

Enhanced Igniters

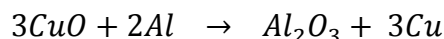
Purpose:

In modern amateur rocketry, the occurrence of failed ignition is termed a hang fire. This is typically caused by discontinuity or insufficient heat output from provided igniters. Implementing Enhanced Igniters will significantly reduce risk of a hang fire at launch site.

Theory:

Within a closed circuit, a small voltage input is applied, which allows current to pass through the provided igniter wires. At the junction point of the two wires, resistance causes the junction to heat up, which ignites a compound covering the junction. The heat generated is assumed to be high enough to ignite the rocket motor.

To increase the heat output, the igniters will be enhanced by coating the junction with a mixture of Copper oxide and Aluminum powders (Thermite). The Thermite compound burns at a much higher temperature than the original igniters. We are also able to control the mass of this Thermite mixture that is implemented. The following chemical reaction occurs during the Thermite combustion:



Where: $M_{Cu} = 63.5 \text{ g/mol}$ $M_{Al} = 27 \text{ g/mol}$ $M_O = 16 \text{ g/mol}$

$$\text{Mass Ratio} : \frac{4.4 \text{ CuO}}{1 \text{ Al}}$$

Materials Used:

Safety Gloves	Masks	Aluminum Powder
Scale	Safety Glasses	Rubber Cement
Hobby knife	Copper-Oxide Powder	Sealable Bag

Procedure:

- 1) Prepare all listed materials and have them ready to use
- 2) Measure mass of CuO and Al powders according to the ratio provided above
- 3) Place both powders into a resealable plastic bag and ensure that they are thoroughly mixed
- 4) On a clean surface apply a bead of rubber cement, and then mix a desired quantity of the thermite mix, thoroughly mix until a malleable ball of thermite is formed (use hobby knife)
- 5) Measure mass of igniter
- 6) Place thermite ball on the junction point of igniter, measure mass again.
- 7) For best results, use approximately 0.2 grams of thermite/rubber mixture

Testing:

Three Estes igniters were tested; One igniter was not altered, one had 0.1 grams of rubber thermite, and the other had 0.2 grams of rubber thermite. The non-altered igniter produced a puff of smoke, the 0.1 gram rubber/thermite produced bright visible flash, and the 0.2 gram rubber thermite showed a significant output of heat.

Conclusion:

Our studies conclude that using an addition of approximately 0.2 grams of rubber thermite will be sufficient in successful igniting a rocket motor.



Figure 1: Scale



Figure 2: Copper Oxide and Aluminum Powder



Figure 3: Copper Oxide /Aluminum Powder mixture (Thermite)

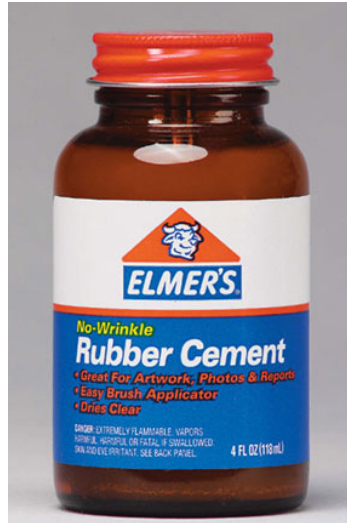


Figure 4: Rubber Cement

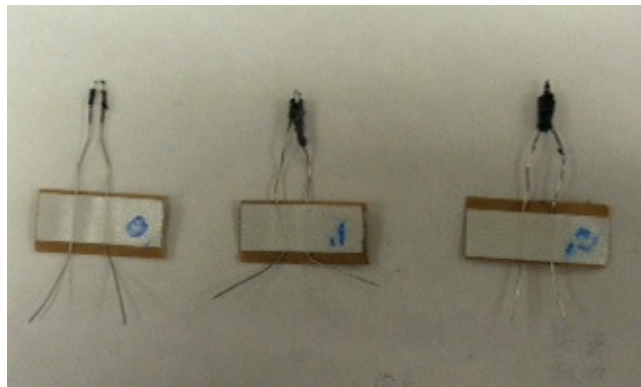


Figure 3: Igniters