Week 3

Situation

During the lab, The AEV was constructed and a new code which is listed in Appendix B, was written to test the functionality of the AEV on the track, and different propeller types were tested to determine the most efficient design. These first steps were crucial in understanding the structure and workings of the AEV, as well as getting familiar with the code for the project. The vehicle itself was created using the default model as outlined in the PDF, and then altered to correct imbalances. The code was written following the basic structure from the lab manual. Due to problems with uploading code and having the machine function correctly, most the lab was spent problem solving which prevented a test run on the track. Additional time was taken outside of lab to finish problem solving and have the AEV function correctly.

Results & Analysis

Due to multiple problems and time constraints, the AEV was not tested on the track. Tests were performed on the tabletop mount. It was found that there was an uneven weight distribution, many bolts were not on tight enough or were placed improperly, and the zip ties blocked the wheels from moving. The team had to adjust the location of the arm to make the wheels located more in the center of the AEV. Also, the bolts were rearranged and screwed on much tighter to keep the AEV intact. Finally, the team cut the zip ties from the sensors to give more space for the wheels to roll on the track. In the time allotted, the AEV did not get the opportunity to travel to the gate or travel at all.

After looking at all of the data, the group determined that the propeller type EP-3030 would be used while moving forward in the lab. As seen in the data tables that are located in the appendix, the EP-3030 propeller had the greatest thrust value and it had the greatest power efficiency. The EP-3030 had a thrust value of 18.49 grams and a power output of 16%. Both of these values were the highest out of all of the propellers which is why the EP-3030 was chosen to move forward with.

The team was able to look at the original code (Appendix B) and see what direction the propellers needed to be spinning in order to move forward or backwards. Since the Mission Concept asks the team to have it go equally forwards as it goes backwards, the team is planning how long it must go forward before it will be asked to be reversed. The team will have to take into account how long it takes the AEV to stop and how long it takes for it to go in the opposite direction. The team will use the simple code to create the blocks of code enabling the AEV to complete the different parts of the task.

Takeaways

1.) Propeller - Propeller type EP-3030 produces the most thrust out of the three types tested.
2.) Hardware – Make sure wires are connected in the right orientation (I.E. motor wires).
3.) AEV design – Must be balanced, otherwise the AEV will not move on track.
4.) Code – Make sure motors run in the same direction at the same time.

Week 4

Situation

The first part in lab three is to design an orthographic drawing of a potential AEV design individually. To do this, time should be spent brainstorming ideas for the sketch by using a list of design considerations found in the lab manual. This is done in preparation for the group planning session. This individual portion of the lab should last for about ten to fifteen minutes. Once this is completed, the group must come together and compare their designs for the second part of the lab. In doing this, a conceptual orthographic drawing will be sketched. The sketch will be used to plan further for the testing and development of the AEV.

Weekly Goals

1.) Come up with a viable AEV design to use as a jumping-off point for testing.
2.) Discuss ways to make AEV as energy-efficient as possible.

Weekly Schedule

Table 1: Week 4 Schedule

Task	Teammates	Start Date	Due Date	Time Needed
Week 3 Progress Report	All	1/28/2017	2/1/2017	2 Hours
Creating Design for AEV	All	2/1/2017	2/4/2017	1 Hour and 20 Minutes
Week 4 Progress Report	All	2/4/2017	2/8/2017	2 Hours

Appendix A

Date: 2/3/17
Time: 1:00 pm
Members Present: Lizzie Rumford, Josh Penko, Collin Barack, Madison Hudak

Topics Discussed: Lab 2 Progress Report

Objective:
The focus of today was to complete the Lab 2 Progress Report due on the 2/4/2017, and to discuss AEV issues along with potential designs.

To Do:
1.) Lab 2 Progress Report.
2.) Discuss AEV designs.
3.) Fix issues encountered in labs 3 and 4.
4.) Troubleshoot the problems causing the AEV to not move.

Decisions:
1.) Work on progress report over 2 days.
2.) Made decisions on the AEV design.

Reflections:
1.) Ask for help earlier should the team need it.
2.) Start earlier when writing a progress report. Consider doing a small amount of work each day on a shared document online.

Appendix B

```
motorSpeed(4,25);              // motor runs at 25% speed for 2 seconds
goFor(2);

motorSpeed(4,20);              // motor runs at 20% speed until position = 394
goToAbsolutePosition(394);     units

reverse(4);                    // reverse motors and run at 30% power for 1.5
motorSpeed(4,30);              seconds
goFor(1.5);

brake(4);                      // brakes all motors
```

Appendix C

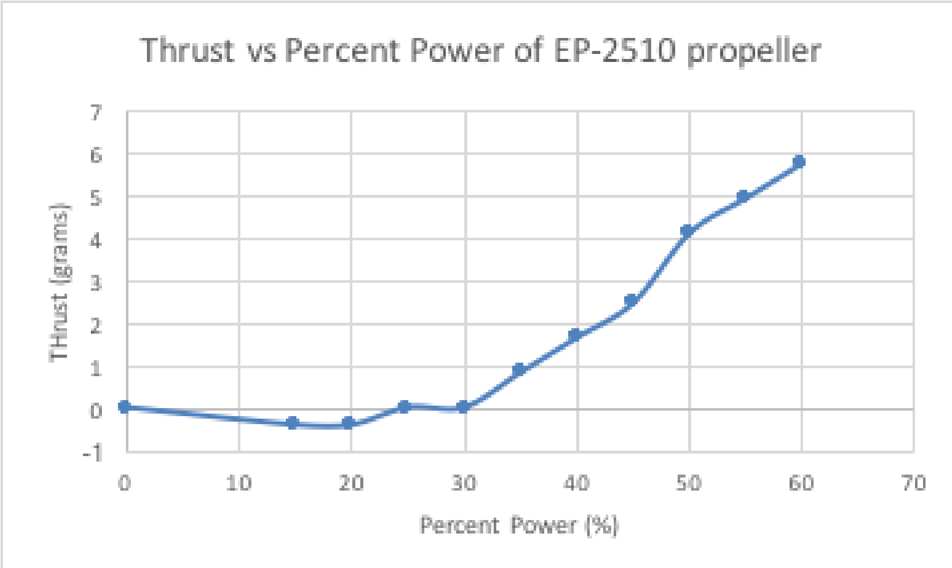
Wind Tunnel Raw Data and Figures and Individual Calculations

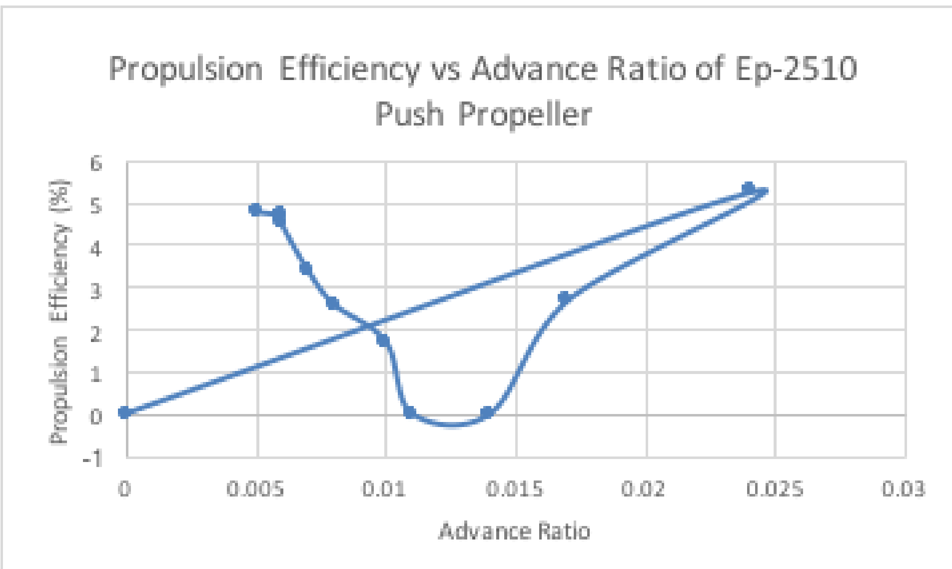
Propeller Type EP – 2510 (Pusher)

Current	Thrust Scale Reading	RPM	Arduino Power Setting
amps	*grams*	*RPM*	*%*
0.01	158	0	0
0.22	157	2950	15
0.32	157	4100	20
0.44	158	4875	25
0.5	158	6300	30
0.58	160	7325	35
0.65	162	8650	40
0.67	164	9760	45
0.76	168	10900	50
0.79	170	12050	55
0.83	172	13233	60

Voltage = 7.4 volts

Thrust Calibration	RPM	Power Input	Power Output	Power Output	Propulsion Efficiency	Advance Ratio
grams	*RPM*	*Watts*	*Horsepower*	*Watts*	*%*	*--*
0.000	0	0.000	0.00000	0.000	0.000	0.000
-0.411	2950	0.244	-0.00002	-0.013	-5.265	0.024
-0.411	4100	0.474	-0.00002	-0.013	-2.715	0.017
0.000	4875	0.814	0.00000	0.000	0.000	0.014
0.000	6300	1.110	0.00000	0.000	0.000	0.011
0.822	7325	1.502	0.00003	0.026	1.712	0.010
1.644	8650	1.924	0.00007	0.051	2.673	0.008
2.466	9760	2.231	0.00010	0.077	3.457	0.007
4.110	10900	2.812	0.00017	0.129	4.572	0.006
4.932	12050	3.215	0.00021	0.154	4.798	0.006
5.754	13233	3.685	0.00024	0.180	4.884	0.005





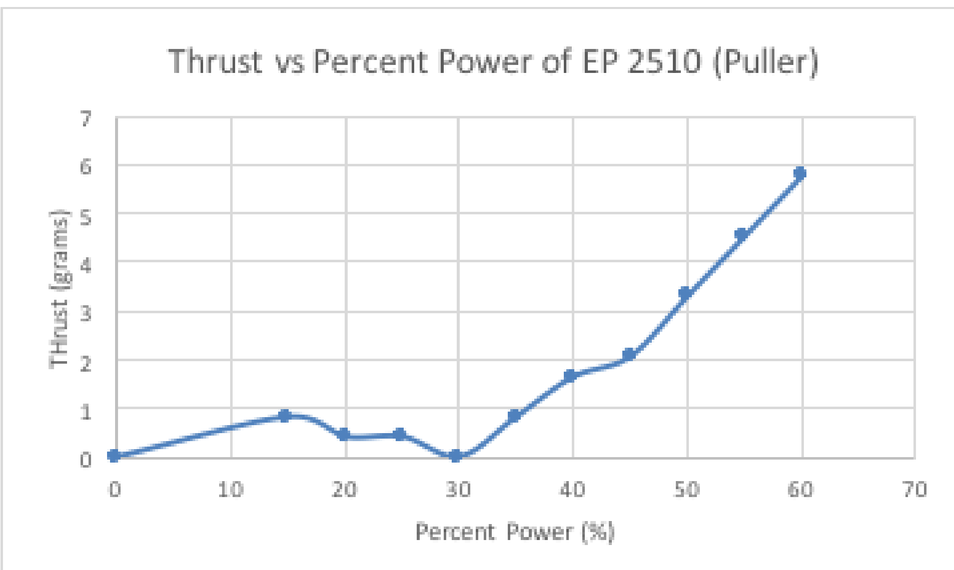
Propeller Type EP – 2510 (Puller)

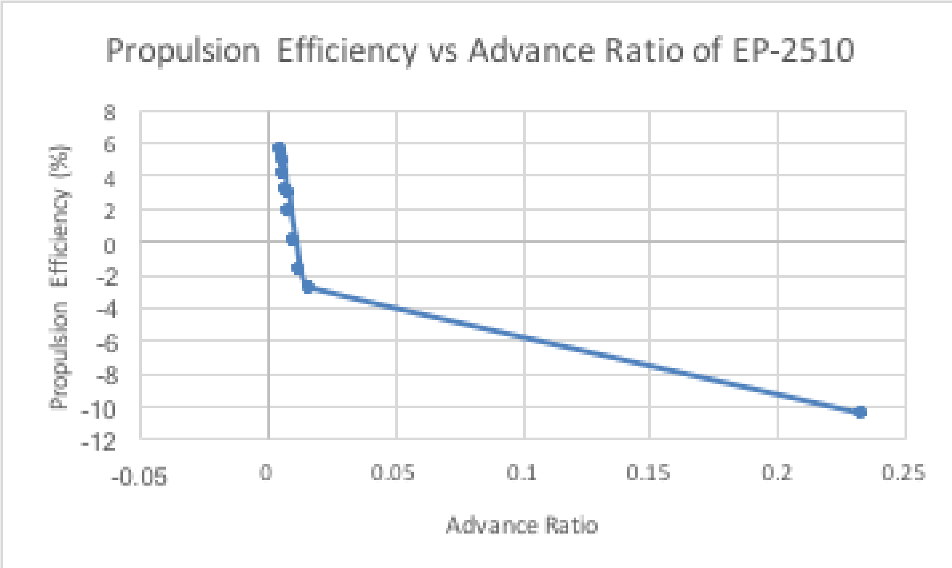
Current	Thrust Scale Reading	RPM	Arduino Power Setting
amps	*grams*	*RPM*	*%*
0.04	156	0	0
0.23	154	3400	15
0.32	155	4670	20
0.4	155	5750	25
0.48	156	6900	30
0.55	158	8200	35
0.61	160	9400	40

0.66	161	10500	45
0.7	164	11700	50
0.73	167	12800	55
0.75	170	14011	60

Voltage = 7.4 volts

Thrust Calibration	RPM	Power Input	Power Output	Power Output	Propulsion Efficiency	Advance Ratio
grams	*RPM*	*Watts*	*Horsepower*	*Watts*	*%*	*--*
-0.82	3400	0.26	0.0000	-0.03	-10.42	0.0233
-0.41	4670	0.47	0.0000	-0.01	-2.81	0.0170
-0.41	5750	0.74	0.0000	-0.01	-1.80	0.0138
0.00	6900	1.07	0.0000	0.00	0.00	0.0115
0.82	8200	1.42	0.0000	0.03	1.87	0.0097
1.64	9400	1.81	0.0001	0.05	2.95	0.0084
2.06	10500	2.20	0.0001	0.07	3.03	0.0075
3.29	11700	2.59	0.0001	0.11	4.11	0.0068
4.52	12800	2.97	0.0002	0.15	4.92	0.0062
5.75	14011	3.33	0.0002	0.19	5.59	0.0057



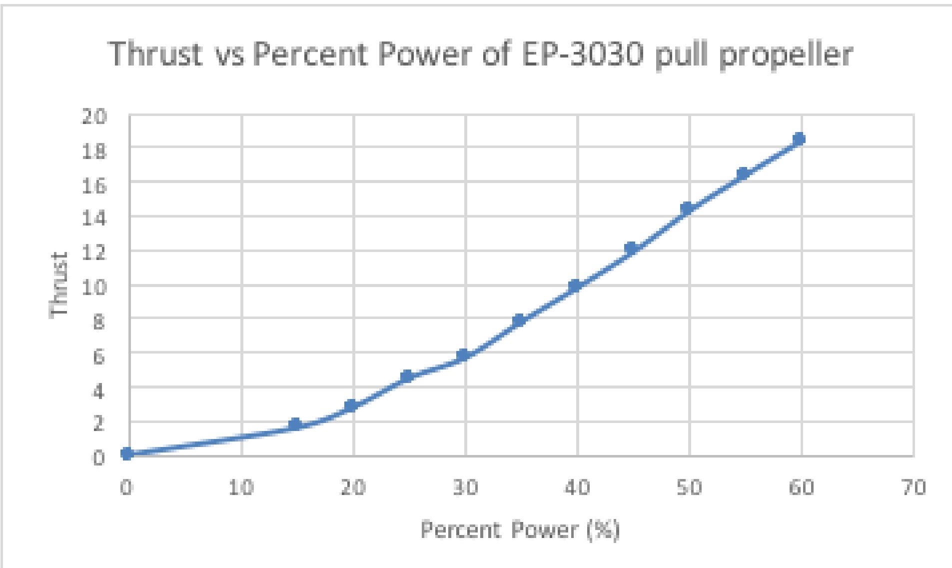


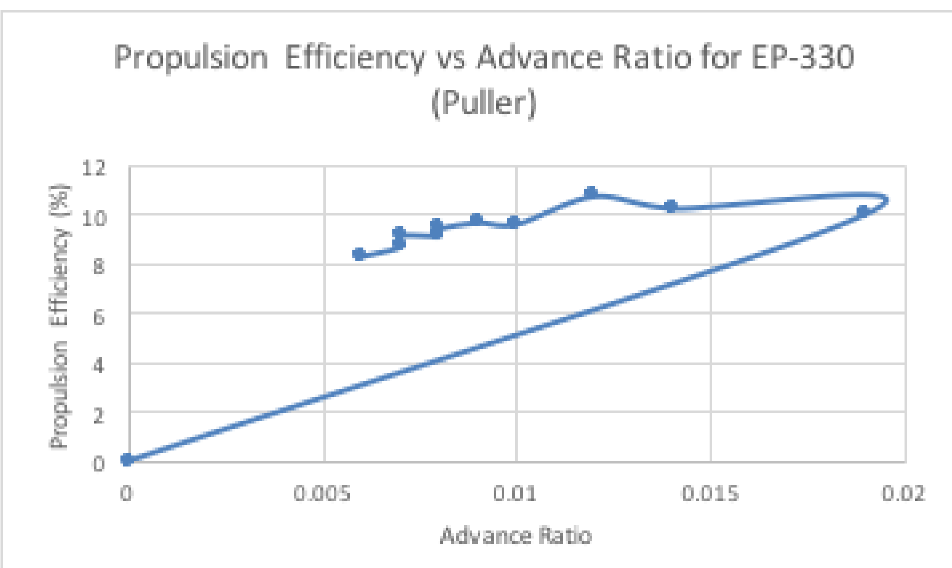
Propeller Type EP – 3030 (Puller)

Current	Thrust Scale Reading	RPM	Arduino Power Setting
amps	*grams*	*RPM*	*%*
0.16	137	0	0
0.35	141	2994	15
0.45	144	3892	20
0.54	148	4610	25
0.64	151	5389	30
0.74	156	6107	35
0.84	161	6706	40
0.93	166	7305	45
1.01	172	7964	50
1.1	177	8562	55
1.18	182	9221	60

Voltage = 7.4 volts

Thrust Calibration	RPM	Power Input	Power Output	Power Output	Propulsion Efficiency	Advance Ratio
grams	*RPM*	*Watts*	*Horsepower*	*Watts*	*%*	*--*
0.000	0	0.000	0.000000	0.000	0.000	0.000
1.644	2994	0.389	0.000061	0.039	10.060	0.019
2.877	3892	0.666	0.000106	0.068	10.270	0.014
4.521	4610	0.999	0.000166	0.107	10.759	0.012
5.754	5389	1.421	0.000212	0.137	9.628	0.010
7.809	6107	1.917	0.000288	0.186	9.687	0.009
9.864	6706	2.486	0.000363	0.235	9.432	0.008
11.919	7305	3.097	0.000439	0.283	9.150	0.008
14.385	7964	3.737	0.000530	0.342	9.152	0.007
16.440	8562	4.477	0.000605	0.391	8.730	0.007
18.495	9221	5.239	0.000681	0.440	8.393	0.006



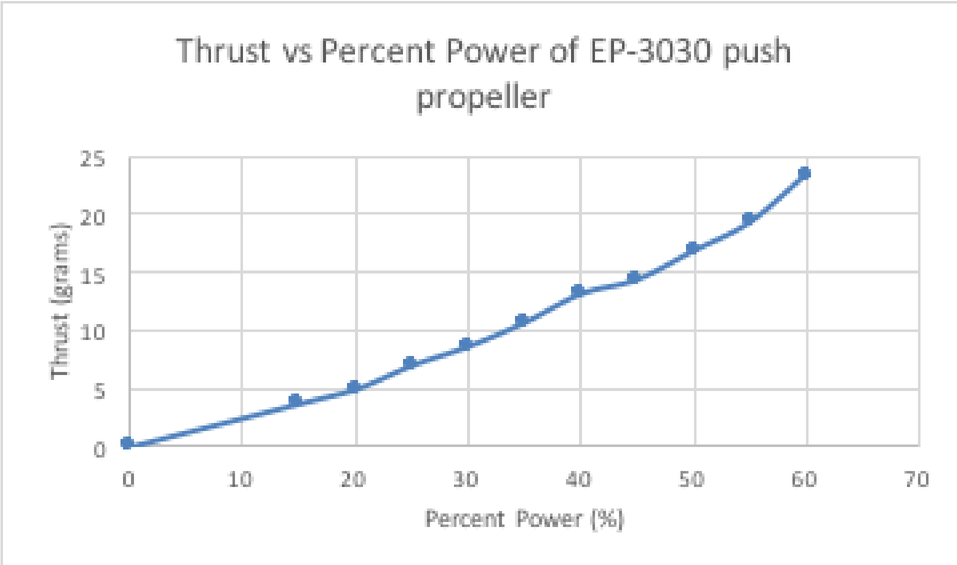


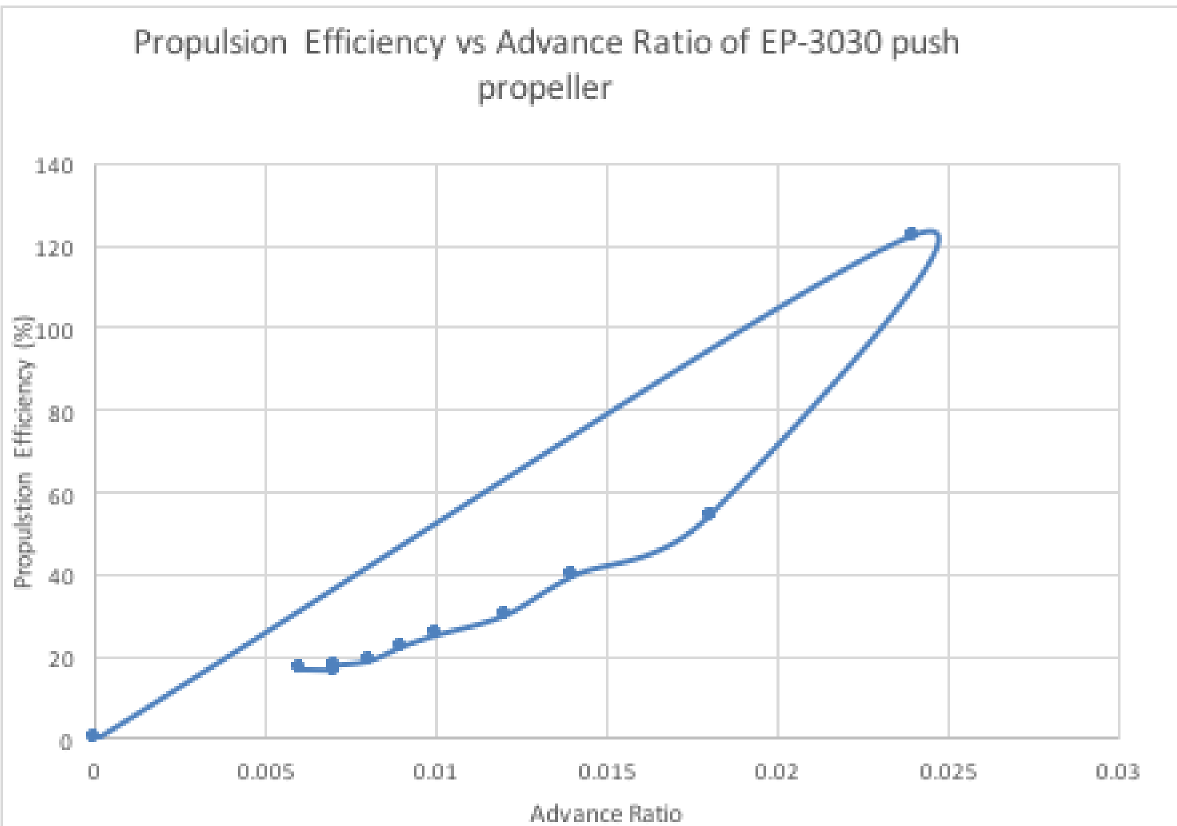
Propeller Type EP- 3030 (Pusher)

Current	Thrust Scale Reading	RPM	Arduino Power Setting
amps	*grams*	*RPM*	*%*
0.14	150	0	0
0.08	141	2500	15
0.18	138	3400	20
0.28	133	4150	25
0.38	129	5000	30
0.48	124	5850	35
0.58	118	6600	40
0.67	115	7450	45
0.75	109	8200	50
0.83	103	9000	55
0.92	93	9600	60

Voltage = 7.4 volts

Thrust Calibration	RPM	Power Input	Power Output	Power Output	Propulsion Efficiency	Advance Ratio
grams	*RPM*	*Watts*	*Horsepower*	*Watts*	*%*	*--*
0.000	0	0.000	0.000000	0.000	0.000	0.000
-3.699	2500	0.089	-0.000146	-0.109	-122.540	0.024
-4.932	3400	0.266	-0.000195	-0.145	-54.462	0.018
-6.987	4150	0.518	-0.000276	-0.206	-39.679	0.014
-8.631	5000	0.844	-0.000340	-0.254	-30.097	0.012
-10.686	5850	1.243	-0.000422	-0.314	-25.286	0.010
-13.152	6600	1.717	-0.000519	-0.387	-22.536	0.009
-14.385	7450	2.231	-0.000567	-0.423	-18.967	0.008
-16.851	8200	2.775	-0.000665	-0.496	-17.864	0.007
-19.317	9000	3.378	-0.000762	-0.568	-16.822	0.007
-23.427	9600	4.085	-0.000924	-0.689	-16.871	0.006





<u>Madison Hudak Individual Calculations</u>

Power Input:

$$P_{in} = VI(\frac{P_{\%}}{100})$$

$$P_{in} = (7.4)(0.22)\left(\frac{15}{100}\right) = 0.2442\, watts$$

Power Output:

$$P_{out} = T_c v$$

$$P_{out} = (-4.0319)(2.9) = -11.69251$$

Calibrated Thrust:

$$T_c = 0.411(T - T_0)$$

$$0.411(157 - 158) = -0.411 grams, \frac{0.00980665}{T_c} = -0.0238960\text{N}$$

Advance Ratio:

$$J = \frac{v}{\left(\frac{RPM}{60}\right)D}$$

$$J = \frac{2.9}{\left(\frac{2950}{60}\right)2.5} = 0.02359$$

Propulsion Efficiency:

$$n_{sys} = \frac{P_{out}}{P_{in}} * 100\%$$

$$n_{sys} = \frac{-0.0238960}{0.2442} * 100\% = -9.77\%$$

Josh Penko Individual Calculations

Calibrated Thrust = 0.411 *(T$-T_0$) (grams)

Calibrated Thrust = 0.411 * (154-156)grams

Calibrated Thrust = -0.82 grams

Power Input= V*I*($\frac{P_{\%}}{100}$) (watts)

Power Input = 7.4volts*0.23amps*$\left(\frac{15}{100}\right)$%

Power Input = 0.26 watts

Power Output = $T_c * $V (horse power)

Power Output =

$$\frac{\left(-0.82\text{grams}*0.002205\frac{lbs}{gram}\right)*\left(3.3\frac{m}{s}*3.28\frac{ft}{s}\right)}{500}$$

Power Output = 0.00004 Horsepower

Propulsion Efficiency = $\frac{P_{out}}{P_{in}} * 100\%$ (%)

Propulsion Efficiency = $\frac{0.07}{2.20} * 100\%$

Propulsion Efficiency = 3.03%

Advance Ratio = $\frac{v}{\left(\frac{RPM}{60}\right)*D}$ (unit less)

Advance Ratio = $\frac{3.3m/s}{\left(\frac{3400RPM}{60}\right)*2.5in}$

Advance Ratio = 0.0233

Collin Barack Individual Calculations

Lizzie Rumford Individual Calculations