

## Shadow Measurements

Date: November 1, 2020

Location: Duarte, CA

Bucket D1: 9.4375 in.

Bucket D2: 8.3125 in.

D: 0.5625 in.

H: 53.8125 in.

Chart of measurements:

Time	S (in.)	X1 (in.)	L=S+X1-D (in.)	$\tan(z)=L/H$	$z = \text{ATAN}(L/H)$ (deg.)
11:00 am	57.1250	4.0625	61.1650	1.1366	48.6589
11:06 am	56.5625	4.0625	60.0625	1.1161	48.1415
11:12 am	56.1250	4.0625	59.6250	1.1080	47.9333
11:18 am	55.8750	4.0625	59.3750	1.1034	47.8135
11:24 am	55.6250	4.0625	59.1250	1.0987	47.6932
11:30 am	55.5625	4.0625	59.0625	1.0976	47.6630
11:36 am	55.4375	4.0625	58.9375	1.0952	47.6026
11:42 am	55.5625	4.0625	59.0625	1.0976	47.6630
11:48 am	55.8750	4.0625	59.3750	1.1034	47.8135
11:54 am	56.0625	4.0625	59.5625	1.1069	47.9034
12:00 pm	56.5625	4.0625	60.0625	1.1161	48.1415

### Analysis:

The measurements were taken in my backyard, with the help of a bucket, a tall PVC pipe, dirt, and a tape measure, and a carpenter's level app. There's a half basketball court in my backyard that is fairly level, which is where I set up the apparatus. Unfortunately, soil was the best sand substitute I had on hand, but it was tightly packed around the pipe after I'd made sure it was straight with the level, and that it was centered inside the bucket. Just before taking the measurements, I rechecked to ensure the pipe was still straight. From there, I measured the length of the pole's every six minutes starting at 11 as true solar noon was around 11:36 am today.

There were a few issues I encountered during the process, with the most prominent one involving light. Cloud cover began coming in around 11:36 am. The clouds cleared up in time for the next measurement, though the clouds rendered the pole's shadow a bit more indistinct than I would've liked towards the edges. The 11:36 am measurement is the most affected by this, although I was still able to get an estimation from there. Another issue involves the tape measure I used. Unfortunately, the only two tape measures I had access to were in Imperial/US units, rather than the metric system, and the smallest unit was 1/16th of an inch. Some of the shadows fell in between these ticks, which made taking that given measurement a bit difficult. Some improvements would be ensuring I had better measuring tools at my disposal, and ensuring I was in an area with enough light to guarantee dark shadows.

### Scatter Plot:



