Scintillator Quality Control

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1 Overview

The development of the calorimeter for the Next Linear Collider (NLC) relies heavily upon the layers of scintillator tile which emit photons with the passage of charged particles. A significant amount of quality control is necessary to insure consistency during the testing and development stages.

2 Specification

Our raw material consists of $100cm \times 10cm$ strips of extruded scintillator developed by Fermilab. The original thickness is given as $5mm$. The extruding process leaves small ridges and valleys in the scintillator.

2.1 Measurement

On each strip of scintillator, 19 thickness measurements were taken at 5cm increments down the length. Each set of 19 measurements were repeated every $2cm$ down the width, resulting in 76 measurements over the entire strip of scintillator. This process was then repeated for each of our four strips of scintillator. The thickness was measured centered at $0.5cm$ as per manufacturer's specifications.

3 Results

For each scintillator strip, S_1, S_2, S_3, and S_4, the average thickness was measured for each of the four rows, and the standard deviation, given in (1), was computed to give the maximum and minimum tolerances.

The Standard Deviation

$$\sigma_x = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2} \tag{1}$$

The resulting data, after making the standard deviation calculations for each row, is given in the table below:

Table 1: Measurements of Each Row of Scintillator

	Row 1	Row 2	Row 3	Row 4
S_1	$4.925 \pm 0.013mm$	$4.853 \pm 0.012mm$	$4.874 \pm 0.008mm$	$4.906 \pm 0.026mm$
S_2	$4.897 \pm 0.013mm$	$4.859 \pm 0.023mm$	$4.859 \pm 0.023mm$	$4.927 \pm 0.020mm$
S_3	$4.887 \pm 0.007mm$	$4.871 \pm 0.004mm$	$4.861 \pm 0.007mm$	$4.860 \pm 0.015mm$
S_4	$4.888 \pm 0.006mm$	$4.879 \pm 0.009mm$	$4.859 \pm 0.007mm$	$4.860 \pm 0.017mm$

The thickness of the scintillator is fairly consistent, showing a slight ridges on the edges (row 1 and 4), and valleys in the center (rows 2 and 3). The average thickness and its standard deviation is given below:

Table 2: Average Thickness Over Entire Scintillator

	Thickness
S_1	$4.889 \pm .032mm$
S_2	$4.885 \pm .035mm$
S_3	$4.870 \pm .014mm$
S_4	$4.871 \pm .016mm$

The thickness over the entire area is resonably uniform where the average fractional uncertainty is approximately 0.4% across all scintillator strips. This small variance is not likely to be large enough to interfere with any of measurements made during the experiment.