case for a 1-lb. rocket.

Photograph 3 - Ramming a small increment of powder over the passfire match. A solid, one-ID thick increment of clay is pressed above this to form the bottom of the report chamber.

Photograph 3 - Bending the passfire up the side of the motor.
Photograph 5 - Passfire match secured to side of motor with a band of pasted 30-lb. Kraft paper.

Photograph 6 - The end plug/time fuse assembly glued into the report chamber. White glue or woodworker’s glue can be used. I do not use hot glue for this step. Twisting the passfire match around the time fuse as shown was done more to facilitate the attachment of the heading than to ensure ignition. In the type of heading used in this example, the passfire match and time fuse end up nestled in the stars and burst charge.

Photograph 7 - Sliding the filled color heading over the passfire and time fuse leading to the report chamber.

Photograph 8 - The completed Color and Report Rocket ready for a stick, a fuse, and a launching tube!
piece of good quality, 8- or 10-ply match into the hole and while holding it there, add enough rocket composition to cover the match by about \( \frac{1}{4} \). Ram/press this final small increment to consolidate the composition around the match. Above this, consolidate a solid increment of clay one ID thick. Bend the match up the side of the tube and secure it with a band of pasted 30- or 40-pound Kraft paper. This essentially turns the black match into piped match so the fire transfer to the heading will be almost immediate. Photograph No. 3 shows the tube on spindle with match sticking out of hole and rammer in the tube. Photograph No. 4 illustrates passfire match bent up to rocket heading area, and Photograph No. 5 how it is covered with a band of pasted paper.

**Step Five: Add Flash Powder and Close with the End Plug/Time Fuse Assembly**

Fill the empty report portion of the rocket tube with flash powder and glue the end plug/time fuse assembly into the tube so the edges of the end plug are even with the top of the tube. Photograph No. 6 depicts the time fuse/end plug assembly glued into the tube.

**Step Six: Attach Heading**

The heading shown in Photograph No. 7 is being attached after being filled with stars and burst (hence, it is being attached while upside down). Depending on the design of your heading, you may want to attach an empty case first and fill from the top. Any heading design that will fit over the passfire and accommodate the time fuse sticking out of the motor will work.

**Some Final Thoughts on This Design**

One interesting variation is to use a small whistle instead of time fuse leading into the report section of the rocket. The whistle enhances the overall effect by building tension in anticipation of the report. For the whistle, I use a tube with an outside diameter equal to the ID of the rocket tube so the tube itself acts as part of the end plug. A \( \frac{1}{2} \) ID “standard” 4-ounce rocket tube usually has an OD of \( \frac{3}{4} \), and when cut to \( 1\frac{3}{4} \) and pressed with a 2–3 second increment of whistle comp, works well as the report delay in the one-pound size. And speaking of variations, it might be possible to adapt this design to girondola drivers, although the extra weight of the longer tube may be more of an issue in this application. Then again, girondola drivers are often end burning (made without a central cavity), so one might be able to use a standard size tube and load an inch less of the thrust composition to make room for the report section.

Assuming one had a suitable shooting site, a flight of ten or more color and report rockets would make a nice mini-finale in a public display. One effect I have always wanted to see is a bouquet of fifty or more color and report rockets all carrying a soft charcoal willow effect in the heading. The sight of all those golden rocket tails rising up majestically like a giant wheat sheaf erupting into an avalanche of gold at their zenith, punctuated a few seconds later with a battery of reports, would be a sight not soon forgotten!