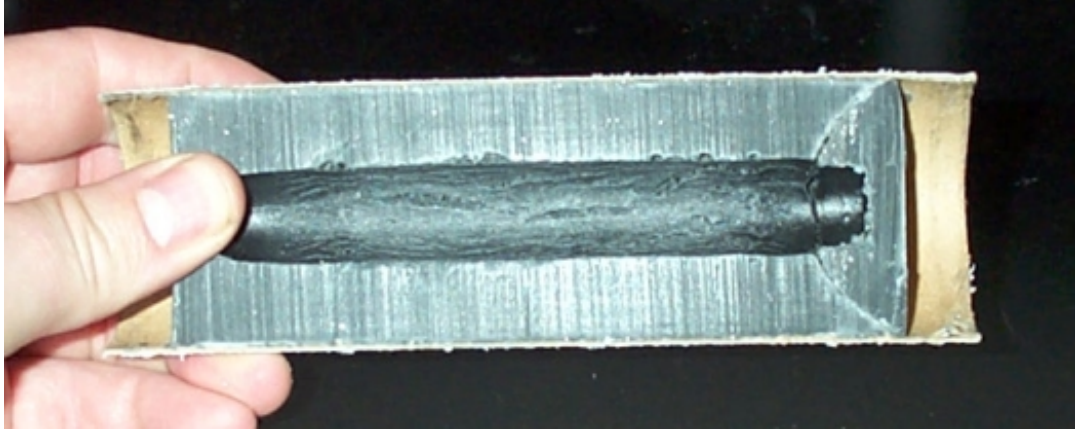


## Fourth spin casting test - December 20th,2004



The fourth test used the same 1% graphite 99 % paraffin mixture was used. The grain was spun for 2 hours in a 60 deg F environment.

The main difference was that the RPM were reduced to half the value they were in the third test. In the third test the lab power supply was set at 7.5v in this test it was set at 4.0v. We tried to hook up the tachometer but it looks like the sensor element is toast. it is likely the RPM is around 300.

No stratification of the graphite powder was noticeable and the entire grain is black in color due to the graphite.

During this test we did not use the outer phenolic liner but just spun the cardboard liner with the two end plugs. Everything seemed to hold up fine.

Surface cracks were again noticed on the inside surface of the grain port, as well as the dome shaped crack on the drive plug end. Due to the over size hole that slides over the Kollmorgen motor shaft and the set screw that holds it into place there is a slight rotating unbalance on the drive end. This oscillation may account for the paraffin breaking on that end as it cools. A good next test would be to eliminate this wobble.

The shrinkage works out to be about 13.3 %. The variation in the shrinkage percentage numbers may be due to the changing volume of the interior surface cracks between the different tests, which we are not able to measure.



**Calculations :**

$$\text{Grain}_{\text{OD}} := 1.75\text{in} \quad \text{GrainLength}_{\text{final}} := 4.98\text{in}$$

$$\text{GrainLength}_{\text{initial}} := 4.95\text{in} \quad \text{GrainPort}_{\text{avg}} := .65\text{in}$$

$$\text{Volume}_{\text{liquidparaffin}} := \left( \frac{\pi \cdot \text{Grain}_{\text{OD}}^2}{4} \right) \cdot \text{GrainLength}_{\text{initial}}$$

$$\text{Volume}_{\text{liquidparaffin}} = 11.906 \text{ in}^3$$

$$\text{Volume}_{\text{solidparaffin}} := \left( \frac{\pi \cdot \text{Grain}_{\text{OD}}^2}{4} - \frac{\pi \cdot \text{GrainPort}_{\text{avg}}^2}{4} \right) \cdot \text{GrainLength}_{\text{final}}$$

$$\text{Volume}_{\text{solidparaffin}} = 10.326 \text{ in}^3$$

$$\text{PercentShrinkage} := \left( 1 - \frac{\text{Volume}_{\text{solidparaffin}}}{\text{Volume}_{\text{liquidparaffin}}} \right) \cdot 100$$

$$\text{PercentShrinkage} = 13.273$$