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Note on mylar film stretching and tension measurement.

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We have established a procedure for producing cathode planes. The cathodes are made from 6.4µm thick aluminized polyester film attached to FR4 frames. The aluminum coating is typically 100 to 200Å thick on both sides. Briefly, we stretch the aluminized mylar film on top of a granite table. We stretch the film a known amount. Then we glue a circular FR4 frame onto the film with a hydraulic press, using epoxy as the adhesive. Next we add an aluminum transfer frame to the film and cut it off of the stretching apparatus. We then turn this assembly over on the granite table and glue a mating FR4 ring to the opposite side, again using the hydraulic press. Finally we cut the finished cathode plane off of the transfer frame. Robert Openshaw can then check for leaks and measure the tension of the film on his test jig.

We started off planning to use the strain gauges on the granite stretching table to monitor the amount of stretch in the mylar film. It may be feasible to do so for production work. However because we had some concerns about linearity and hysteresis in the digital readout system, we did something more direct. We simply measured the amount of elongation of the film with a ruler as we stretched it.

We did three tests in which we stretched the film at different tensions and mounted it to cathode frames. Robert Openshaw then measured the resulting tension by flowing gas into a volume bounded by the film, and measuring the resulting change in volume and pressure as the film deflected under the gas pressure.

In order to calculate tensions from a known stretch we need values for Young's modulus, and because this is a biaxial stretch we also need Poisson's ratio. We measured both of these numbers for the mylar film that we are using. We got E=5200 Mpa for Young's modulus and μ=.34 for Poisson's ratio.

Using the formula $\sigma=E\epsilon(1+\mu)/(1-\mu^2)$ we can then calculate the expected tension for the film and compare it with the tension that Robert observed.

Elongation %	Predicted Tension Mpa	Measured Tension Mpa for 6.4µm film
0.2	15.8	32.7 = 1.19 lb/in
0.5	39.4	42.6 = 1.55 lb/in
0.8	63.0	53.6 = 1.95 lb/in

Agreement between the measured and calculated tensions is not very good. We would like to understand why the agreement is not very good but it is not essential for the production of cathodes because we measure the amount of stretch directly and Robert measures the amount of deflection for a given pressure difference directly. So Robert can inspect the cathodes and tell us whether or not they are acceptable without having to understand the exact stress-strain relationship for the material.