**Results**

The first set of data that was collected in the running of this experiment was the time it took for dye injected into the water tunnel to travel 0.87 m. This was accomplished through the use of three separate timers, each of which recorded a separate value for said time. An average of these values was then taken and was in turn used to estimate the velocity of the water passing through the water tunnel’s test section, as shown in Equation (1), where V refers to velocity in m/s, d refers to distance, and t refers to time.

(1)

The standard deviation of each velocity measurement was then found, as shown in Equation (2) below, were refers to the average velocity, Vi refers to each velocity measurement, and n refers to the number of measurements taken.

(2)

The average values obtained from Equation (1) were then compared to those indicated by the digital flow speed measurement on the water tunnel itself.

Finally, the uncertainty of each velocity measurement was found through the use of Equation (3) below, where Δt refers to the uncertainty of each time measurement and Δd refers to the uncertainty in the distance measurement.

(3)

The results of these calculations are shown in Table 4-1 below.

**Table 4-1. Indicated and Calculated Flow Speed Measurements, with Error Characteristics**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trial Number** | **Time (s)** | **Velocity (m/s)** | **Uncertainty (±m/s)** | **Standard Deviation (m/s)** | **Mean Velocity (m/s)** | **Indicated Velocity (m/s)** |
| **1** | 3.6 | 0.242 | 0.005 | 0.00672 | 0.242 | 6.28 |
| 3.7 | 0.235 | 0.005 |
| 3.5 | 0.249 | 0.005 |
| **2** | 2.3 | 0.378 | 0.010 | 0.01648 | 0.379 | 9.48 |
| 2.4 | 0.363 | 0.010 |
| 2.2 | 0.395 | 0.011 |
| **3** | 1.8 | 0.483 | 0.016 | 0.03023 | 0.513 | 13.56 |
| 1.7 | 0.512 | 0.018 |
| 1.6 | 0.544 | 0.020 |

The second set of data that was collected over the course of the lab was velocity values measured at 9 different points through the use of the laser Doppler anemometry device discussed in the Introduction section. For each trial in the experiment, the LDA device took the mean and standard deviation of the thousands of velocity measurements that it captured at each of its 9 measurement points. These mean values at each point were then averaged to calculate the overall flow speed of the tunnel itself, as to compare to those values indicated by the tunnels flow speed measurement device and the results listed in Table-1. The results of these calculations are shown in Table 4-2 below, while the raw data captured from the LDA for each flow speed measurement are shown in the Appendix.

**Table 4-2. LDA Flow Speed Measurements**

|  |  |  |  |
| --- | --- | --- | --- |
| **Trial** | **LDA Velocity (m/s)** | **Timed Velocity (m/s)** | **Indicated Velocity (m/s)** |
| **1** | 0.203 | 0.242 | 6.28 |
| **2** | 0.320 | 0.379 | 9.48 |
| **3** | 0.442 | 0.513 | 13.56 |