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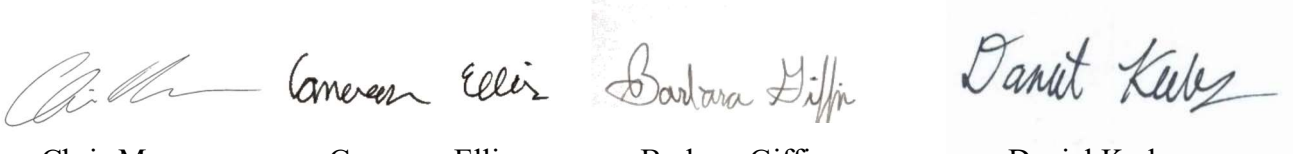
May 5, 2017

To Whom It May Concern,

The attached document contains the work of the Aerodynamics Team of the CubeSat Functionality and Microgravity Testing Platform Senior Design Project. As a whole, the project seeks to develop a low-cost method for creating a high-quality microgravity environment. Comparison of different aerodynamic body designs, feasibility of passive boundary layer methods, and quantification of restorative moments were major objectives of the Aerodynamics Team.

This team was able to reach several key conclusions. First, implementation of a Ringleb cusp on the aft portion of the aerobody to reduce drag and control boundary layer separation characteristics was determined to be feasible, though further testing from actual flights is needed prior to picking an aerobody design. Second, application of turbulator tape in order to further control flow separation was also determined to be feasible, but, again, flight tests are needed to fully verify these results. Finally, future teams can calculate restorative moments once a final center of mass is determined.

Sincerely,



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CubeSat Functionality and Microgravity Testing Platform

Aerodynamics Team

Senior Design 2016-2017

Chris Marcum, Cameron Ellis,

Barbara Giffin, Daniel Kerbs

May 5, 2017

To: Dr. Kevin Kilty
From: Cameron Ellis, Barbara Giffin, Daniel Kerbs, Chris Marcum

Subject: Senior Design 2016-2017 Academic Year– NASA Microgravity-Aerodynamics
Date: 5/5/2017

Project Objective

The objective of the CubeSat Functionality and Microgravity Testing Platform program is to develop a product that companies and universities can use to analyze and test the functionality of CubeSat projects in a space-like microgravity environment. Drop facilities—commonly referred to as drop towers--are currently one of the main forms of microgravity testing at ground level. These facilities achieve a microgravity environment of 10^{-3} and 10^{-5} g, and can be achieved for approximately 2-5 seconds. These facilities are expensive, and have long waitlists. Due to these restrictions, there is a need for a more cost-efficient and improved testing method. This program's goal is to provide such a method. These concepts are a continuation of the concept introduced during last year's senior design class by Alexandra Crook, and has been funded through a NASA, USIP-SFRO grant.

The main objectives of this team are modifying the current aerodynamic profile of the platform in order to reduce drag and provide increased stability, locating the aerodynamic center, and quantifying restorative moments. The current design utilizes a partially-proven design created by Fabio R. Goldschmied in the 1950s and 1960s. He performed a variety of tests, the methods of which were not clearly defined, at least one was never even reported, but the results were encouraging. Current design of our monocoque uses his initial aerobody shape. Future designs will be implemented based heavily on what is called a ringleb cusp, a design also tested by Goldschmied. This ringleb cusp uses a method of passive boundry layer control by creation of voxtex which aids flow reattachment, and was hypothesized by the patent-filer, Friedrich O. Ringleb, to hold the reattachment point constant as velocity and Reynolds numbers increase. Since detached flow increases pressure drag, implementation of this design should lower the overall drag on the body over a high range of Reynolds Numbers. It will also help provide stability during flight by controlling the boundary layer and allowing it to converge before the chosen control surface, such as the boom and tail fins. The current design and future ringleb cusp designs will be tested using methods outlined later in this document.

Design Constraints

This project has a number of constraints associated with the monocoque design dimensions and attributes, as well as design of the test apparatuses and procedures. Table 1-3 in Appendix I lists each of the monocoque design goals, constraints associated with these goals, and possible solutions. Tables 4-6 in Appendix I lists each of the wind tunnel testing goals, constraints, and possible solutions.

Preliminary Analysis

While many in-flight characteristics will be observed during test flights in the spring and summer

semesters, references for these characteristics need to be obtained beforehand in order to ensure the data being recorded is accurate. Furthermore, if data recorded during flight does not match wind tunnel data due to variables that were not considered or flight conditions that cannot be created using ground based tests, than such variables can be accommodated for in future testing and design decisions. In addition, the functionality of different aerobody designs can be determined prior to these flights, which is beneficial to the project in many ways. Ground-based tests and the functionality of various profile designs will be evaluated in the following ways:

- Wind Tunnel Testing:
    - General air-flow across the current profile design will be determined using streak-line smoke testing in the mezzanine wind tunnel in the Engineering Building. This will allow us to evaluate different designs, as well as verify useful qualitative aspects of the design (i.e. proper air circulation, boundary layer behavior, turbulent flow evolution down the boom, etc.).
    - Drag forces on the body will be obtained during wind tunnel tests at velocities representative of in-flight conditions. This not only gives a baseline comparison to any data obtained during flight, but also helps determine optimal aerobody design.
    - Location of the aerodynamic center of the aerobody without the boom and tail fins can be obtained through pressure readings along the body. Ensuring this point is along the center axis and behind the center of gravity ensures a more stable freefall, and reduces the risk of entering a flat spin during flight.
    - Quantitative analysis of the restoring moments can be obtained by measuring the lift and drag on the body at varying angles of attack. These forces were then evaluated to compute the restoring moments about the center of gravity.
    - Limitations: While these tests will portray basic air flow across the aerobody, there are a number of limitations to them. Any quantitative data that could be collected from this test may not be representative of the actual flow characteristics during flight because some parameters simply cannot be accurately recreated during wind tunnel tests, such as variable cross winds. In addition, pressures can only be measured along the aerobody without the boom and tail fins. While an assumption can be made that the use of a boom and tail fins will move the aerodynamic center further behind the center of gravity, the exact location can't be determined so any restorative moment data obtained can only be applied to designs without the boom and tailfins.
- SolidWorks:
    - In addition to all designs being created in SolidWorks, the approximate location of the center of mass can be determined through the Mass Properties evaluation tool. This program will also allow us to observe the other groups' progress and any changes they make that pertain to our design.
    - Limitations: The center of mass evaluation through SolidWorks is only an approximation, and is based on the ideal design with no imperfections resulting from manufacturing or human error. Due to this, the center of mass of the entire package as it will drop, must also be determined through physical testing before

any actual flights.

The Reynolds Number (Re) ranges for both wind tunnel tests and flights at elevation can be made equal do to the difference in densities and dynamic viscosities. Using values for all of the above parameters given in "Aerodynamics for Engineers: Fifth Edition" by John Bertin and Russell Cummings, and with the assumption that the Re ranges at ground level is the same at elevation, we can set the two equations equal to each other and solve for the velocities at ground level that would give equal Re to those at altitude. This will require determination of air density and air viscosity at ground level altitude to give the best estimate. Assuming the Re is the same for both in-flight and in the wind tunnel also assumes that any streamline tests obtained are representative of what will occur during flight. In addition, if the drag coefficient is assumed to be a function of Re only, the estimated drag coefficient at altitude can be calculated using the wind tunnel. A derivation of the wind tunnel velocities that will produce equal Re to in-flight, along with tables and graphs comparing different parameters can be seen in Appendix III.

Budget Considerations

The project in its entirety, including all other teams, will be funded through the NASA USIP SFRO grant. The Aerodynamics team will have very minimal cost considerations, due to very limited manufacturing times and processes, including:

- Cusp designs will be manufactured using the University of Wyoming Visual Arts 3D printer in Brandon Gellis' MakerSpace as well as the 3D printer in the CEAS Machine Shop. Currently, any 3D prints from the MakerSpace will not be charged. However, Mr. Gellis has informed the groups that there will eventually be a charge for manufacturing times and material use. This cost will be minimal, and will most likely be comparable to the UW IT department's charge of $1.50/hour. Costs for the CEAS 3D printer are approximately $3.00 per cubic inch.
- An additional monocoque is need for wind tunnel testing purposes. This monocoque will be manufactured by the Fixturing and Assembly team. For testing, the 3D cusp was adhered to the test monocoque using epoxy and modeling clay to smooth transitions. These will be purchased for a minimal charge.
- An appropriate oil/liquid must be purchased in order to conduct streamline tests.

Safety Considerations

During wind tunnel testing, all typical lab safety procedures will be observed, which include but are not limited to:

- No loose clothing will be worn during testing due to the rotating elements
- Long hair will be pulled back
- A safe zone will be enforced around the rotating elements
- Hearing protection will be utilized

- If multiple designs will be tested at once, then the wind tunnel will be allowed to come to a complete stop, and all power will be cutoff before anyone is allowed to enter the safe zone (i.e. lockout, tag out). This eliminates any possibility that someone will turn on the wind tunnel while someone is in the safe zone.

Extensive ground level testing will be performed in order to mitigate these risks, most importantly of which being the wind tunnel testing. This will allow the group to determine adequate fixturing and assembly methods that will reduce the probability of failure.

Schedule

Any and all testing, calculations, and reports for every group in the project will have a deadline of April 20th in order to present at the CubeSat workshop in San Luis Obispo, California. Design of the cusp is ongoing, with initial designs completed around the end of October to early November. These designs will be narrowed down to the two or three best designs through wind tunnel testing in November and December. Included in these tests will be the initial design without any cusp, in order to give us baseline measurements and determine if substantial improvements have been made.

Tentative dates have been set which will be reached during winter break and the spring semester. During winter break, the following events will take place:

- Streamline tests on the initial design by Dec. 30th
- Drag force measurements by Jan. 6th
- Develop a method of determining the aerodynamic center by Jan. 6th
- Design the 3D printable ringleb cusp by Jan. 23rd

During the spring semester, the entire project underwent testing to ensure each component was operating as expected. This included testing communications and electronic packages, observing parachute deployment, and refining the recovery methods. Observations and data collected from these tests would inform each group of needed improvements, and design revisions will occur. For this group, the following events took place in the spring:

- Print and adhere cusp by Mar. 17th
- Streamline tests on ringleb cusp design by Apr. 7th
- Drag force measurements by Apr. 7th
- Locate center of pressure on initial design and ringleb cusp design by mid-March

The results from these ground-based tests were quantified before both the Ellbogen Competition final presentation and the CubeSat Conference in San Luis Obispo, California, both of which are mid-April.

Aerobody Designs - Background

An aerobody design was previously chosen by last year's microgravity team. It was fabricated during the summer of 2016. Initial analysis was performed using this design because it provided a strong baseline upon which we could compare all of the changes to the aerobody design. These changes consisted of applying a ringleb cusp to the back end of the monocoque as well as through the application of turbulator tape. This team also investigated the feasibility of removing the boom and tails fins, as these account for a significant percentage of the total weight and drag of the aerobody. In addition, the controls group is developing an active attitude control system, and if this proves to be adequate for stabilization needs, then the boom and tail fins would be rendered useless. Therefore, both the original design and updated designs were tested both with and without the boom and tail fins to show how the aerobody will perform during a potential flight.

Aerobody Designs - Original Design

The original individuals who worked on the Microgravity Project modeled the original design after a proven aerobody design from Fabio, R. Goldschmied, an aerodynamicist who worked throughout the 1950s to 1970s on many aerodynamic designs and principals. One of his research papers contained axial and radial profile points of the design, and these points were normalized to the desired length and diameter to create the body design that was used by all Microgravity teams this year. This original design incorporated the use of a boom and tail fins, as a passive attitude control system that pushes the center of pressure further aft of the center of gravity, and created significant restoring moments at various angles of attack.

Aerobody Designs - Ringleb Cusp Applied

Another design tested by Goldschmied included what he referred to as a ringleb cusp. An image for this cusp can be found below:

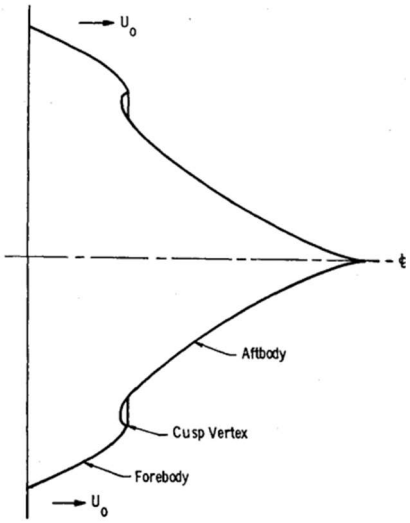

Fig. 8 Typical cusp BLC aftbody design.

Figure 1. Ringleb cusp profile published by Goldschmied.

The significant effect this profile provides is a passive boundary layer control that reduces pressure drag on the back of the aerobody. Again, in one of his papers Goldschmeid publishes axial and radial points that are normalized to a desired length and diameter. These points were then used to create an updated aerodynamic profile using measured points from the original design.

Points from the original design were measured directly from a fabricated testing specimen using a coordinate measuring machine (CMM). **Figures 2 and 3** show the general process by which these points were found. Approximately 50 points were taken along the back half of the monocoque in order to create the most precise and accurate representation of the profile shape. Once these points were found, they were exported into Excel, and then into SolidWorks. These points were then plotted against the normalized cusp points obtained from the Goldschmied paper and the two plots were cut off at the intersections. By revolving the resulting shape around the centerline, the cusp design was obtained. The final revolved cusp design is shown below in **Figure 4**. This cusp was then applied to one of the Kevlar bodies with epoxy, and modeling clay was applied to the edges to ensure that the transitions between the body and the cusp were as smooth as possible.

Figure 2. Use of CMM to create a profile of original design.

Figure 3. USe of CMM along pre-defined profile line.

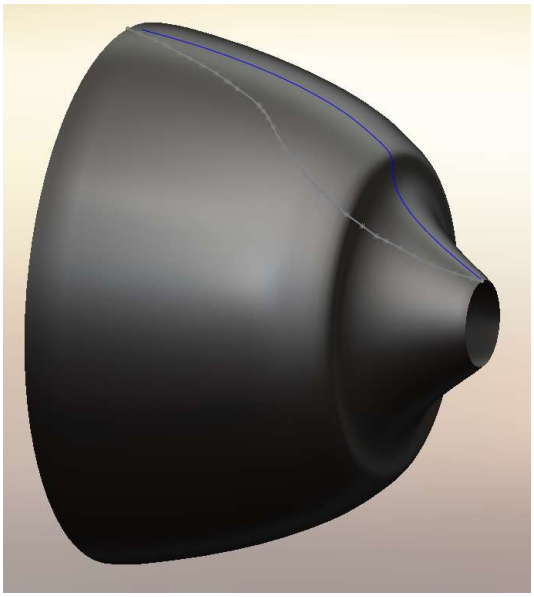

Figure 4. Revolved SolidWorks Ringleb cusp.

Aerobody Designs - Turbulator Tape Applied

Turbulator tape can be found in a number of different shapes, such as chevron lines and dimple tape. The purpose of these designs are to cause disturbances in the flow along a desired aerobody. The disturbances cause the flow to trip from a laminar or transitional flow to a turbulent flow, thus promoting the flow to stay attached to the body for longer than it would without any tape applied. Commercial applications for this tape include wings on small aircraft and wind turbine blades. Images for the turbulator tape used for this project are shown below:

Figure 5. Chevron turbulator tape.

Figure 6. Dimpled turbulator tape.

Application of the turbulator tape occurred after streamline tests were performed. Depending on these tests, the tape was applied approximately 3-4 inches in front of where the flow separated from the body without the tape applied. Then, since the aerobody is symmetric, the tape was applied as evenly as possible to prevent any non-symmetric flows from occurring along the body, causing aerodynamic effects that cannot be accounted for.

Wind Tunnel Testing: Smoke Trails

Fluid flow across bodies can be visualized in a variety of different ways: smoke trails, China clay flows, and surface oil flows are common ways to observe fluid flow. The mezzanine wind tunnel is capable of producing smoke trails through the use of resistive wiring that is coated in oil. As the wire heats up, it burns the oil and causes it to smoke, producing a clean smoke trail when the blower is operating. These smoke trails then allow the boundary layer behavior to be observed. As stated in **Table 4**, both kerosene and glycerin can be used to produce high quality smoke trails. While kerosene can be used and is easily obtainable, it is unfavorable to use for this project due to the risk of unwanted combustion, and its smell when it smokes. Glycerin is fairly easy to come by, and it is safe to handle without any additional precautions. Therefore, glycerin was be used to produce all smoke trails.

The wind tunnel was designed to allow the operators to control the placement of streamlines during testing. This is accomplished through a manually operated gear and chain system, which is attached to the resistive wires used to heat the glycerin. A paper towel drenched in glycerin was used to apply the glycerin to the wire, in order to create small droplets on the wire that produce higher quality trails. Simply brushing the glycerin on the wire using the paper towel was sufficient to produce these trails. In addition, Ike Ruse, a certified professional engineer who has assisted us greatly in the development of our wind tunnel tests, set up high speed cameras that can take pictures, and record videos in order to provide high quality visualizations of the stream lines as time progresses.

Images of streamline tests obtained using the wind tunnel can be found below. These

images show the results from the original aerobody streamline tests, as well the results from the design with both the cusp and turbulator tape applied. As can be seen in **Figure 8**, the flow separates at approximately 75% of the total body length. Beyond this, it can be argued that an unsteady wake develops, although this wasn't captured directly by the streamlines. Due to this unsteady wake, the boom and tail fins begin vibrating significantly at higher wind speeds, and are observed in all tests performed with the boom and tail fins attached.

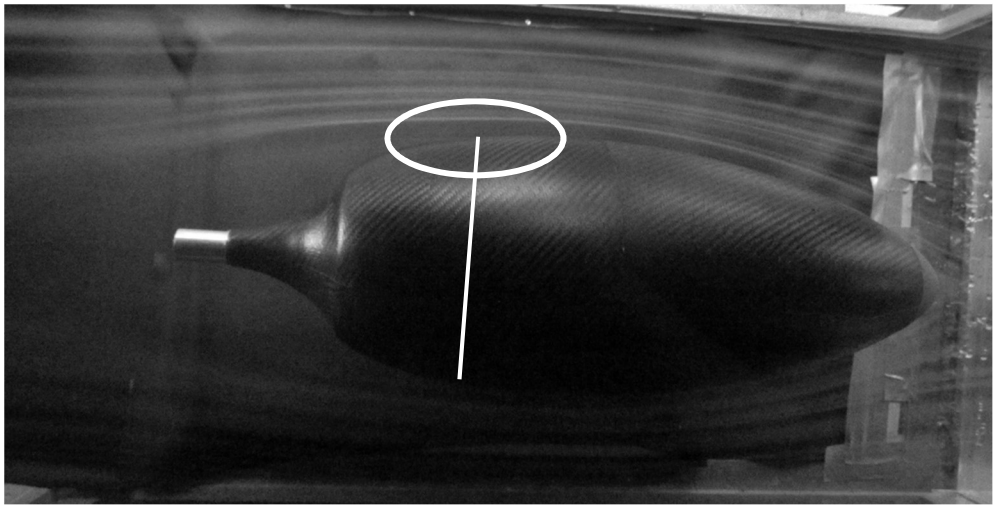

Figure 7. Boundary layer effects on original design, no boom and tail fins.

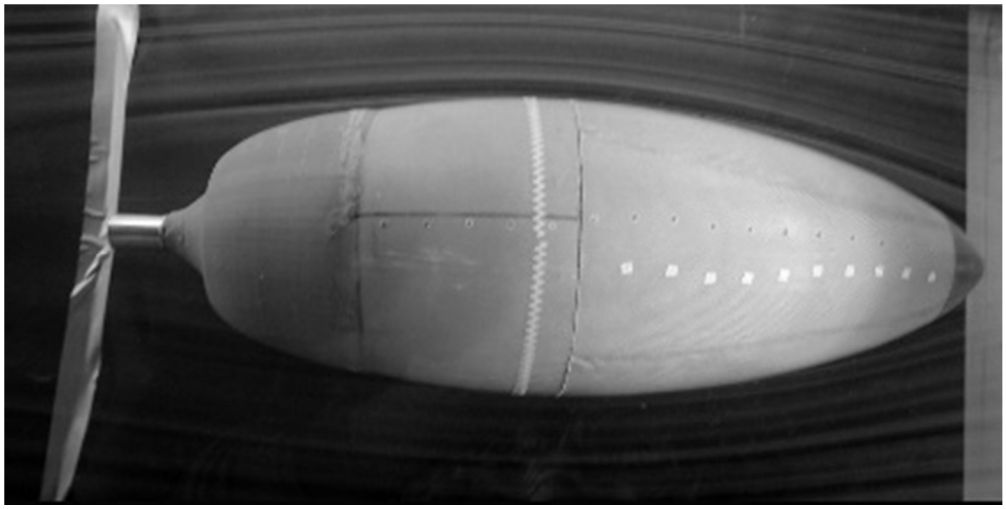

Figure 8. Boundary layer effects on Ringleb Cusp design, with turbulator tape, no boom.

One aspect of the boundary layer, with the Ringleb cusp and turbulator tape attached, was a vortex that developed directly aft of the cusp. While we couldn't capture this result in still images, we did capture it in the form of a video, and was presented during our Undergraduate Research Day presentation. This result was significant, because it both proved that the flow was staying attached to the body longer than with the original design, and also supported the result Goldschmied reported to occur with his designs.

Wind Tunnel Testing: Drag Quantification

One of the primary objectives for this project is to minimize drag on the aerobody to create the highest quality microgravity possible. While drag quantification can and will be determined during test flights, these quantities depend heavily on accelerometer data obtained during the flight. A baseline needs to be established in order to determine whether or not the data collected during these flights accurately represents the drag forces experienced on the body. As described earlier, ground based testing using the mezzanine wind tunnel will produce an accurate representation of in-flight characteristics. The wind tunnel is currently outfitted with two strain gauges attached to simple cantilevers that are oriented perpendicular to each other. These gauges are attached to a baseplate, which can move in the x and y direction through the use of air bearings. When the aerobody is attached the baseplate, and the wind tunnel is operating, drag and lift forces cause the cantilevers to deflect, and the corresponding strains can be measured. Using a simple mechanics of materials approach, these strains can be used to obtain the forces that induced the deflections of the beams. These forces correspond to drag and lift on the body. Images of this setup are included in Appendix III.

Drag quantification testing was completed on eight different aerobody setups: Original aerobody, original without boom, original with turbulator tape, original with turbulator tape and without boom, aerobody with the ringleb cusp attached, aerobody with cusp and turbulator tape, aerobody with cusp and no boom, aerobody with cusp, turbulator tape, and no boom. Individual testing results can been found in Appendix VI. The design with the lowest drag coefficient was the aerobody with the cusp attached and no boom, which differed slightly from our original assumptions as to which design would have the lowest coefficient. While the turbulator tape did decrease the drag on the original aerobody by keeping the boundary layer attached to the body longer, it did not have any appreciable effect on the cusp design. Since the cusp already controls the boundary layer, the turbulator tape has little to no impact since the flow already stays attached until the edge of the cusp.

Wind Tunnel Testing: Locating Center of Pressure

Locating the center of pressure (CP) can be done in a number of different ways. For the purposes of this project the chosen method is drilling pressure taps along the length of the monocoque and measuring the pressure at those points. From there the center of pressure can be calculated similar to how the center of gravity can be found. The CP can only be found for the monocoque; due to the limited amount of space in the interior of the boom, it is not possible to obtain any pressure measurements along its length, nor was it feasible to manufacture brand new tail fins with pressure taps pre-drilled into them. Despite this, the CP for just the monocoque can give some unique insights, especially when comparing them between designs.

In addition to experimentally determining the center of pressure, it can be theoretically calculated from Goldschmeid's papers. He published the pressure distribution results on his aerobody designs, and from these plots the center of pressure can be calculated. The equation

below yields the center of pressure location:

$$CP = \frac{\sum \left(\frac{1}{2} C_p \rho_\infty {v_\infty}^2 + P_\infty\right) xL}{\sum \left(\frac{1}{2} C_p \rho_\infty {v_\infty}^2 + P_\infty\right) L}$$

The plot below was provided in Goldschmeid's papers:

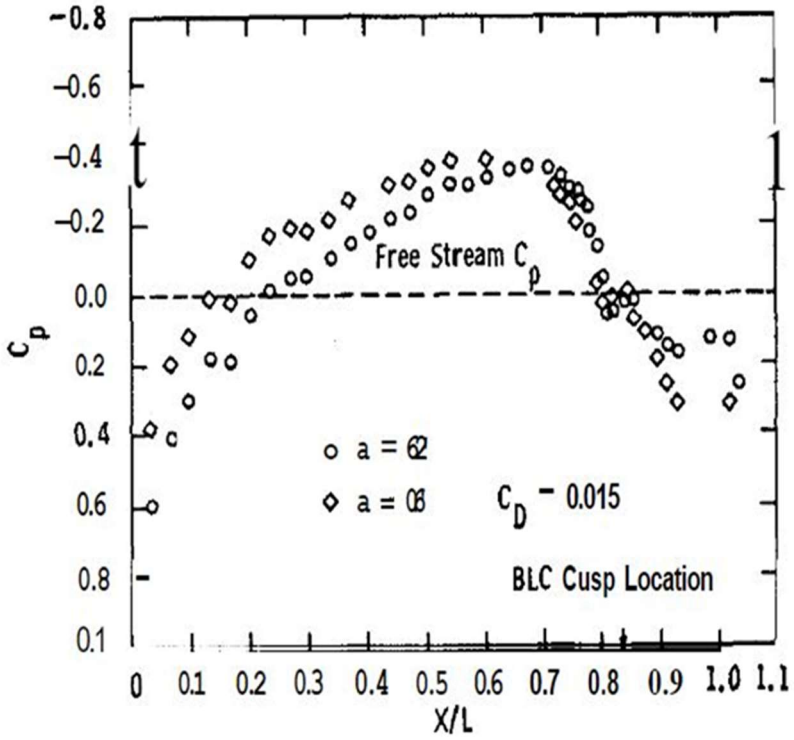

Figure 9. Goldschmeid pressure distribution.

Given the static pressure coefficients provided in this plot, and taking the relative atmospheric conditions we expect during test flights as well as the geometric terms of the manufactured aerobody, a location for the center of pressure can be found.

In practice, experimentally determining the center of pressure yielded highly inaccurate results, and this could be for a variety of reasons:

- Our pressure taps were drilled in a straight line down the length of the monocoque. This could create small wakes and eddies at preceding tap locations, causing the pressure measurements to be off significantly.
- The manometer used to measure the pressure at these taps wasn't precise enough to measure the small changes in static pressure that was experienced at these taps.]

Because of these inaccuracies, the results have not been reported in this paper. Theoretically determining the center of pressure did yield reasonable results, and can be found below:

Table 1. Center of pressure location.

CP Sum	14.923	47.998
CP (m - in)	0.3109	12.200
CP % (x/L)	0.49961	

These results show that the center of pressure is located at 12.2 inches from the nose of the aerobody. From this location, theoretical restoring moments can be determined for the design without the boom and tail fins.

Wind Tunnel Testing: Determining Restoring Moments

Determining the restoring moments on the aerobody is desired to understand flight stability during freefall. If the package cannot self-stabilize, additional stabilization methods must be implemented. The wind tunnel has the capability to vary angle of attack by two degree increments, up to a 30 degree angle of attack. By varying the angle of attack and recording the corresponding lift and drag forces, a net restoring moment can be calculated. Since lift and drag forces operate through the center of pressure, and the aerobody was mounted at the center of mass, the distance between these two points would act as the moment arm for the restoring forces. However, since the center of mass will vary as other teams continue on their designs and depends on package loading, a single restoring moment could not be calculated for each angle of attack. To aid in further design, a spreadsheet was created with allows for a restoring moment calculation, dependent on center of mass and center of pressure. Without any further aerodynamic changes, the center of pressure shouldn't vary, so by keeping track of the center of mass and expected velocity a restoring moment can be calculated using this tool. This table is found on the teams group files on OneDrive, but as it is an interactive tool, it has not been included in this report.

Appendix I: Design Constraint Tables

Table 2. Monocoque Design Constraints - ID 1.

Monocoque Design Constraints				
ID	Design Goal	Constraints	Possible Solutions	Final Solutions
1	Keep drag coefficient consistantly low over the entire range of flight	The experimental bay (and thus the maximum diameter of the monocoque) must be large enough to fit both the CubeSat experiment and the CubeSat railing. This maximum diameter affects overall drag. The optimal fineness ratio must be 3:1 between the length and the maximum diameter. Can only increase pressure drag a certain amount before the net impact begins to increase overall drag.	The monocoque design from last year adequately fit the 2U CubeSat Railing designed during the summer. The updated railing design will determine if we need to change the dimensions of the monocoque, which will then alter the fineness ratio. If the diameter needs to increase, then the boom will also need to increase in length to keep the 3:1 fineness ratio.	Final solution will be determined after the final design of the CubeSat rail is manufactured.

Table 3. Monocoque Design Constraints - ID 2 & 3.

2	Optimize location of the center of pressure	Boom design must be light and long in order to push center of pressure behind center of mass.	Boom can be manufactured in-house using a filament winding machine (can be expensive).	TBD
		Maximum length is constrained by a 3:1 ratio between the length and the maximum diameter.	Boom can be ordered from companies such as McMaster-Carr (could have inappropriate dimensions, weight, filament orientation).	TBD
		Diameter of boom is constrained by the manufacturer's design, which then ultimately influences the ringeleb cusp design.	Boom length can be altered to fit desired fineness ratio by cutting it to length in the machine shop.	TBD
3	Reduce skin friction drag	Material chosen to coat the surface must be inexpensive, safe to handle, and easy to apply after the monocoque has been fabricated.	Applying clear coat to the surface might reduce the skin drag. Applying primer and spraypaint to the surface might keep the skin drag minimal (would have to prevent pooling of the paint from occuring).	TBD

Table 4. Monocoque Design Constraints - ID 4.

4	Design 3D printable cusp	Must be easily applied to and easily removed from the test monocoque for wind tunnel testing.	Brandon Gellis from the UW Visual Arts Makerspace has a 3D printer with very high resolution, but the cusp must be small enough to fit on the printing base. As a secondary option, we could utilize the UW IT departments 3D printer.	Currently, the Makerspace printer is the primary source for our printing needs. However, if it isn't operable, the IT printer will work for testing purposes, but not final designs.
		Must be adhered to the final monocoque such that unwanted forces, moments, and vibrations aren't induced.	Could use Epoxy Base Bonding Adhesive from Fibre Glast to adhere cusp to monocoque.	TBD, but will most likely utilize solution given.
		Must match the SolidWorks model within acceptable tolerances.	Could use the coordinate measuring machine (CMM) to check the tolerances, and then adjust as needed.	TBD, but will most likely utilize solution given.

Appendix II: Wind Tunnel Testing Constraints

Table 5. Wind tunnel testing constraints - ID 1.

Wind Tunnel Testing Constraints				
ID	Design Goal	Constraints	Possible Solutions	Final Solutions
1	Streamline tests for boundary layer visualization	Liquid/oil used to create the smoke must be safe to resistively heat without combusting.	Kerosene can be used (probably want to avoid, could combust at higher temps and smells awful), or glycerin.	Glycerin is safe to use, doesn't smell as much, and can conventiently be applied.
		Streamline must be moveable in order to place flow across the nose/center axis of the monocoque.	Predetermined through wind tunnel design.	Streamline can be moved manually using a gear and chain system.
		High speed photography/videography is necessary in order to better quantify boundary layer behavior.	Could rent cameras from the IT department, or order high speed equipment using budgeted money (cost then becomes an issue).	High speed cameras were ordered by the ME department for future use beyond the scope of this project.

Table 6. Wind tunnel testing constraints - ID 2.

2	Drag quantification	Monocoque mounting must be stable in order to prevent any unwanted forces/moments.	Utilize 3D printer to create appropriate streamline shapes that would not heavily affect the flow.	TBD, but will most likely utilize solution given.
		Drag forces on the body must be measured directly.	Predetermined through wind tunnel design.	Use load cells and strain gauges to measure drag forces as it slides along the air bearings.
		Calibration method of the load cells must be accurate in order to eliminate uncertainty in measurements.	Use an incremental methodology that increases force on the body by hanging weights off a pulley, and measure the voltage. Record relationship between the weight and the voltage.	TBD, but will most likely utilize solution given.
		Need to accurately measure flow speed upstream in order to determine Reynolds number of flow.	Predetermined through wind tunnel design.	A pitot tube is used to measure the static and dynamic pressures upstream of the aerobody, which is then sent directly into the VI programming used to control the wind tunnel, which allows us to directly measure and change the air flow speed.

Table 7. Wind tunnel testing constraints - ID 3.

		Pressure ports must be sufficiently small in order to accureatly represent pressures. Subsequently, the pressure taps must be small enough to fit the pressure ports.	Either buy small cylindrical tubes and then drill the holes to the appropriate size, or drill the holes and then constrain the tubing to fit those holes.	TBD
3	Locate center of drag	Pressure measurement method should have minimal affect on the overall flow across the body.	Could use the pressure measurement tools already available in the wind tunnel already, or set up a Venturi device at each of the ports.	TBD
		Must account for both the monocoque and the boom/tail fins.	TBD	TBD

Appendix III: Wind Tunnel Velocity Derivation and Calculations

List of symbols and their definitions:

Symbol	Definition
Re	Reynolds number
ρ	Air density (kg/m^3)
V	Air Velocity (m/s)
D	Hydraulic Diameter (m)
μ	Dynamic viscosity (kg/s-m)

The subscripts G and E imply values at ground level and at elevation, respectively.

Equivalent wind tunnel velocities derivation:

$$Re = \frac{\rho V D}{\mu} \quad \textbf{(1)}$$

$$Re_G = Re_E \quad \textbf{(2)}$$

$$\frac{\rho_G V_G D}{\mu_G} = \frac{\rho_E V_E D}{\mu_E} \quad \textbf{(3)}$$

$$\frac{\rho_G V_G}{\mu_G} = \frac{\rho_E V_E}{\mu_E} \quad \textbf{(4)}$$

$$\rho_G V_G = \frac{\mu_G \rho_E V_E}{\mu_E} \quad \textbf{(5)}$$

$$V_G = \frac{\mu_G \rho_E V_E}{\mu_E \rho_G} \quad \textbf{(6)}$$

Velocity Calculations:

Velocities representative of equal Reynolds numbers are shown below in Table 7. The in-flight velocities were calculated under the assumption of ideal acceleration with no drag, simply to show the comparisons. The end time of 20 seconds is assumed to be the period of pure freefall, before the deployment of the parachute.

Table 8. Matching flight conditions.

Time (s)	Alt. (km)	V_{Flight} (m/s)	V_{Tunnel} (m/s)
0.1	30.0000	0.10	0.1
1	29.9951	9.81	0.2
2	29.9804	19.62	0.4
3	29.9559	29.43	0.6
4	29.9215	39.24	0.8
5	29.8774	49.05	1.0
6	29.8234	58.86	1.3
7	29.7597	68.67	1.5
8	29.6861	78.48	1.7
9	29.6027	88.29	1.9
10	29.5095	98.10	2.1
11	29.4065	107.91	2.7
12	29.2937	117.72	2.9
13	29.1711	127.53	3.2
14	29.0386	137.34	3.4
15	28.8964	147.15	3.7
16	28.7443	156.96	3.9
17	28.5825	166.77	4.2
18	28.4108	176.58	5.2
19	28.2293	186.39	5.5
20	28.0380	196.20	5.8

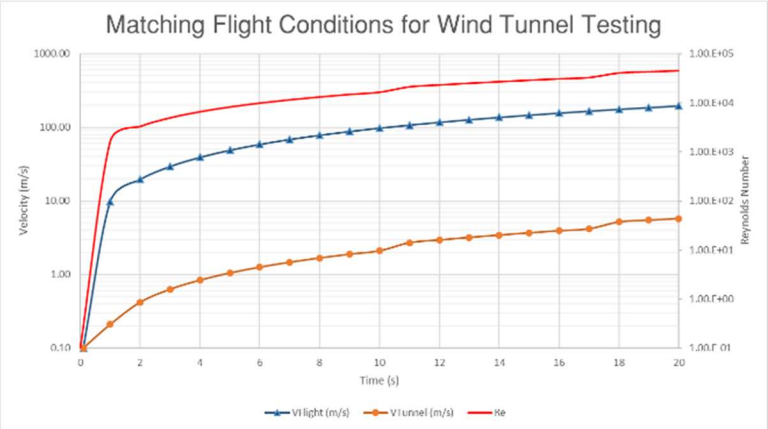

Figure 10. Matching flight conditions.

Appendix IV: Images of drag quantification apparatus

Figure 11. Image of drag and lift measurement apparatus.

Figure 12. Honeycomb screen downstream.

Figure 13. Image of blower used to create flow.

Appendix V – Drag Quantification Results
Note: All plots shown are taking into account the effect the threaded rod has on the system.

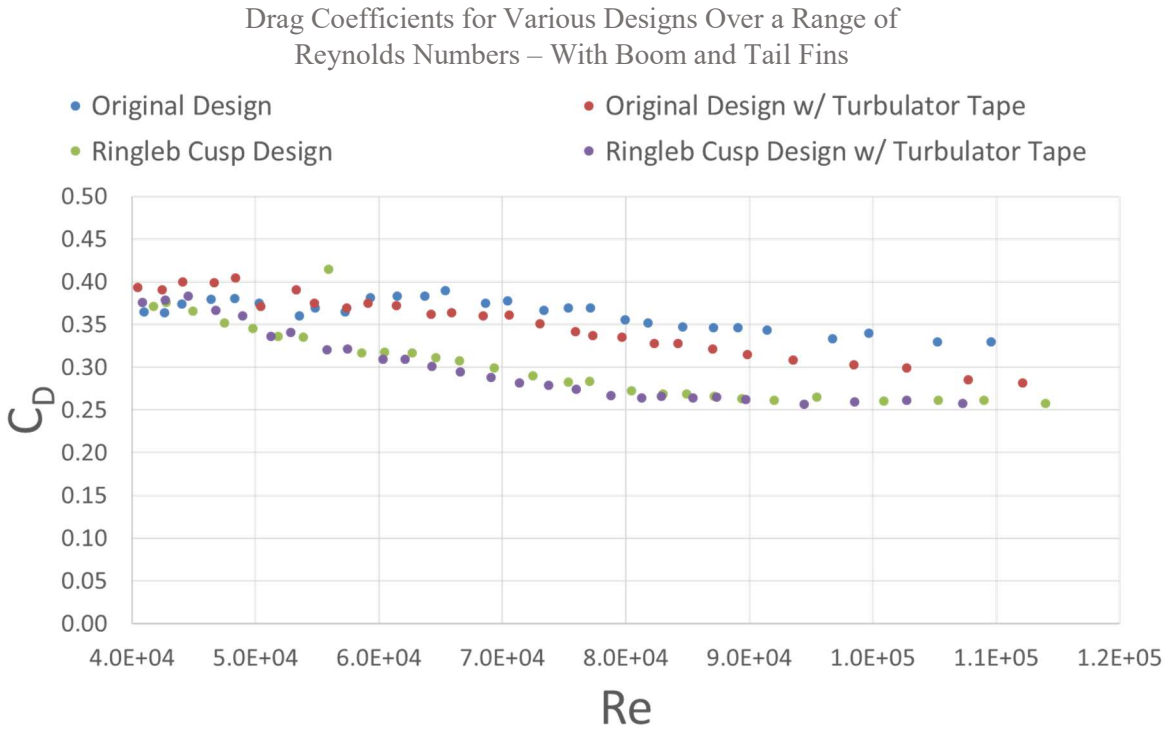

Figure 14. Average drag coefficients for designs with the boom and tail fins attached.

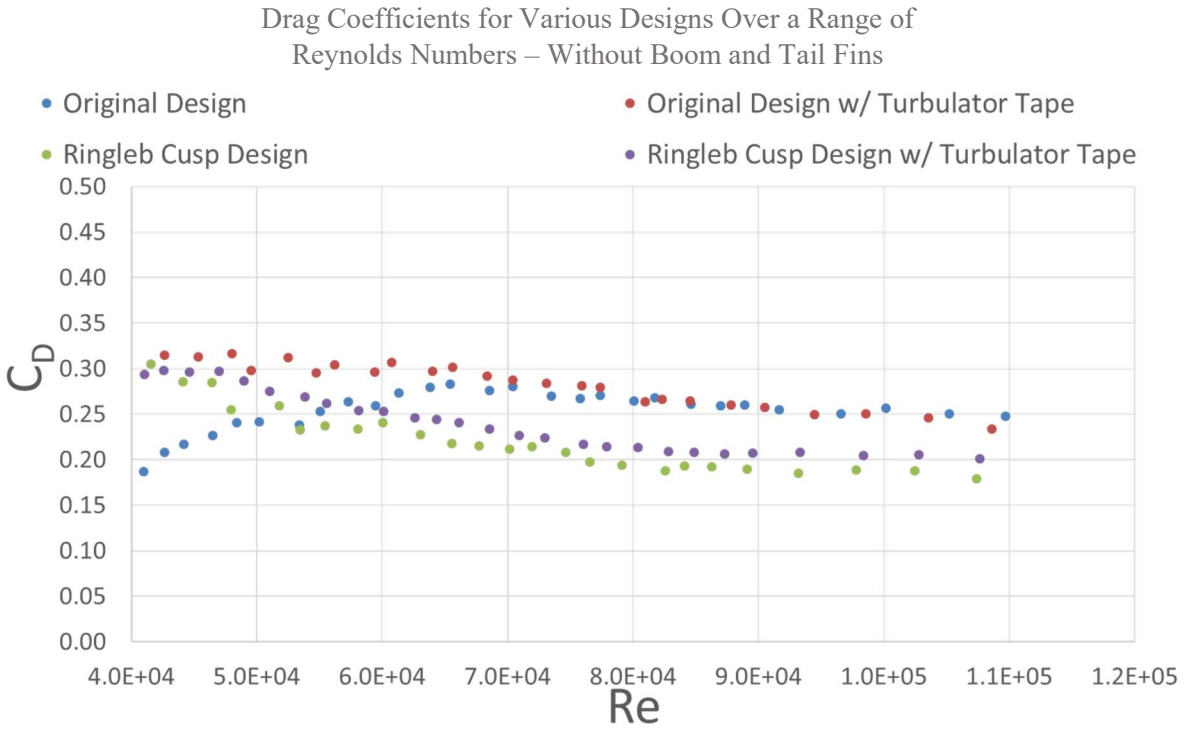

Figure 15. Average drag coefficients for designs without the boom and tail fins attached.

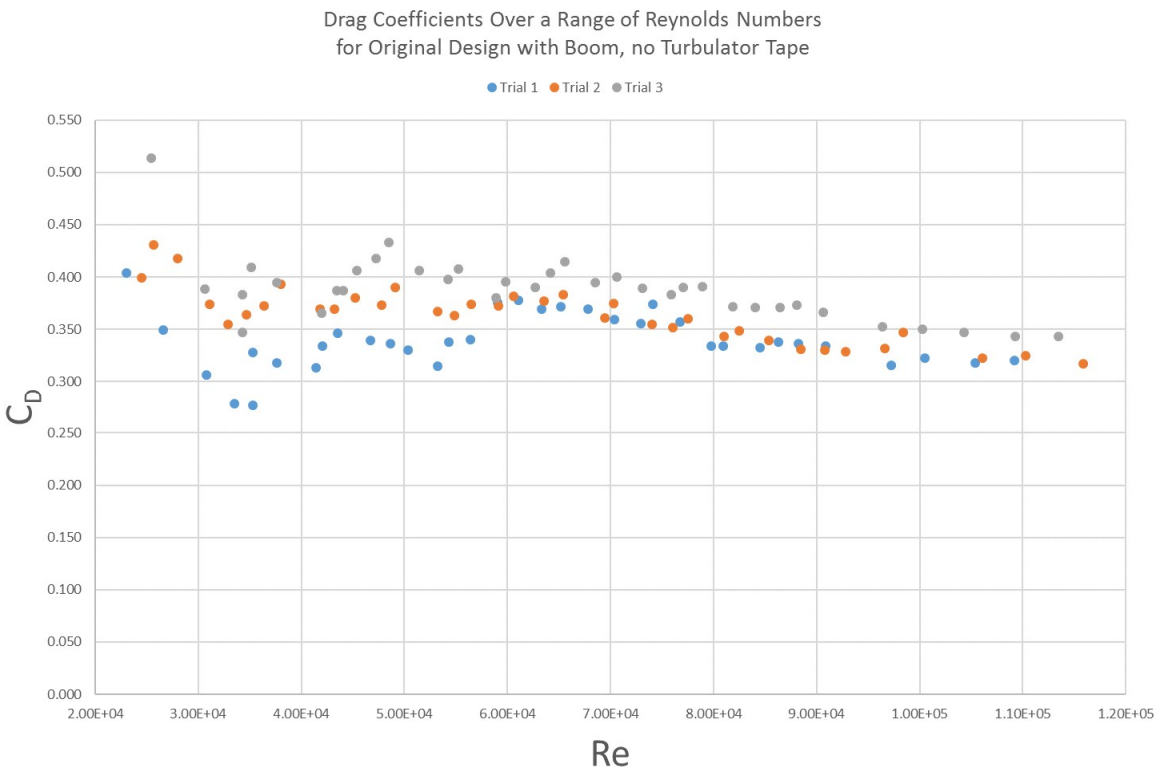

Figure 16. Drag coefficients for original aerobody.

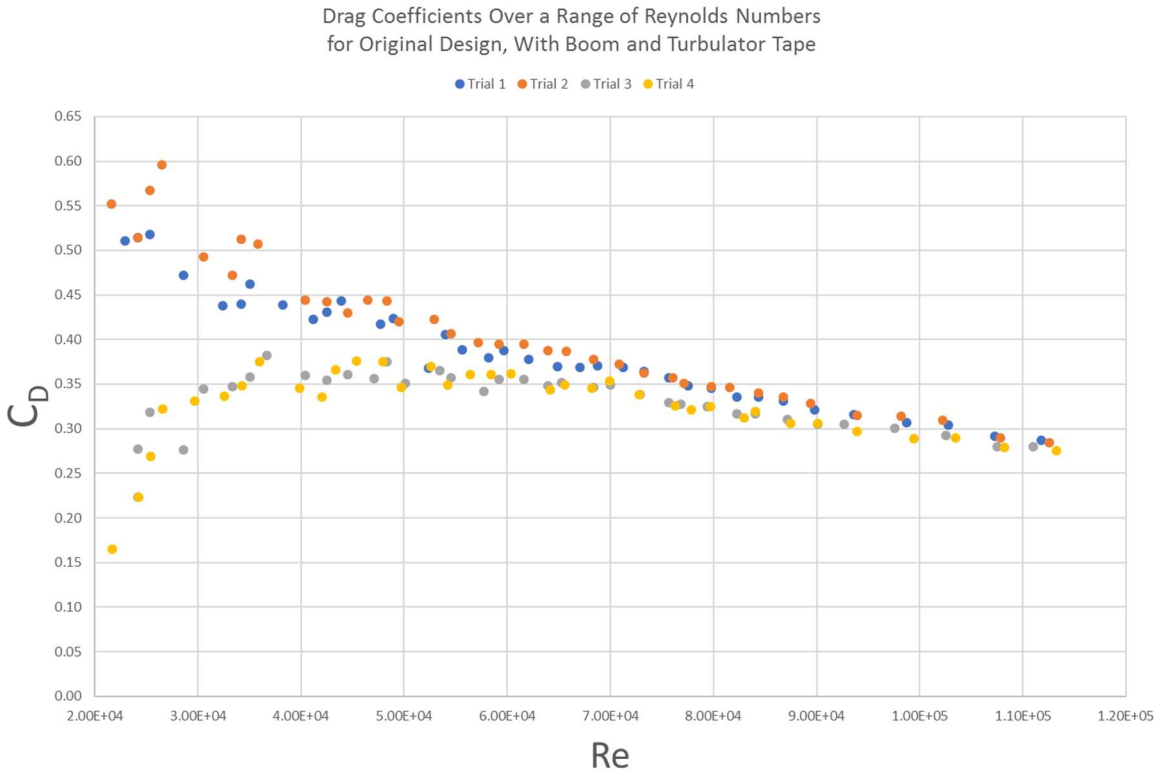

Figure 17. Drag coefficients for original aerobody with turbulator tape.

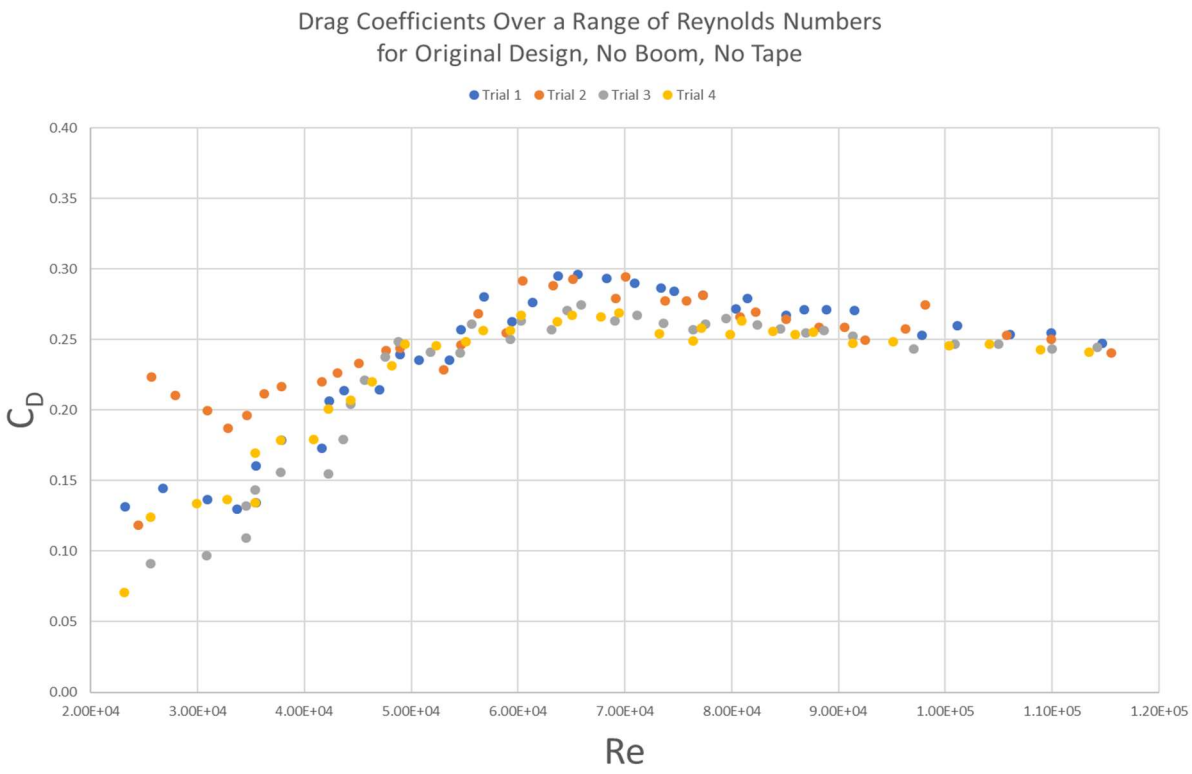

Figure 18. Drag coefficients for original aerobody with no boom and no tape.

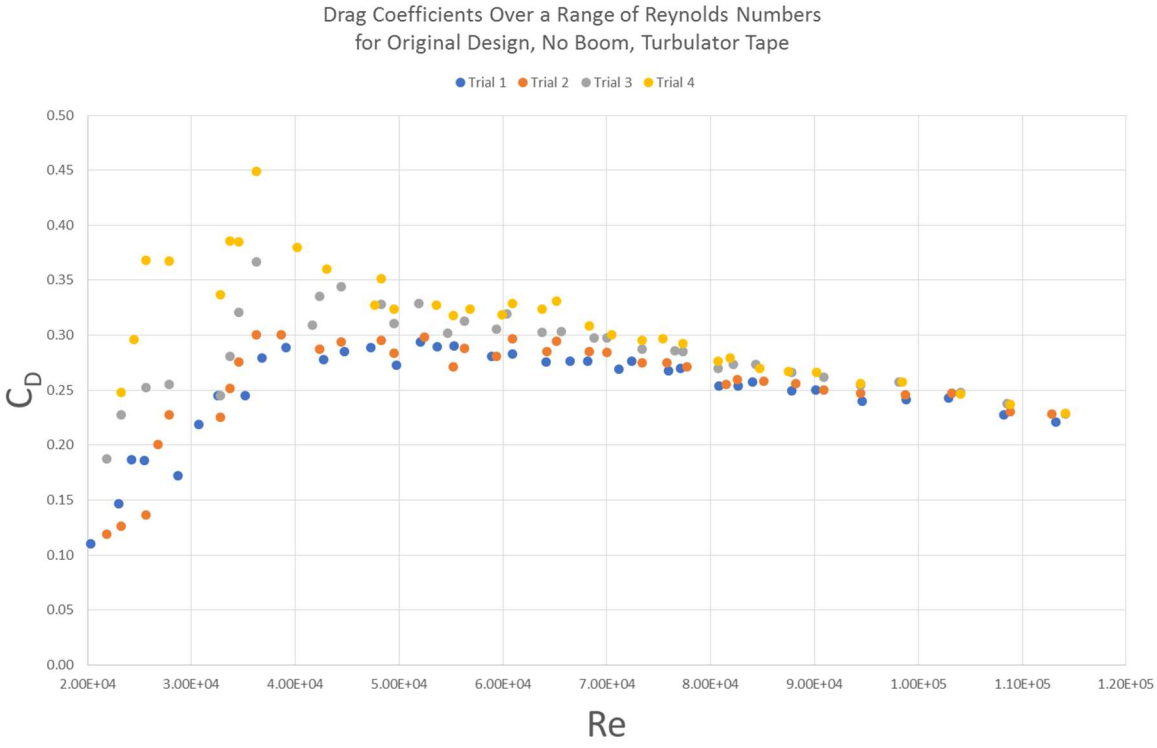

Figure 19. Drag coefficients for original aerobody with tape applied and no boom.

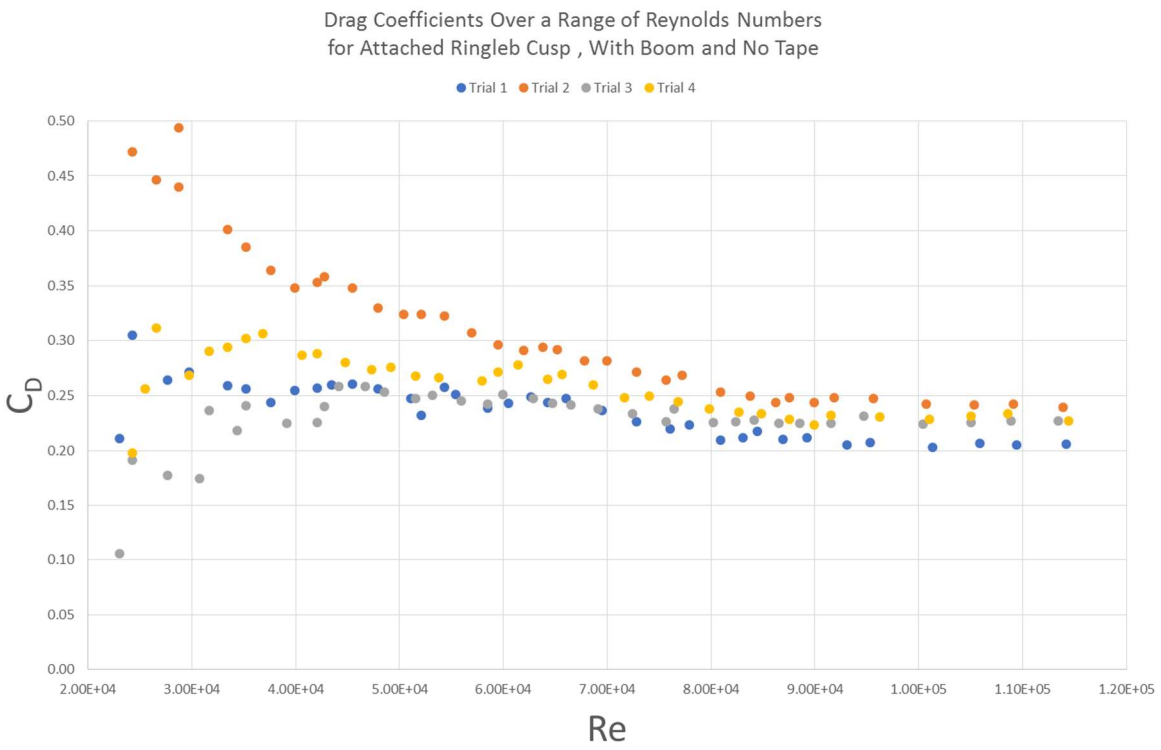

Figure 20. Drag coefficients for ringleb cusp aerobody, with boom and no tape.

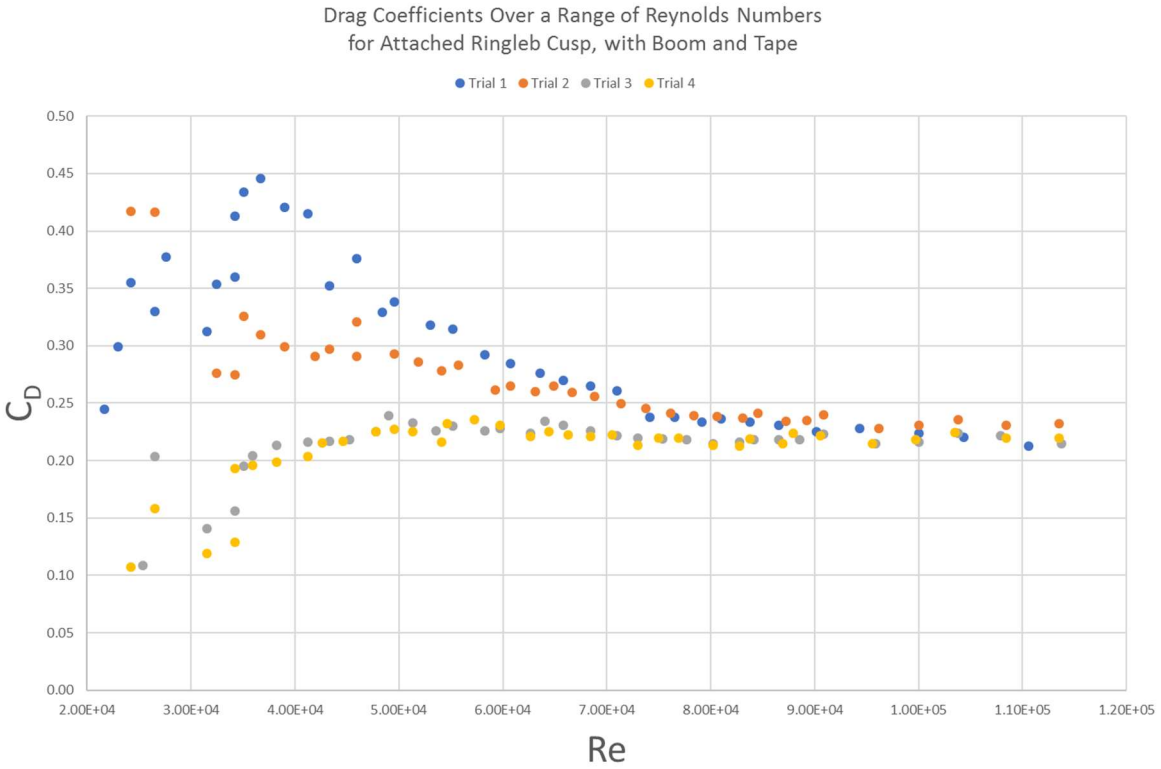

Figure 21. Drag coefficients for ringleb cusp aerobody, with boom and tape.

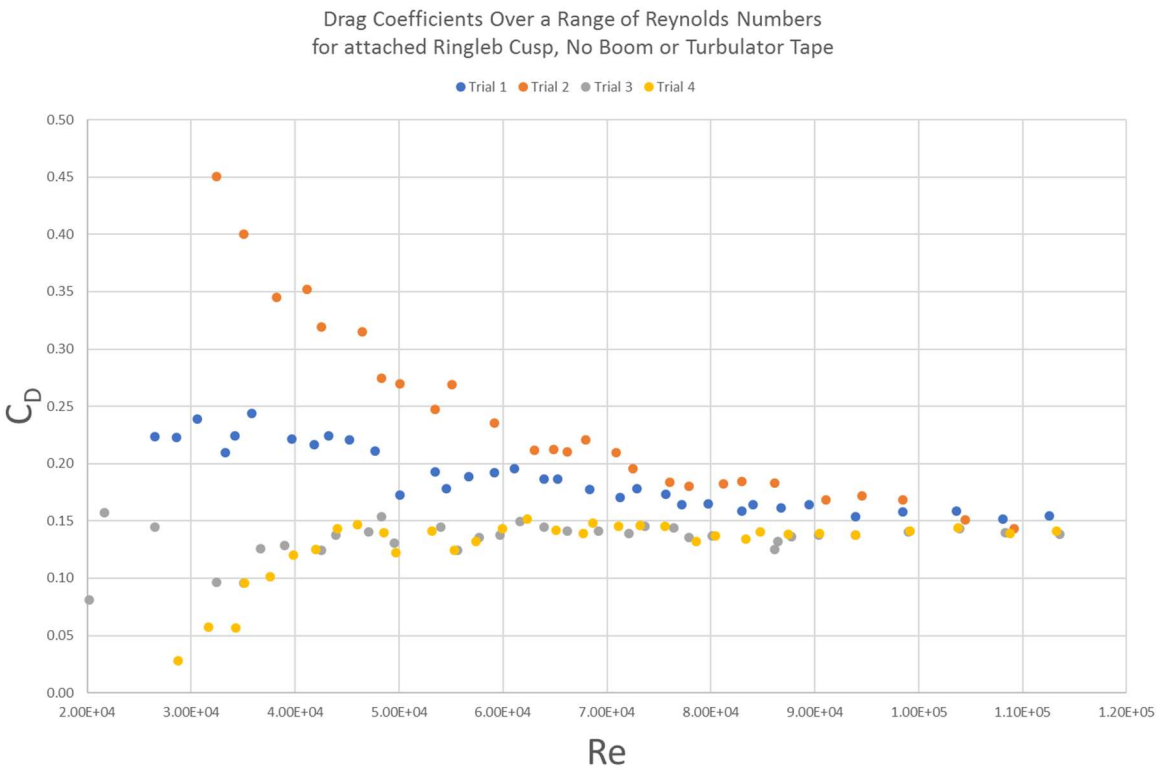

Figure 22. Drag coefficients for ringleb cusp aerobody, without boom and tape.

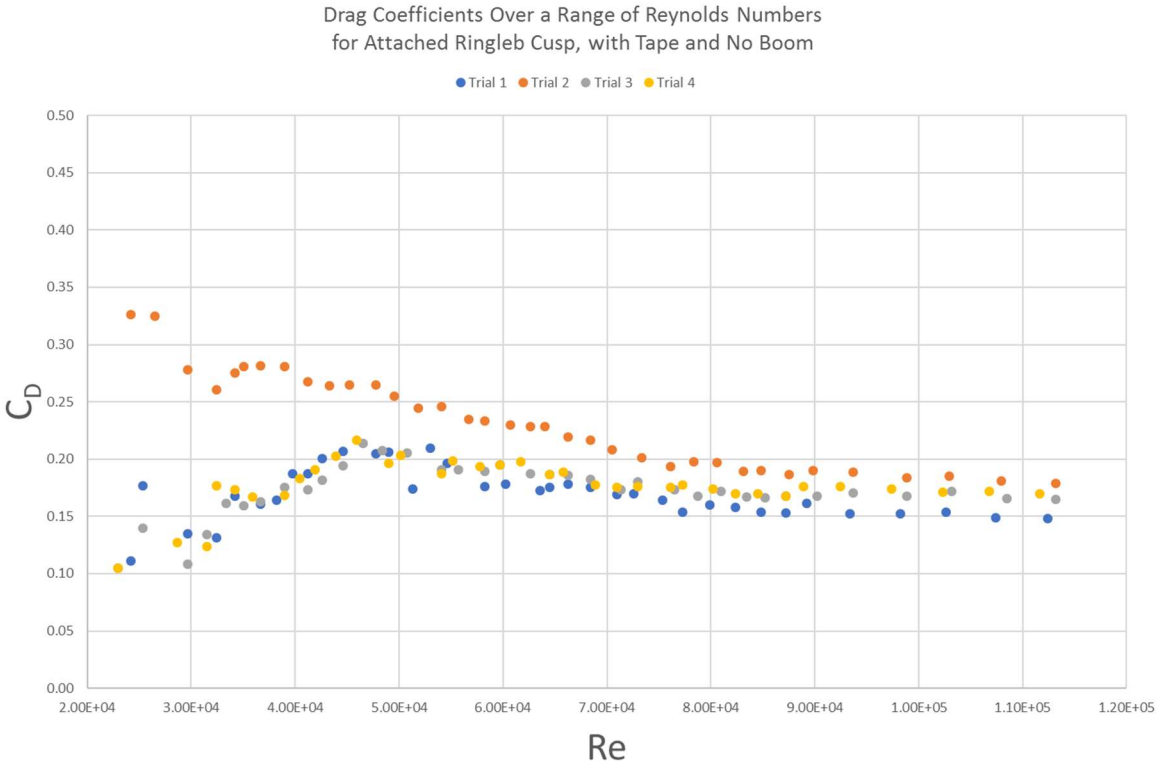

Figure 23. Drag coefficients for ringleb cusp aerobody, without boom but with tape.

Appendix VI – Drag Quantification Tables

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78	kPa
T	298.6	K
ρ air	0.911	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Drag Quantifcation ---Threaded Rod --- Trial 1

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.008	0.002	0.000203	1.9874	2.09	0.03	0.0060	2.17E+04	0.39
11	0.010	0.002	0.000254	2.4843	2.34	0.03	0.0060	2.43E+04	0.31
12	0.013	0.003	0.000330	3.2295	2.66	0.03	0.0063	2.77E+04	0.25
13	0.015	0.003	0.000381	3.7264	2.86	0.03	0.0063	2.97E+04	0.22
14	0.020	0.004	0.000508	4.9685	3.30	0.03	0.0067	3.43E+04	0.17
15	0.021	0.005	0.000533	5.2170	3.38	0.03	0.0070	3.52E+04	0.17
16	0.022	0.005	0.000559	5.4654	3.46	0.03	0.0070	3.60E+04	0.17
17	0.026	0.005	0.000660	6.4591	3.77	0.03	0.0070	3.91E+04	0.14
18	0.029	0.006	0.000737	7.2044	3.98	0.03	0.0074	4.13E+04	0.13
19	0.030	0.007	0.000762	7.4528	4.04	0.03	0.0077	4.20E+04	0.13
20	0.034	0.007	0.000864	8.4465	4.31	0.03	0.0077	4.47E+04	0.12
21	0.037	0.007	0.000940	9.1918	4.49	0.03	0.0077	4.67E+04	0.11
22	0.040	0.008	0.001016	9.9371	4.67	0.04	0.0081	4.85E+04	0.10
23	0.043	0.008	0.001092	10.6823	4.84	0.04	0.0081	5.03E+04	0.10
24	0.046	0.007	0.001168	11.4276	5.01	0.03	0.0077	5.20E+04	0.09
25	0.051	0.007	0.001295	12.6698	5.27	0.03	0.0077	5.48E+04	0.08
26	0.056	0.008	0.001422	13.9119	5.53	0.04	0.0081	5.74E+04	0.07
27	0.060	0.009	0.001524	14.9056	5.72	0.04	0.0084	5.94E+04	0.07
28	0.066	0.009	0.001676	16.3961	6.00	0.04	0.0084	6.23E+04	0.07
29	0.069	0.010	0.001753	17.1414	6.13	0.04	0.0088	6.37E+04	0.07
30	0.073	0.010	0.001854	18.1351	6.31	0.04	0.0088	6.55E+04	0.06
31	0.077	0.010	0.001956	19.1288	6.48	0.04	0.0088	6.73E+04	0.06
32	0.083	0.011	0.002108	20.6194	6.73	0.04	0.0092	6.99E+04	0.06
33	0.091	0.012	0.002311	22.6068	7.04	0.04	0.0095	7.32E+04	0.05
34	0.097	0.012	0.002464	24.0974	7.27	0.04	0.0095	7.56E+04	0.05
35	0.104	0.014	0.002642	25.8364	7.53	0.05	0.0102	7.82E+04	0.05
36	0.111	0.013	0.002819	27.5753	7.78	0.04	0.0099	8.08E+04	0.05
37	0.118	0.015	0.002997	29.3143	8.02	0.05	0.0106	8.33E+04	0.05
38	0.122	0.016	0.003099	30.3080	8.16	0.05	0.0109	8.47E+04	0.05
39	0.130	0.017	0.003302	32.2954	8.42	0.05	0.0113	8.75E+04	0.04
40	0.149	0.017	0.003785	37.0155	9.01	0.05	0.0113	9.36E+04	0.04
42	0.152	0.021	0.003861	37.7608	9.10	0.06	0.0127	9.46E+04	0.04
44	0.165	0.024	0.004191	40.9904	9.49	0.06	0.0137	9.85E+04	0.04
46	0.183	0.026	0.004648	45.4620	9.99	0.06	0.0144	1.04E+05	0.04
48	0.197	0.028	0.005004	48.9400	10.37	0.07	0.0151	1.08E+05	0.04
50	0.216	0.030	0.005486	53.6601	10.85	0.07	0.0158	1.13E+05	0.04

Drag Quantifcation ---Threaded Rod --- Trial 2

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78.3	kPa
T	298.1	K
ρ air	0.916	kg/m^3
ρ water	997	kg/m^3
μ	1.83E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re \quad \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.008	0.004	0.000203	1.9874	2.08	0.01	0.0014	2.19E+04	0.09
11	0.010	0.004	0.000254	2.4843	2.33	0.01	0.0014	2.45E+04	0.07
12	0.011	0.004	0.000279	2.7327	2.44	0.01	0.0014	2.57E+04	0.07
13	0.013	0.005	0.000330	3.2295	2.66	0.01	0.0018	2.79E+04	0.07
14	0.018	0.006	0.000457	4.4717	3.12	0.01	0.0021	3.28E+04	0.06
15	0.020	0.007	0.000508	4.9685	3.29	0.01	0.0025	3.46E+04	0.06
16	0.020	0.007	0.000508	4.9685	3.29	0.01	0.0025	3.46E+04	0.06
17	0.023	0.007	0.000584	5.7138	3.53	0.01	0.0025	3.71E+04	0.06
18	0.026	0.007	0.000660	6.4591	3.76	0.01	0.0025	3.94E+04	0.05
19	0.029	0.007	0.000737	7.2044	3.97	0.01	0.0025	4.17E+04	0.04
20	0.032	0.007	0.000813	7.9496	4.17	0.01	0.0025	4.38E+04	0.04
21	0.036	0.007	0.000914	8.9434	4.42	0.01	0.0025	4.64E+04	0.04
22	0.040	0.008	0.001016	9.9371	4.66	0.01	0.0028	4.89E+04	0.04
23	0.042	0.009	0.001067	10.4339	4.77	0.01	0.0032	5.01E+04	0.04
24	0.048	0.009	0.001219	11.9245	5.10	0.01	0.0032	5.36E+04	0.03
25	0.051	0.010	0.001295	12.6698	5.26	0.02	0.0035	5.52E+04	0.04
26	0.054	0.011	0.001372	13.4150	5.41	0.02	0.0039	5.68E+04	0.04
27	0.059	0.011	0.001499	14.6572	5.66	0.02	0.0039	5.94E+04	0.03
28	0.068	0.012	0.001727	16.8930	6.07	0.02	0.0042	6.38E+04	0.03
29	0.070	0.013	0.001778	17.3899	6.16	0.02	0.0046	6.47E+04	0.03
30	0.077	0.014	0.001956	19.1288	6.46	0.02	0.0049	6.79E+04	0.03
31	0.080	0.014	0.002032	19.8741	6.59	0.02	0.0049	6.92E+04	0.03
32	0.084	0.015	0.002134	20.8678	6.75	0.02	0.0053	7.09E+04	0.03
33	0.090	0.015	0.002286	22.3584	6.99	0.02	0.0053	7.34E+04	0.03
34	0.099	0.016	0.002515	24.5942	7.33	0.03	0.0056	7.70E+04	0.03
35	0.103	0.017	0.002616	25.5879	7.47	0.03	0.0060	7.85E+04	0.03
36	0.109	0.018	0.002769	27.0785	7.69	0.03	0.0063	8.07E+04	0.03
37	0.117	0.019	0.002972	29.0659	7.97	0.03	0.0067	8.37E+04	0.03
38	0.122	0.020	0.003099	30.3080	8.13	0.03	0.0070	8.54E+04	0.03
39	0.129	0.021	0.003277	32.0470	8.36	0.03	0.0074	8.78E+04	0.03
40	0.147	0.022	0.003734	36.5187	8.93	0.03	0.0077	9.38E+04	0.03
42	0.150	0.024	0.003810	37.2640	9.02	0.04	0.0084	9.47E+04	0.03
44	0.168	0.026	0.004267	41.7356	9.55	0.04	0.0092	1.00E+05	0.03
46	0.181	0.028	0.004597	44.9652	9.91	0.04	0.0099	1.04E+05	0.03
48	0.200	0.031	0.005080	49.6853	10.42	0.05	0.0109	1.09E+05	0.03
50	0.217	0.034	0.005512	53.9085	10.85	0.05	0.0120	1.14E+05	0.03

Threaded Rod --- Trial 1			Threaded Rod --- Trial 2			Average		
Re-Mano	Drag Coefficient	Drag Force [N]	Re-Mano	Drag Coefficient	Drag Force [N]	Re-Mano	Drag Coefficient	Drag Force [N]
2.17E+04	0.39	0.03	2.19E+04	0.09	0.01	2.18E+04	0.24	0.02
2.43E+04	0.31	0.03	2.45E+04	0.07	0.01	2.44E+04	0.19	0.02
2.77E+04	0.25	0.03	2.57E+04	0.07	0.01	2.67E+04	0.16	0.02
2.97E+04	0.22	0.03	2.79E+04	0.07	0.01	2.88E+04	0.14	0.02
3.43E+04	0.17	0.03	3.28E+04	0.06	0.01	3.36E+04	0.12	0.02
3.52E+04	0.17	0.03	3.46E+04	0.06	0.01	3.49E+04	0.12	0.02
3.60E+04	0.17	0.03	3.46E+04	0.06	0.01	3.53E+04	0.11	0.02
3.91E+04	0.14	0.03	3.71E+04	0.06	0.01	3.81E+04	0.10	0.02
4.13E+04	0.13	0.03	3.94E+04	0.05	0.01	4.04E+04	0.09	0.02
4.20E+04	0.13	0.03	4.17E+04	0.04	0.01	4.18E+04	0.09	0.02
4.47E+04	0.12	0.03	4.38E+04	0.04	0.01	4.42E+04	0.08	0.02
4.67E+04	0.11	0.03	4.64E+04	0.04	0.01	4.65E+04	0.07	0.02
4.85E+04	0.10	0.04	4.89E+04	0.04	0.01	4.87E+04	0.07	0.02
5.03E+04	0.10	0.04	5.01E+04	0.04	0.01	5.02E+04	0.07	0.03
5.20E+04	0.09	0.03	5.36E+04	0.03	0.01	5.28E+04	0.06	0.02
5.48E+04	0.08	0.03	5.52E+04	0.04	0.02	5.50E+04	0.06	0.03
5.74E+04	0.07	0.04	5.68E+04	0.04	0.02	5.71E+04	0.06	0.03
5.94E+04	0.07	0.04	5.94E+04	0.03	0.02	5.94E+04	0.05	0.03
6.23E+04	0.07	0.04	6.38E+04	0.03	0.02	6.30E+04	0.05	0.03
6.37E+04	0.07	0.04	6.47E+04	0.03	0.02	6.42E+04	0.05	0.03
6.55E+04	0.06	0.04	6.79E+04	0.03	0.02	6.67E+04	0.05	0.03
6.73E+04	0.06	0.04	6.92E+04	0.03	0.02	6.82E+04	0.05	0.03
6.99E+04	0.06	0.04	7.09E+04	0.03	0.02	7.04E+04	0.04	0.03
7.32E+04	0.05	0.04	7.34E+04	0.03	0.02	7.33E+04	0.04	0.03
7.56E+04	0.05	0.04	7.70E+04	0.03	0.03	7.63E+04	0.04	0.03
7.82E+04	0.05	0.05	7.85E+04	0.03	0.03	7.84E+04	0.04	0.04
8.08E+04	0.05	0.04	8.07E+04	0.03	0.03	8.08E+04	0.04	0.04
8.33E+04	0.05	0.05	8.37E+04	0.03	0.03	8.35E+04	0.04	0.04
8.47E+04	0.05	0.05	8.54E+04	0.03	0.03	8.51E+04	0.04	0.04
8.75E+04	0.04	0.05	8.78E+04	0.03	0.03	8.77E+04	0.04	0.04
9.36E+04	0.04	0.05	9.38E+04	0.03	0.03	9.37E+04	0.03	0.04
9.46E+04	0.04	0.06	9.47E+04	0.03	0.04	9.47E+04	0.04	0.05
9.85E+04	0.04	0.06	1.00E+05	0.03	0.04	9.94E+04	0.04	0.05
1.04E+05	0.04	0.06	1.04E+05	0.03	0.04	1.04E+05	0.03	0.05
1.08E+05	0.04	0.07	1.09E+05	0.03	0.05	1.09E+05	0.03	0.06
1.13E+05	0.04	0.07	1.14E+05	0.03	0.05	1.13E+05	0.03	0.06

Drag Quantifcation --- Original Aerobody with Boom, No Tape --- Trial 1

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78.3	kPa
T	298.1	K
ρ air	0.916	kg/m^3
ρ water	997	kg/m^3
μ	1.83E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.009	0.020	0.000229	2.2358	2.21	0.03	0.0070	2.32E+04	0.41
11	0.012	0.023	0.000305	2.9811	2.55	0.04	0.0081	2.68E+04	0.35
12	0.016	0.027	0.000406	3.9748	2.95	0.04	0.0095	3.09E+04	0.31
13	0.019	0.029	0.000483	4.7201	3.21	0.05	0.0102	3.37E+04	0.28
14	0.021	0.032	0.000533	5.2170	3.38	0.05	0.0113	3.54E+04	0.28
15	0.021	0.038	0.000533	5.2170	3.38	0.06	0.0134	3.54E+04	0.33
16	0.024	0.042	0.000610	5.9622	3.61	0.07	0.0148	3.79E+04	0.32
17	0.029	0.050	0.000737	7.2044	3.97	0.08	0.0176	4.17E+04	0.31
18	0.030	0.055	0.000762	7.4528	4.03	0.09	0.0194	4.24E+04	0.33
19	0.032	0.061	0.000813	7.9496	4.17	0.10	0.0215	4.38E+04	0.35
20	0.037	0.069	0.000940	9.1918	4.48	0.11	0.0243	4.70E+04	0.34
21	0.040	0.074	0.001016	9.9371	4.66	0.12	0.0260	4.89E+04	0.34
22	0.043	0.078	0.001092	10.6823	4.83	0.12	0.0275	5.07E+04	0.33
23	0.048	0.083	0.001219	11.9245	5.10	0.13	0.0292	5.36E+04	0.32
24	0.050	0.093	0.001270	12.4213	5.21	0.15	0.0327	5.47E+04	0.34
25	0.054	0.101	0.001372	13.4150	5.41	0.16	0.0355	5.68E+04	0.34
26	0.059	0.122	0.001499	14.6572	5.66	0.19	0.0429	5.94E+04	0.38
27	0.063	0.131	0.001600	15.6509	5.85	0.21	0.0461	6.14E+04	0.38
28	0.068	0.138	0.001727	16.8930	6.07	0.22	0.0486	6.38E+04	0.37
29	0.072	0.147	0.001829	17.8867	6.25	0.23	0.0517	6.56E+04	0.37
30	0.078	0.158	0.001981	19.3773	6.50	0.25	0.0556	6.83E+04	0.37
31	0.084	0.166	0.002134	20.8678	6.75	0.26	0.0584	7.09E+04	0.36
32	0.090	0.176	0.002286	22.3584	6.99	0.28	0.0619	7.34E+04	0.36
33	0.093	0.191	0.002362	23.1037	7.10	0.30	0.0672	7.46E+04	0.37
34	0.100	0.196	0.002540	24.8426	7.36	0.31	0.0690	7.73E+04	0.36
35	0.108	0.198	0.002743	26.8301	7.65	0.31	0.0697	8.04E+04	0.33
36	0.111	0.204	0.002819	27.5753	7.76	0.32	0.0718	8.15E+04	0.34
37	0.121	0.221	0.003073	30.0596	8.10	0.35	0.0778	8.51E+04	0.33
38	0.126	0.234	0.003200	31.3017	8.27	0.37	0.0824	8.68E+04	0.34
39	0.132	0.244	0.003353	32.7923	8.46	0.38	0.0859	8.89E+04	0.34
40	0.140	0.257	0.003556	34.7797	8.71	0.40	0.0905	9.15E+04	0.33
42	0.160	0.278	0.004064	39.7482	9.32	0.44	0.0978	9.78E+04	0.32
44	0.171	0.303	0.004343	42.4809	9.63	0.47	0.1066	1.01E+05	0.32
46	0.188	0.329	0.004775	46.7042	10.10	0.52	0.1158	1.06E+05	0.32
48	0.202	0.356	0.005131	50.1821	10.47	0.56	0.1253	1.10E+05	0.32
50	0.220	0.338	0.005588	54.6538	10.92	0.53	0.1190	1.15E+05	0.28

Drag Quantifcation --- Original Aerobody with Boom, No Tape --- Trial 2

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78.3	kPa
T	298.1	K
ρ air	0.916	kg/m^3
ρ water	997	kg/m^3
μ	1.83E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.009	0.020	0.000229	2.2358	2.21	0.03	0.0070	2.32E+04	0.41
11	0.012	0.023	0.000305	2.9811	2.55	0.04	0.0081	2.68E+04	0.35
12	0.016	0.027	0.000406	3.9748	2.95	0.04	0.0095	3.09E+04	0.31
13	0.019	0.029	0.000483	4.7201	3.21	0.05	0.0102	3.37E+04	0.28
14	0.021	0.032	0.000533	5.2170	3.38	0.05	0.0113	3.54E+04	0.28
15	0.021	0.038	0.000533	5.2170	3.38	0.06	0.0134	3.54E+04	0.33
16	0.024	0.042	0.000610	5.9622	3.61	0.07	0.0148	3.79E+04	0.32
17	0.029	0.050	0.000737	7.2044	3.97	0.08	0.0176	4.17E+04	0.31
18	0.030	0.055	0.000762	7.4528	4.03	0.09	0.0194	4.24E+04	0.33
19	0.032	0.061	0.000813	7.9496	4.17	0.10	0.0215	4.38E+04	0.35
20	0.037	0.069	0.000940	9.1918	4.48	0.11	0.0243	4.70E+04	0.34
21	0.040	0.074	0.001016	9.9371	4.66	0.12	0.0260	4.89E+04	0.34
22	0.043	0.078	0.001092	10.6823	4.83	0.12	0.0275	5.07E+04	0.33
23	0.048	0.083	0.001219	11.9245	5.10	0.13	0.0292	5.36E+04	0.32
24	0.050	0.093	0.001270	12.4213	5.21	0.15	0.0327	5.47E+04	0.34
25	0.054	0.101	0.001372	13.4150	5.41	0.16	0.0355	5.68E+04	0.34
26	0.059	0.122	0.001499	14.6572	5.66	0.19	0.0429	5.94E+04	0.38
27	0.063	0.131	0.001600	15.6509	5.85	0.21	0.0461	6.14E+04	0.38
28	0.068	0.138	0.001727	16.8930	6.07	0.22	0.0486	6.38E+04	0.37
29	0.072	0.147	0.001829	17.8867	6.25	0.23	0.0517	6.56E+04	0.37
30	0.078	0.158	0.001981	19.3773	6.50	0.25	0.0556	6.83E+04	0.37
31	0.084	0.166	0.002134	20.8678	6.75	0.26	0.0584	7.09E+04	0.36
32	0.090	0.176	0.002286	22.3584	6.99	0.28	0.0619	7.34E+04	0.36
33	0.093	0.191	0.002362	23.1037	7.10	0.30	0.0672	7.46E+04	0.37
34	0.100	0.196	0.002540	24.8426	7.36	0.31	0.0690	7.73E+04	0.36
35	0.108	0.198	0.002743	26.8301	7.65	0.31	0.0697	8.04E+04	0.33
36	0.111	0.204	0.002819	27.5753	7.76	0.32	0.0718	8.15E+04	0.34
37	0.121	0.221	0.003073	30.0596	8.10	0.35	0.0778	8.51E+04	0.33
38	0.126	0.234	0.003200	31.3017	8.27	0.37	0.0824	8.68E+04	0.34
39	0.132	0.244	0.003353	32.7923	8.46	0.38	0.0859	8.89E+04	0.34
40	0.140	0.257	0.003556	34.7797	8.71	0.40	0.0905	9.15E+04	0.33
42	0.160	0.278	0.004064	39.7482	9.32	0.44	0.0978	9.78E+04	0.32
44	0.171	0.303	0.004343	42.4809	9.63	0.47	0.1066	1.01E+05	0.32
46	0.188	0.329	0.004775	46.7042	10.10	0.52	0.1158	1.06E+05	0.32
48	0.202	0.356	0.005131	50.1821	10.47	0.56	0.1253	1.10E+05	0.32
50	0.220	0.338	0.005588	54.6538	10.92	0.53	0.1190	1.15E+05	0.28

Drag Quantifcation --- Original Aerobody with Boom, No Tape --- Trial 3

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78.3	kPa
T	298.1	K
ρ air	0.916	kg/m^3
ρ water	997	kg/m^3
μ	1.83E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re \quad \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.009	0.017	0.000229	2.2358	2.21	0.03	0.0060	2.32E+04	0.34
11	0.012	0.020	0.000305	2.9811	2.55	0.03	0.0070	2.68E+04	0.30
12	0.016	0.023	0.000406	3.9748	2.95	0.04	0.0081	3.09E+04	0.26
13	0.019	0.025	0.000483	4.7201	3.21	0.04	0.0088	3.37E+04	0.24
14	0.021	0.028	0.000533	5.2170	3.38	0.04	0.0099	3.54E+04	0.24
15	0.021	0.032	0.000533	5.2170	3.38	0.05	0.0113	3.54E+04	0.28
16	0.024	0.037	0.000610	5.9622	3.61	0.06	0.0130	3.79E+04	0.28
17	0.029	0.041	0.000737	7.2044	3.97	0.06	0.0144	4.17E+04	0.26
18	0.030	0.048	0.000762	7.4528	4.03	0.08	0.0169	4.24E+04	0.29
19	0.032	0.052	0.000813	7.9496	4.17	0.08	0.0183	4.38E+04	0.30
20	0.037	0.058	0.000940	9.1918	4.48	0.09	0.0204	4.70E+04	0.29
21	0.040	0.067	0.001016	9.9371	4.66	0.10	0.0236	4.89E+04	0.31
22	0.043	0.071	0.001092	10.6823	4.83	0.11	0.0250	5.07E+04	0.30
23	0.048	0.078	0.001219	11.9245	5.10	0.12	0.0275	5.36E+04	0.30
24	0.050	0.086	0.001270	12.4213	5.21	0.13	0.0303	5.47E+04	0.31
25	0.054	0.099	0.001372	13.4150	5.41	0.16	0.0348	5.68E+04	0.33
26	0.059	0.102	0.001499	14.6572	5.66	0.16	0.0359	5.94E+04	0.32
27	0.063	0.113	0.001600	15.6509	5.85	0.18	0.0398	6.14E+04	0.33
28	0.068	0.128	0.001727	16.8930	6.07	0.20	0.0451	6.38E+04	0.34
29	0.072	0.136	0.001829	17.8867	6.25	0.21	0.0479	6.56E+04	0.34
30	0.078	0.145	0.001981	19.3773	6.50	0.23	0.0510	6.83E+04	0.34
31	0.084	0.153	0.002134	20.8678	6.75	0.24	0.0539	7.09E+04	0.33
32	0.090	0.162	0.002286	22.3584	6.99	0.25	0.0570	7.34E+04	0.33
33	0.093	0.166	0.002362	23.1037	7.10	0.26	0.0584	7.46E+04	0.33
34	0.100	0.176	0.002540	24.8426	7.36	0.28	0.0619	7.73E+04	0.32
35	0.108	0.184	0.002743	26.8301	7.65	0.29	0.0648	8.04E+04	0.31
36	0.111	0.193	0.002819	27.5753	7.76	0.30	0.0679	8.15E+04	0.32
37	0.121	0.202	0.003073	30.0596	8.10	0.32	0.0711	8.51E+04	0.30
38	0.126	0.213	0.003200	31.3017	8.27	0.33	0.0750	8.68E+04	0.31
39	0.132	0.223	0.003353	32.7923	8.46	0.35	0.0785	8.89E+04	0.31
40	0.140	0.235	0.003556	34.7797	8.71	0.37	0.0827	9.15E+04	0.31
42	0.160	0.252	0.004064	39.7482	9.32	0.39	0.0887	9.78E+04	0.29
44	0.171	0.276	0.004343	42.4809	9.63	0.43	0.0971	1.01E+05	0.29
46	0.188	0.296	0.004775	46.7042	10.10	0.46	0.1042	1.06E+05	0.29
48	0.202	0.319	0.005131	50.1821	10.47	0.50	0.1123	1.10E+05	0.29
50	0.220	0.338	0.005588	54.6538	10.92	0.53	0.1190	1.15E+05	0.28

Drag Quantifcation --- Original Aerobody with Boom and Tape --- Trial 1

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	77.4	kPa
T	298.6	K
ρ air	0.904	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Accounting for Rod[N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.009	0.023	0.000229	2.2358	2.22	0.06	0.04	0.0134	2.29E+04	0.51
11	0.010	0.026	0.000254	2.4843	2.34	0.06	0.04	0.0144	2.42E+04	0.51
12	0.011	0.029	0.000279	2.7327	2.46	0.07	0.05	0.0155	2.53E+04	0.52
13	0.014	0.034	0.000356	3.4780	2.77	0.08	0.06	0.0172	2.86E+04	0.47
14	0.018	0.041	0.000457	4.4717	3.15	0.09	0.07	0.0197	3.24E+04	0.44
15	0.020	0.046	0.000508	4.9685	3.32	0.10	0.08	0.0215	3.42E+04	0.44
16	0.021	0.051	0.000533	5.2170	3.40	0.10	0.08	0.0232	3.50E+04	0.46
17	0.025	0.058	0.000635	6.2107	3.71	0.11	0.09	0.0257	3.82E+04	0.44
18	0.029	0.065	0.000737	7.2044	3.99	0.13	0.11	0.0282	4.12E+04	0.42
19	0.031	0.071	0.000787	7.7012	4.13	0.13	0.11	0.0303	4.25E+04	0.43
20	0.033	0.078	0.000838	8.1981	4.26	0.15	0.13	0.0327	4.39E+04	0.44
21	0.039	0.087	0.000991	9.6886	4.63	0.16	0.14	0.0359	4.77E+04	0.42
22	0.041	0.093	0.001041	10.1855	4.75	0.17	0.15	0.0380	4.89E+04	0.42
23	0.047	0.099	0.001194	11.6760	5.08	0.18	0.15	0.0401	5.24E+04	0.37
24	0.050	0.109	0.001270	12.4213	5.24	0.19	0.17	0.0436	5.40E+04	0.41
25	0.053	0.117	0.001346	13.1666	5.40	0.21	0.18	0.0465	5.56E+04	0.39
26	0.058	0.125	0.001473	14.4087	5.65	0.22	0.19	0.0493	5.82E+04	0.38
27	0.061	0.134	0.001549	15.1540	5.79	0.23	0.20	0.0524	5.97E+04	0.39
28	0.066	0.141	0.001676	16.3961	6.02	0.24	0.21	0.0549	6.21E+04	0.38
29	0.072	0.150	0.001829	17.8867	6.29	0.26	0.23	0.0581	6.48E+04	0.37
30	0.077	0.160	0.001956	19.1288	6.51	0.27	0.24	0.0616	6.71E+04	0.37
31	0.081	0.169	0.002057	20.1225	6.67	0.29	0.26	0.0648	6.88E+04	0.37
32	0.087	0.180	0.002210	21.6131	6.91	0.31	0.28	0.0686	7.13E+04	0.37
33	0.092	0.188	0.002337	22.8552	7.11	0.32	0.29	0.0714	7.33E+04	0.36
34	0.098	0.196	0.002489	24.3458	7.34	0.33	0.30	0.0743	7.56E+04	0.36
35	0.103	0.207	0.002616	25.5879	7.52	0.35	0.31	0.0781	7.76E+04	0.35
36	0.109	0.217	0.002769	27.0785	7.74	0.36	0.32	0.0817	7.98E+04	0.35
37	0.116	0.224	0.002946	28.8175	7.98	0.37	0.33	0.0841	8.23E+04	0.34
38	0.122	0.235	0.003099	30.3080	8.19	0.39	0.35	0.0880	8.44E+04	0.34
39	0.129	0.245	0.003277	32.0470	8.42	0.41	0.37	0.0915	8.68E+04	0.33
40	0.138	0.254	0.003505	34.2829	8.71	0.42	0.38	0.0947	8.98E+04	0.32
42	0.150	0.277	0.003810	37.2640	9.08	0.46	0.41	0.1028	9.36E+04	0.32
44	0.167	0.298	0.004242	41.4872	9.58	0.49	0.44	0.1102	9.88E+04	0.31
46	0.181	0.319	0.004597	44.9652	9.97	0.52	0.47	0.1176	1.03E+05	0.30
48	0.197	0.338	0.005004	48.9400	10.41	0.55	0.49	0.1242	1.07E+05	0.29
50	0.214	0.360	0.005436	53.1633	10.85	0.59	0.53	0.1320	1.12E+05	0.29

Drag Quantifcation --- Original Aerobody with Boom and Tape --- Trial 2

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	77.4	kPa
T	298.6	K
ρ air	0.904	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Accounting for Rod[N]	Calculated Drag [lb$_f$]	Re-Mano	Drag Coefficient
10	0.008	0.022	0.000203	1.9874	2.10	0.06	0.04	0.0130	2.16E+04	0.55
11	0.010	0.026	0.000254	2.4843	2.34	0.06	0.04	0.0144	2.42E+04	0.51
12	0.011	0.032	0.000279	2.7327	2.46	0.07	0.05	0.0165	2.53E+04	0.57
13	0.012	0.037	0.000305	2.9811	2.57	0.08	0.06	0.0183	2.65E+04	0.60
14	0.016	0.041	0.000406	3.9748	2.97	0.09	0.07	0.0197	3.06E+04	0.49
15	0.019	0.047	0.000483	4.7201	3.23	0.10	0.08	0.0218	3.33E+04	0.47
16	0.020	0.054	0.000508	4.9685	3.32	0.11	0.09	0.0243	3.42E+04	0.51
17	0.022	0.059	0.000559	5.4654	3.48	0.12	0.10	0.0260	3.58E+04	0.51
18	0.028	0.066	0.000711	6.9559	3.92	0.13	0.11	0.0285	4.04E+04	0.44
19	0.031	0.073	0.000787	7.7012	4.13	0.14	0.12	0.0310	4.25E+04	0.44
20	0.034	0.078	0.000864	8.4465	4.32	0.15	0.13	0.0327	4.46E+04	0.43
21	0.037	0.088	0.000940	9.1918	4.51	0.16	0.14	0.0363	4.65E+04	0.44
22	0.040	0.095	0.001016	9.9371	4.69	0.17	0.15	0.0387	4.83E+04	0.44
23	0.042	0.101	0.001067	10.4339	4.80	0.18	0.15	0.0408	4.95E+04	0.42
24	0.048	0.109	0.001219	11.9245	5.14	0.19	0.17	0.0436	5.29E+04	0.42
25	0.051	0.118	0.001295	12.6698	5.29	0.21	0.18	0.0468	5.46E+04	0.41
26	0.056	0.126	0.001422	13.9119	5.55	0.22	0.19	0.0496	5.72E+04	0.40
27	0.060	0.134	0.001524	14.9056	5.74	0.23	0.20	0.0524	5.92E+04	0.39
28	0.065	0.145	0.001651	16.1477	5.98	0.25	0.22	0.0563	6.16E+04	0.40
29	0.070	0.153	0.001778	17.3899	6.20	0.26	0.23	0.0591	6.39E+04	0.39
30	0.074	0.161	0.001880	18.3836	6.38	0.28	0.25	0.0619	6.57E+04	0.39
31	0.080	0.170	0.002032	19.8741	6.63	0.29	0.26	0.0651	6.83E+04	0.38
32	0.086	0.180	0.002184	21.3647	6.88	0.31	0.28	0.0686	7.09E+04	0.37
33	0.092	0.187	0.002337	22.8552	7.11	0.32	0.29	0.0711	7.33E+04	0.36
34	0.099	0.198	0.002515	24.5942	7.38	0.33	0.30	0.0750	7.60E+04	0.36
35	0.102	0.207	0.002591	25.3395	7.49	0.35	0.31	0.0781	7.72E+04	0.35
36	0.109	0.218	0.002769	27.0785	7.74	0.36	0.32	0.0820	7.98E+04	0.35
37	0.114	0.227	0.002896	28.3206	7.92	0.38	0.34	0.0852	8.16E+04	0.35
38	0.122	0.238	0.003099	30.3080	8.19	0.40	0.36	0.0890	8.44E+04	0.34
39	0.129	0.248	0.003277	32.0470	8.42	0.41	0.37	0.0926	8.68E+04	0.34
40	0.137	0.257	0.003480	34.0344	8.68	0.43	0.39	0.0957	8.94E+04	0.33
42	0.151	0.278	0.003835	37.5124	9.11	0.46	0.41	0.1031	9.39E+04	0.32
44	0.165	0.301	0.004191	40.9904	9.52	0.49	0.44	0.1112	9.82E+04	0.31
46	0.179	0.321	0.004547	44.4683	9.92	0.53	0.48	0.1183	1.02E+05	0.31
48	0.199	0.340	0.005055	49.4369	10.46	0.56	0.50	0.1249	1.08E+05	0.29
50	0.217	0.362	0.005512	53.9085	10.92	0.59	0.53	0.1327	1.13E+05	0.28

Drag Quantifcation --- Original Aerobody with Boom and Tape --- Trial 3

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	77.4	kPa
T	298.6	K
ρ air	0.904	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Accounting for Rod[N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.010	0.025	0.000254	2.4843	2.34	0.04	0.02	0.0088	2.42E+04	0.22
11	0.010	0.028	0.000254	2.4843	2.34	0.04	0.02	0.0099	2.42E+04	0.28
12	0.011	0.032	0.000279	2.7327	2.46	0.05	0.03	0.0113	2.53E+04	0.32
13	0.014	0.034	0.000356	3.4780	2.77	0.05	0.03	0.0120	2.86E+04	0.28
14	0.016	0.043	0.000406	3.9748	2.97	0.07	0.05	0.0151	3.06E+04	0.34
15	0.019	0.049	0.000483	4.7201	3.23	0.08	0.06	0.0172	3.33E+04	0.35
16	0.021	0.054	0.000533	5.2170	3.40	0.08	0.06	0.0190	3.50E+04	0.36
17	0.023	0.061	0.000584	5.7138	3.56	0.10	0.08	0.0215	3.66E+04	0.38
18	0.028	0.068	0.000711	6.9559	3.92	0.11	0.09	0.0239	4.04E+04	0.36
19	0.031	0.073	0.000787	7.7012	4.13	0.11	0.09	0.0257	4.25E+04	0.35
20	0.034	0.080	0.000864	8.4465	4.32	0.13	0.11	0.0282	4.46E+04	0.36
21	0.038	0.087	0.000965	9.4402	4.57	0.14	0.12	0.0306	4.71E+04	0.36
22	0.040	0.095	0.001016	9.9371	4.69	0.15	0.13	0.0334	4.83E+04	0.37
23	0.043	0.102	0.001092	10.6823	4.86	0.16	0.13	0.0359	5.01E+04	0.35
24	0.049	0.111	0.001245	12.1729	5.19	0.17	0.15	0.0391	5.35E+04	0.37
25	0.051	0.119	0.001295	12.6698	5.29	0.19	0.16	0.0419	5.46E+04	0.36
26	0.057	0.126	0.001448	14.1603	5.60	0.20	0.17	0.0443	5.77E+04	0.34
27	0.060	0.136	0.001524	14.9056	5.74	0.21	0.18	0.0479	5.92E+04	0.36
28	0.065	0.146	0.001651	16.1477	5.98	0.23	0.20	0.0514	6.16E+04	0.36
29	0.070	0.153	0.001778	17.3899	6.20	0.24	0.21	0.0539	6.39E+04	0.35
30	0.073	0.160	0.001854	18.1351	6.33	0.25	0.22	0.0563	6.53E+04	0.35
31	0.080	0.171	0.002032	19.8741	6.63	0.27	0.24	0.0602	6.83E+04	0.35
32	0.084	0.180	0.002134	20.8678	6.79	0.28	0.25	0.0634	7.00E+04	0.35
33	0.091	0.188	0.002311	22.6068	7.07	0.29	0.26	0.0662	7.29E+04	0.34
34	0.098	0.196	0.002489	24.3458	7.34	0.31	0.28	0.0690	7.56E+04	0.33
35	0.101	0.207	0.002565	25.0911	7.45	0.32	0.28	0.0729	7.68E+04	0.33
36	0.108	0.218	0.002743	26.8301	7.70	0.34	0.30	0.0767	7.94E+04	0.32
37	0.116	0.227	0.002946	28.8175	7.98	0.36	0.32	0.0799	8.23E+04	0.32
38	0.121	0.236	0.003073	30.0596	8.15	0.37	0.33	0.0831	8.41E+04	0.32
39	0.130	0.247	0.003302	32.2954	8.45	0.39	0.35	0.0869	8.71E+04	0.31
40	0.139	0.258	0.003531	34.5313	8.74	0.40	0.36	0.0908	9.01E+04	0.30
42	0.147	0.278	0.003734	36.5187	8.99	0.44	0.39	0.0978	9.26E+04	0.31
44	0.163	0.301	0.004140	40.4935	9.47	0.47	0.42	0.1059	9.76E+04	0.30
46	0.180	0.321	0.004572	44.7168	9.95	0.50	0.45	0.1130	1.03E+05	0.29
48	0.198	0.342	0.005029	49.1884	10.43	0.54	0.48	0.1204	1.08E+05	0.28
50	0.211	0.362	0.005359	52.4180	10.77	0.57	0.51	0.1274	1.11E+05	0.28

Drag Quantifcation --- Original Aerobody with Boom and Tape --- Trial 4

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78	kPa
T	298.6	K
ρ air	0.911	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Accounting for Rod[N]	Calculated Drag [lb$_f$]	Re-Mano	Drag Coefficient
10	0.008	0.020	0.000203	1.9874	2.09	0.03	0.01	0.0070	2.17E+04	0.16
11	0.010	0.025	0.000254	2.4843	2.34	0.04	0.02	0.0088	2.43E+04	0.22
12	0.011	0.029	0.000279	2.7327	2.45	0.05	0.03	0.0102	2.54E+04	0.27
13	0.012	0.034	0.000305	2.9811	2.56	0.05	0.03	0.0120	2.66E+04	0.32
14	0.015	0.040	0.000381	3.7264	2.86	0.06	0.04	0.0141	2.97E+04	0.33
15	0.018	0.046	0.000457	4.4717	3.13	0.07	0.05	0.0162	3.25E+04	0.34
16	0.020	0.051	0.000508	4.9685	3.30	0.08	0.06	0.0180	3.43E+04	0.35
17	0.022	0.058	0.000559	5.4654	3.46	0.09	0.07	0.0204	3.60E+04	0.37
18	0.027	0.064	0.000686	6.7075	3.84	0.10	0.08	0.0225	3.99E+04	0.35
19	0.030	0.068	0.000762	7.4528	4.04	0.11	0.09	0.0239	4.20E+04	0.34
20	0.032	0.077	0.000813	7.9496	4.18	0.12	0.10	0.0271	4.34E+04	0.37
21	0.035	0.085	0.000889	8.6949	4.37	0.13	0.11	0.0299	4.54E+04	0.38
22	0.039	0.093	0.000991	9.6886	4.61	0.15	0.13	0.0327	4.79E+04	0.38
23	0.042	0.099	0.001067	10.4339	4.79	0.16	0.13	0.0348	4.97E+04	0.35
24	0.047	0.108	0.001194	11.6760	5.06	0.17	0.15	0.0380	5.26E+04	0.37
25	0.050	0.115	0.001270	12.4213	5.22	0.18	0.15	0.0405	5.42E+04	0.35
26	0.054	0.126	0.001372	13.4150	5.43	0.20	0.17	0.0443	5.64E+04	0.36
27	0.058	0.134	0.001473	14.4087	5.62	0.21	0.18	0.0472	5.84E+04	0.36
28	0.062	0.142	0.001575	15.4024	5.82	0.22	0.19	0.0500	6.04E+04	0.36
29	0.070	0.151	0.001778	17.3899	6.18	0.24	0.21	0.0531	6.42E+04	0.34
30	0.073	0.159	0.001854	18.1351	6.31	0.25	0.22	0.0560	6.55E+04	0.35
31	0.079	0.169	0.002007	19.6257	6.56	0.26	0.23	0.0595	6.82E+04	0.35
32	0.083	0.180	0.002108	20.6194	6.73	0.28	0.25	0.0634	6.99E+04	0.35
33	0.090	0.186	0.002286	22.3584	7.01	0.29	0.26	0.0655	7.28E+04	0.34
34	0.099	0.196	0.002515	24.5942	7.35	0.31	0.28	0.0690	7.63E+04	0.33
35	0.103	0.207	0.002616	25.5879	7.50	0.32	0.28	0.0729	7.79E+04	0.32
36	0.108	0.218	0.002743	26.8301	7.67	0.34	0.30	0.0767	7.97E+04	0.32
37	0.117	0.226	0.002972	29.0659	7.99	0.35	0.31	0.0795	8.30E+04	0.31
38	0.120	0.236	0.003048	29.8112	8.09	0.37	0.33	0.0831	8.40E+04	0.32
39	0.130	0.244	0.003302	32.2954	8.42	0.38	0.34	0.0859	8.75E+04	0.31
40	0.138	0.257	0.003505	34.2829	8.68	0.40	0.36	0.0905	9.01E+04	0.31
42	0.150	0.276	0.003810	37.2640	9.04	0.43	0.38	0.0971	9.40E+04	0.30
44	0.168	0.298	0.004267	41.7356	9.57	0.47	0.42	0.1049	9.94E+04	0.29
46	0.182	0.321	0.004623	45.2136	9.96	0.50	0.45	0.1130	1.03E+05	0.29
48	0.199	0.343	0.005055	49.4369	10.42	0.54	0.48	0.1207	1.08E+05	0.28
50	0.218	0.368	0.005537	54.1570	10.90	0.58	0.52	0.1295	1.13E+05	0.28

Drag Quantifcation --- Original Aerobody, No Boom, No Tape --- Trial 1

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78.3	kPa
T	298.1	K
ρ air	0.916	kg/m^3
ρ water	997	kg/m^3
μ	1.83E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Monocoque Drag [N]	Rod Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.009	0.017	0.000229	2.2358	2.21	0.03	0.02	0.0060	2.32E+04	0.13
11	0.012	0.020	0.000305	2.9811	2.55	0.03	0.02	0.0070	2.68E+04	0.14
12	0.016	0.023	0.000406	3.9748	2.95	0.04	0.02	0.0081	3.09E+04	0.14
13	0.019	0.025	0.000483	4.7201	3.21	0.04	0.02	0.0088	3.37E+04	0.13
14	0.021	0.028	0.000533	5.2170	3.38	0.04	0.02	0.0099	3.54E+04	0.13
15	0.021	0.032	0.000533	5.2170	3.38	0.05	0.02	0.0113	3.54E+04	0.16
16	0.024	0.037	0.000610	5.9622	3.61	0.06	0.02	0.0130	3.79E+04	0.18
17	0.029	0.041	0.000737	7.2044	3.97	0.06	0.02	0.0144	4.17E+04	0.17
18	0.030	0.048	0.000762	7.4528	4.03	0.08	0.02	0.0169	4.24E+04	0.21
19	0.032	0.052	0.000813	7.9496	4.17	0.08	0.02	0.0183	4.38E+04	0.21
20	0.037	0.058	0.000940	9.1918	4.48	0.09	0.02	0.0204	4.70E+04	0.21
21	0.040	0.067	0.001016	9.9371	4.66	0.10	0.02	0.0236	4.89E+04	0.24
22	0.043	0.071	0.001092	10.6823	4.83	0.11	0.02	0.0250	5.07E+04	0.24
23	0.048	0.078	0.001219	11.9245	5.10	0.12	0.03	0.0275	5.36E+04	0.24
24	0.050	0.086	0.001270	12.4213	5.21	0.13	0.02	0.0303	5.47E+04	0.26
25	0.054	0.099	0.001372	13.4150	5.41	0.16	0.03	0.0348	5.68E+04	0.28
26	0.059	0.102	0.001499	14.6572	5.66	0.16	0.03	0.0359	5.94E+04	0.26
27	0.063	0.113	0.001600	15.6509	5.85	0.18	0.03	0.0398	6.14E+04	0.28
28	0.068	0.128	0.001727	16.8930	6.07	0.20	0.03	0.0451	6.38E+04	0.29
29	0.072	0.136	0.001829	17.8867	6.25	0.21	0.03	0.0479	6.56E+04	0.30
30	0.078	0.145	0.001981	19.3773	6.50	0.23	0.03	0.0510	6.83E+04	0.29
31	0.084	0.153	0.002134	20.8678	6.75	0.24	0.03	0.0539	7.09E+04	0.29
32	0.090	0.162	0.002286	22.3584	6.99	0.25	0.03	0.0570	7.34E+04	0.29
33	0.093	0.166	0.002362	23.1037	7.10	0.26	0.03	0.0584	7.46E+04	0.28
34	0.100	0.176	0.002540	24.8426	7.36	0.28	0.03	0.0619	7.73E+04	0.28
35	0.108	0.184	0.002743	26.8301	7.65	0.29	0.04	0.0648	8.04E+04	0.27
36	0.111	0.193	0.002819	27.5753	7.76	0.30	0.04	0.0679	8.15E+04	0.28
37	0.121	0.202	0.003073	30.0596	8.10	0.32	0.04	0.0711	8.51E+04	0.27
38	0.126	0.213	0.003200	31.3017	8.27	0.33	0.04	0.0750	8.68E+04	0.27
39	0.132	0.223	0.003353	32.7923	8.46	0.35	0.04	0.0785	8.89E+04	0.27
40	0.140	0.235	0.003556	34.7797	8.71	0.37	0.04	0.0827	9.15E+04	0.27
42	0.160	0.252	0.004064	39.7482	9.32	0.39	0.05	0.0887	9.78E+04	0.25
44	0.171	0.276	0.004343	42.4809	9.63	0.43	0.05	0.0971	1.01E+05	0.26
46	0.188	0.296	0.004775	46.7042	10.10	0.46	0.05	0.1042	1.06E+05	0.25
48	0.202	0.319	0.005131	50.1821	10.47	0.50	0.06	0.1123	1.10E+05	0.25
50	0.220	0.338	0.005588	54.6538	10.92	0.53	0.06	0.1190	1.15E+05	0.25

Drag Quantifcation --- Original Aerobody, No Boom, No Tape --- Trial 2

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78.3	kPa
T	298.1	K
ρ air	0.916	kg/m^3
ρ water	997	kg/m^3
μ	1.83E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Monocoque Drag [N]	Rod Drag [N]	Calculated Drag [lb$_f$]	Re-Mano	Drag Coefficient
10	0.010	0.017	0.000254	2.4843	2.33	0.03	0.02	0.0060	2.45E+04	0.12
11	0.011	0.024	0.000279	2.7327	2.44	0.04	0.02	0.0084	2.57E+04	0.22
12	0.013	0.026	0.000330	3.2295	2.66	0.04	0.02	0.0092	2.79E+04	0.21
13	0.016	0.029	0.000406	3.9748	2.95	0.05	0.02	0.0102	3.09E+04	0.20
14	0.018	0.031	0.000457	4.4717	3.12	0.05	0.02	0.0109	3.28E+04	0.19
15	0.020	0.035	0.000508	4.9685	3.29	0.05	0.02	0.0123	3.46E+04	0.20
16	0.022	0.039	0.000559	5.4654	3.45	0.06	0.02	0.0137	3.63E+04	0.21
17	0.024	0.042	0.000610	5.9622	3.61	0.07	0.02	0.0148	3.79E+04	0.22
18	0.029	0.049	0.000737	7.2044	3.97	0.08	0.02	0.0172	4.17E+04	0.22
19	0.031	0.053	0.000787	7.7012	4.10	0.08	0.02	0.0187	4.31E+04	0.23
20	0.034	0.058	0.000864	8.4465	4.29	0.09	0.02	0.0204	4.51E+04	0.23
21	0.038	0.065	0.000965	9.4402	4.54	0.10	0.02	0.0229	4.77E+04	0.24
22	0.040	0.069	0.001016	9.9371	4.66	0.11	0.02	0.0243	4.89E+04	0.24
23	0.047	0.075	0.001194	11.6760	5.05	0.12	0.03	0.0264	5.30E+04	0.23
24	0.050	0.083	0.001270	12.4213	5.21	0.13	0.02	0.0292	5.47E+04	0.25
25	0.053	0.094	0.001346	13.1666	5.36	0.15	0.03	0.0331	5.63E+04	0.27
26	0.058	0.098	0.001473	14.4087	5.61	0.15	0.03	0.0345	5.89E+04	0.25
27	0.061	0.115	0.001549	15.1540	5.75	0.18	0.03	0.0405	6.04E+04	0.29
28	0.067	0.124	0.001702	16.6446	6.03	0.19	0.03	0.0436	6.33E+04	0.29
29	0.071	0.133	0.001803	17.6383	6.21	0.21	0.03	0.0468	6.52E+04	0.29
30	0.080	0.142	0.002032	19.8741	6.59	0.22	0.03	0.0500	6.92E+04	0.28
31	0.082	0.152	0.002083	20.3710	6.67	0.24	0.03	0.0535	7.00E+04	0.29
32	0.091	0.159	0.002311	22.6068	7.03	0.25	0.03	0.0560	7.38E+04	0.28
33	0.096	0.167	0.002438	23.8489	7.22	0.26	0.03	0.0588	7.58E+04	0.28
34	0.100	0.176	0.002540	24.8426	7.36	0.28	0.03	0.0619	7.73E+04	0.28
35	0.109	0.182	0.002769	27.0785	7.69	0.28	0.04	0.0641	8.07E+04	0.27
36	0.113	0.190	0.002870	28.0722	7.83	0.30	0.04	0.0669	8.22E+04	0.27
37	0.121	0.200	0.003073	30.0596	8.10	0.31	0.04	0.0704	8.51E+04	0.26
38	0.130	0.210	0.003302	32.2954	8.40	0.33	0.04	0.0739	8.82E+04	0.26
39	0.137	0.221	0.003480	34.0344	8.62	0.35	0.04	0.0778	9.05E+04	0.26
40	0.143	0.223	0.003632	35.5250	8.81	0.35	0.04	0.0785	9.25E+04	0.25
42	0.155	0.249	0.003937	38.5061	9.17	0.39	0.05	0.0876	9.63E+04	0.26
44	0.161	0.275	0.004089	39.9967	9.34	0.43	0.05	0.0968	9.81E+04	0.27
46	0.187	0.294	0.004750	46.4558	10.07	0.46	0.05	0.1035	1.06E+05	0.25
48	0.202	0.314	0.005131	50.1821	10.47	0.49	0.06	0.1105	1.10E+05	0.25
50	0.223	0.334	0.005664	55.3991	11.00	0.52	0.06	0.1176	1.15E+05	0.24

Drag Quantifcation --- Original Aerobody, No Boom, No Tape --- Trial 3

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	77.7	kPa
T	297.2	K
ρ air	0.912	kg/m^3
ρ water	997	kg/m^3
μ	1.83E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Monocoque Drag [N]	Rod Drag [N]	Calculated Drag [lb$_f$]	Re-Mano	Drag Coefficient
10	0.011	0.006	0.000279	2.7327	2.45	0.03	0.02	0.0056	2.56E+04	0.09
11	0.016	0.009	0.000406	3.9748	2.95	0.03	0.02	0.0067	3.09E+04	0.10
12	0.020	0.013	0.000508	4.9685	3.30	0.04	0.02	0.0081	3.45E+04	0.11
13	0.020	0.016	0.000508	4.9685	3.30	0.04	0.02	0.0092	3.45E+04	0.13
14	0.021	0.019	0.000533	5.2170	3.38	0.05	0.02	0.0102	3.54E+04	0.14
15	0.024	0.024	0.000610	5.9622	3.62	0.05	0.02	0.0120	3.78E+04	0.16
16	0.030	0.029	0.000762	7.4528	4.04	0.06	0.02	0.0137	4.23E+04	0.15
17	0.032	0.035	0.000813	7.9496	4.18	0.07	0.02	0.0158	4.37E+04	0.18
18	0.033	0.041	0.000838	8.1981	4.24	0.08	0.02	0.0180	4.43E+04	0.20
19	0.035	0.047	0.000889	8.6949	4.37	0.09	0.02	0.0201	4.57E+04	0.22
20	0.038	0.054	0.000965	9.4402	4.55	0.10	0.02	0.0225	4.76E+04	0.24
21	0.040	0.059	0.001016	9.9371	4.67	0.11	0.02	0.0243	4.88E+04	0.25
22	0.045	0.065	0.001143	11.1792	4.95	0.12	0.02	0.0264	5.18E+04	0.24
23	0.050	0.072	0.001270	12.4213	5.22	0.13	0.03	0.0289	5.46E+04	0.24
24	0.052	0.080	0.001321	12.9182	5.32	0.14	0.02	0.0317	5.57E+04	0.26
25	0.059	0.087	0.001499	14.6572	5.67	0.15	0.03	0.0341	5.93E+04	0.25
26	0.061	0.095	0.001549	15.1540	5.76	0.16	0.03	0.0370	6.03E+04	0.26
27	0.067	0.102	0.001702	16.6446	6.04	0.18	0.03	0.0394	6.32E+04	0.26
28	0.070	0.112	0.001778	17.3899	6.18	0.19	0.03	0.0429	6.46E+04	0.27
29	0.073	0.119	0.001854	18.1351	6.31	0.20	0.03	0.0454	6.59E+04	0.27
30	0.080	0.125	0.002032	19.8741	6.60	0.21	0.03	0.0475	6.90E+04	0.26
31	0.085	0.134	0.002159	21.1163	6.80	0.23	0.03	0.0507	7.12E+04	0.27
32	0.091	0.141	0.002311	22.6068	7.04	0.24	0.03	0.0531	7.36E+04	0.26
33	0.098	0.149	0.002489	24.3458	7.31	0.25	0.03	0.0560	7.64E+04	0.26
34	0.101	0.156	0.002565	25.0911	7.42	0.26	0.03	0.0584	7.76E+04	0.26
35	0.106	0.167	0.002692	26.3332	7.60	0.28	0.04	0.0623	7.95E+04	0.26
36	0.114	0.176	0.002896	28.3206	7.88	0.29	0.04	0.0655	8.24E+04	0.26
37	0.120	0.184	0.003048	29.8112	8.09	0.30	0.04	0.0683	8.45E+04	0.26
38	0.127	0.193	0.003226	31.5502	8.32	0.32	0.04	0.0714	8.70E+04	0.25
39	0.132	0.202	0.003353	32.7923	8.48	0.33	0.04	0.0746	8.87E+04	0.26
40	0.140	0.211	0.003556	34.7797	8.73	0.35	0.04	0.0778	9.13E+04	0.25
42	0.158	0.231	0.004013	39.2514	9.28	0.38	0.05	0.0848	9.70E+04	0.24
44	0.171	0.254	0.004343	42.4809	9.65	0.41	0.05	0.0929	1.01E+05	0.25
46	0.185	0.275	0.004699	45.9589	10.04	0.45	0.05	0.1003	1.05E+05	0.25
48	0.203	0.298	0.005156	50.4306	10.52	0.48	0.06	0.1084	1.10E+05	0.24
50	0.219	0.323	0.005563	54.4054	10.92	0.52	0.06	0.1172	1.14E+05	0.24

Drag Quantifcation --- Original Aerobody, No Boom, No Tape --- Trial 4

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	77.7	kPa
T	297.2	K
ρ air	0.912	kg/m^3
ρ water	997	kg/m^3
μ	1.83E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Monocoque Drag [N]	Rod Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.009	0.004	0.000229	2.2358	2.21	0.02	0.02	0.0049	2.32E+04	0.07
11	0.011	0.008	0.000279	2.7327	2.45	0.03	0.02	0.0063	2.56E+04	0.12
12	0.015	0.012	0.000381	3.7264	2.86	0.03	0.02	0.0077	2.99E+04	0.13
13	0.018	0.015	0.000457	4.4717	3.13	0.04	0.02	0.0088	3.27E+04	0.14
14	0.021	0.018	0.000533	5.2170	3.38	0.04	0.02	0.0099	3.54E+04	0.13
15	0.021	0.023	0.000533	5.2170	3.38	0.05	0.02	0.0116	3.54E+04	0.17
16	0.024	0.027	0.000610	5.9622	3.62	0.06	0.02	0.0130	3.78E+04	0.18
17	0.028	0.031	0.000711	6.9559	3.91	0.06	0.02	0.0144	4.08E+04	0.18
18	0.030	0.037	0.000762	7.4528	4.04	0.07	0.02	0.0165	4.23E+04	0.20
19	0.033	0.042	0.000838	8.1981	4.24	0.08	0.02	0.0183	4.43E+04	0.21
20	0.036	0.048	0.000914	8.9434	4.43	0.09	0.02	0.0204	4.63E+04	0.22
21	0.039	0.054	0.000991	9.6886	4.61	0.10	0.02	0.0225	4.82E+04	0.23
22	0.041	0.061	0.001041	10.1855	4.73	0.11	0.02	0.0250	4.94E+04	0.25
23	0.046	0.068	0.001168	11.4276	5.01	0.12	0.03	0.0275	5.23E+04	0.25
24	0.051	0.075	0.001295	12.6698	5.27	0.13	0.02	0.0299	5.51E+04	0.25
25	0.054	0.082	0.001372	13.4150	5.42	0.14	0.03	0.0324	5.67E+04	0.26
26	0.059	0.090	0.001499	14.6572	5.67	0.16	0.03	0.0352	5.93E+04	0.26
27	0.061	0.097	0.001549	15.1540	5.76	0.17	0.03	0.0377	6.03E+04	0.27
28	0.068	0.106	0.001727	16.8930	6.09	0.18	0.03	0.0408	6.36E+04	0.26
29	0.071	0.113	0.001803	17.6383	6.22	0.19	0.03	0.0433	6.50E+04	0.27
30	0.077	0.122	0.001956	19.1288	6.48	0.21	0.03	0.0465	6.77E+04	0.27
31	0.081	0.129	0.002057	20.1225	6.64	0.22	0.03	0.0489	6.95E+04	0.27
32	0.090	0.136	0.002286	22.3584	7.00	0.23	0.03	0.0514	7.32E+04	0.25
33	0.098	0.145	0.002489	24.3458	7.31	0.24	0.03	0.0546	7.64E+04	0.25
34	0.100	0.153	0.002540	24.8426	7.38	0.26	0.03	0.0574	7.72E+04	0.26
35	0.107	0.162	0.002718	26.5816	7.63	0.27	0.04	0.0605	7.98E+04	0.25
36	0.110	0.172	0.002794	27.3269	7.74	0.28	0.04	0.0641	8.09E+04	0.26
37	0.118	0.180	0.002997	29.3143	8.02	0.30	0.04	0.0669	8.38E+04	0.26
38	0.124	0.188	0.003150	30.8049	8.22	0.31	0.04	0.0697	8.59E+04	0.25
39	0.129	0.197	0.003277	32.0470	8.38	0.32	0.04	0.0729	8.77E+04	0.26
40	0.140	0.207	0.003556	34.7797	8.73	0.34	0.04	0.0764	9.13E+04	0.25
42	0.152	0.227	0.003861	37.7608	9.10	0.37	0.05	0.0834	9.51E+04	0.25
44	0.169	0.250	0.004293	41.9841	9.60	0.41	0.05	0.0915	1.00E+05	0.25
46	0.182	0.271	0.004623	45.2136	9.96	0.44	0.05	0.0989	1.04E+05	0.25
48	0.199	0.292	0.005055	49.4369	10.41	0.47	0.06	0.1063	1.09E+05	0.24
50	0.216	0.315	0.005486	53.6601	10.85	0.51	0.06	0.1144	1.13E+05	0.24

Drag Quantifcation --- Original Aerobody, No Boom, With Tape --- Trial 1

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78	kPa
T	298.6	K
ρ air	0.911	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.007	0.002	0.000178	1.7390	1.95	0.03	0.01	0.0060	2.03E+04	0.11
11	0.009	0.005	0.000229	2.2358	2.22	0.03	0.01	0.0070	2.30E+04	0.15
12	0.010	0.008	0.000254	2.4843	2.34	0.04	0.02	0.0081	2.43E+04	0.19
13	0.011	0.009	0.000279	2.7327	2.45	0.04	0.02	0.0084	2.54E+04	0.19
14	0.014	0.011	0.000356	3.4780	2.76	0.04	0.02	0.0092	2.87E+04	0.17
15	0.016	0.017	0.000406	3.9748	2.95	0.05	0.03	0.0113	3.07E+04	0.22
16	0.018	0.022	0.000457	4.4717	3.13	0.06	0.04	0.0130	3.25E+04	0.25
17	0.021	0.026	0.000533	5.2170	3.38	0.06	0.04	0.0144	3.52E+04	0.25
18	0.023	0.033	0.000584	5.7138	3.54	0.08	0.06	0.0169	3.68E+04	0.28
19	0.026	0.039	0.000660	6.4591	3.77	0.08	0.06	0.0190	3.91E+04	0.29
20	0.031	0.045	0.000787	7.7012	4.11	0.09	0.07	0.0211	4.27E+04	0.28
21	0.034	0.051	0.000864	8.4465	4.31	0.10	0.08	0.0232	4.47E+04	0.29
22	0.038	0.058	0.000965	9.4402	4.55	0.11	0.09	0.0257	4.73E+04	0.29
23	0.042	0.067	0.001067	10.4339	4.79	0.13	0.10	0.0289	4.97E+04	0.27
24	0.046	0.072	0.001168	11.4276	5.01	0.14	0.12	0.0306	5.20E+04	0.29
25	0.049	0.082	0.001245	12.1729	5.17	0.15	0.12	0.0341	5.37E+04	0.29
26	0.052	0.087	0.001321	12.9182	5.33	0.16	0.13	0.0359	5.53E+04	0.29
27	0.059	0.095	0.001499	14.6572	5.67	0.17	0.14	0.0387	5.89E+04	0.28
28	0.063	0.102	0.001600	15.6509	5.86	0.18	0.15	0.0412	6.09E+04	0.28
29	0.070	0.110	0.001778	17.3899	6.18	0.20	0.17	0.0440	6.42E+04	0.28
30	0.075	0.118	0.001905	18.6320	6.40	0.21	0.18	0.0468	6.64E+04	0.28
31	0.079	0.124	0.002007	19.6257	6.56	0.22	0.19	0.0489	6.82E+04	0.28
32	0.086	0.131	0.002184	21.3647	6.85	0.23	0.20	0.0514	7.11E+04	0.27
33	0.089	0.139	0.002261	22.1100	6.97	0.24	0.21	0.0542	7.24E+04	0.28
34	0.098	0.148	0.002489	24.3458	7.31	0.26	0.23	0.0574	7.59E+04	0.27
35	0.101	0.160	0.002565	25.0911	7.42	0.27	0.23	0.0616	7.71E+04	0.27
36	0.111	0.165	0.002819	27.5753	7.78	0.28	0.24	0.0634	8.08E+04	0.25
37	0.116	0.172	0.002946	28.8175	7.95	0.29	0.25	0.0658	8.26E+04	0.25
38	0.120	0.180	0.003048	29.8112	8.09	0.31	0.27	0.0686	8.40E+04	0.26
39	0.131	0.190	0.003327	32.5439	8.45	0.32	0.28	0.0722	8.78E+04	0.25
40	0.138	0.200	0.003505	34.2829	8.68	0.34	0.30	0.0757	9.01E+04	0.25
42	0.152	0.217	0.003861	37.7608	9.10	0.36	0.31	0.0817	9.46E+04	0.24
44	0.166	0.237	0.004216	41.2388	9.52	0.39	0.34	0.0887	9.88E+04	0.24
46	0.180	0.257	0.004572	44.7168	9.91	0.43	0.38	0.0957	1.03E+05	0.24
48	0.199	0.272	0.005055	49.4369	10.42	0.45	0.39	0.1010	1.08E+05	0.23
50	0.218	0.288	0.005537	54.1570	10.90	0.47	0.41	0.1066	1.13E+05	0.22

Drag Quantifcation --- Original Aerobody, No Boom, With Tape --- Trial 2

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78	kPa
T	298.6	K
ρ air	0.911	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re \quad \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.008	0.003	0.000203	1.9874	2.09	0.03	0.01	0.0063	2.17E+04	0.12
11	0.009	0.004	0.000229	2.2358	2.22	0.03	0.01	0.0067	2.30E+04	0.13
12	0.011	0.006	0.000279	2.7327	2.45	0.03	0.01	0.0074	2.54E+04	0.14
13	0.012	0.011	0.000305	2.9811	2.56	0.04	0.02	0.0092	2.66E+04	0.20
14	0.013	0.014	0.000330	3.2295	2.66	0.05	0.03	0.0102	2.77E+04	0.23
15	0.018	0.020	0.000457	4.4717	3.13	0.05	0.03	0.0123	3.25E+04	0.23
16	0.019	0.024	0.000483	4.7201	3.22	0.06	0.04	0.0137	3.34E+04	0.25
17	0.020	0.028	0.000508	4.9685	3.30	0.07	0.05	0.0151	3.43E+04	0.28
18	0.022	0.034	0.000559	5.4654	3.46	0.08	0.06	0.0172	3.60E+04	0.30
19	0.025	0.039	0.000635	6.2107	3.69	0.08	0.06	0.0190	3.84E+04	0.30
20	0.030	0.045	0.000762	7.4528	4.04	0.09	0.07	0.0211	4.20E+04	0.29
21	0.033	0.051	0.000838	8.1981	4.24	0.10	0.08	0.0232	4.41E+04	0.29
22	0.039	0.061	0.000991	9.6886	4.61	0.12	0.10	0.0267	4.79E+04	0.30
23	0.041	0.068	0.001041	10.1855	4.73	0.13	0.10	0.0292	4.91E+04	0.28
24	0.046	0.073	0.001168	11.4276	5.01	0.14	0.12	0.0310	5.20E+04	0.30
25	0.051	0.080	0.001295	12.6698	5.27	0.15	0.12	0.0334	5.48E+04	0.27
26	0.053	0.088	0.001346	13.1666	5.38	0.16	0.13	0.0363	5.58E+04	0.29
27	0.059	0.095	0.001499	14.6572	5.67	0.17	0.14	0.0387	5.89E+04	0.28
28	0.062	0.105	0.001575	15.4024	5.82	0.19	0.16	0.0422	6.04E+04	0.30
29	0.069	0.112	0.001753	17.1414	6.13	0.20	0.17	0.0447	6.37E+04	0.28
30	0.071	0.119	0.001803	17.6383	6.22	0.21	0.18	0.0472	6.46E+04	0.29
31	0.078	0.126	0.001981	19.3773	6.52	0.22	0.19	0.0496	6.77E+04	0.28
32	0.082	0.132	0.002083	20.3710	6.69	0.23	0.20	0.0517	6.95E+04	0.28
33	0.090	0.140	0.002286	22.3584	7.01	0.24	0.21	0.0546	7.28E+04	0.28
34	0.096	0.149	0.002438	23.8489	7.24	0.26	0.23	0.0577	7.52E+04	0.28
35	0.101	0.161	0.002565	25.0911	7.42	0.28	0.24	0.0619	7.71E+04	0.27
36	0.111	0.166	0.002819	27.5753	7.78	0.28	0.24	0.0637	8.08E+04	0.26
37	0.114	0.173	0.002896	28.3206	7.89	0.29	0.25	0.0662	8.19E+04	0.26
38	0.121	0.182	0.003073	30.0596	8.12	0.31	0.27	0.0693	8.44E+04	0.26
39	0.130	0.193	0.003302	32.2954	8.42	0.33	0.29	0.0732	8.75E+04	0.26
40	0.138	0.200	0.003505	34.2829	8.68	0.34	0.30	0.0757	9.01E+04	0.25
42	0.149	0.219	0.003785	37.0155	9.01	0.37	0.32	0.0824	9.36E+04	0.25
44	0.163	0.237	0.004140	40.4935	9.43	0.39	0.34	0.0887	9.79E+04	0.25
46	0.178	0.258	0.004521	44.2199	9.85	0.43	0.38	0.0961	1.02E+05	0.25
48	0.198	0.274	0.005029	49.1884	10.39	0.45	0.39	0.1017	1.08E+05	0.23
50	0.213	0.290	0.005410	52.9148	10.78	0.48	0.42	0.1073	1.12E+05	0.23

Drag Quantifcation --- Original Aerobody, No Boom, With Tape --- Trial 3

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78	kPa
T	298.6	K
ρ air	0.911	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.006	0.017	0.000152	1.4906	1.81	0.03	0.01	0.0060	1.88E+04	0.13
11	0.008	0.021	0.000203	1.9874	2.09	0.03	0.01	0.0074	2.17E+04	0.19
12	0.009	0.024	0.000229	2.2358	2.22	0.04	0.02	0.0084	2.30E+04	0.23
13	0.011	0.028	0.000279	2.7327	2.45	0.04	0.02	0.0099	2.54E+04	0.25
14	0.013	0.031	0.000330	3.2295	2.66	0.05	0.03	0.0109	2.77E+04	0.26
15	0.018	0.037	0.000457	4.4717	3.13	0.06	0.04	0.0130	3.25E+04	0.25
16	0.019	0.042	0.000483	4.7201	3.22	0.07	0.05	0.0148	3.34E+04	0.28
17	0.020	0.048	0.000508	4.9685	3.30	0.08	0.06	0.0169	3.43E+04	0.32
18	0.022	0.057	0.000559	5.4654	3.46	0.09	0.07	0.0201	3.60E+04	0.37
19	0.029	0.062	0.000737	7.2044	3.98	0.10	0.08	0.0218	4.13E+04	0.31
20	0.030	0.068	0.000762	7.4528	4.04	0.11	0.09	0.0239	4.20E+04	0.34
21	0.033	0.075	0.000838	8.1981	4.24	0.12	0.10	0.0264	4.41E+04	0.34
22	0.039	0.083	0.000991	9.6886	4.61	0.13	0.11	0.0292	4.79E+04	0.33
23	0.041	0.089	0.001041	10.1855	4.73	0.14	0.11	0.0313	4.91E+04	0.31
24	0.045	0.094	0.001143	11.1792	4.95	0.15	0.13	0.0331	5.15E+04	0.33
25	0.050	0.102	0.001270	12.4213	5.22	0.16	0.13	0.0359	5.42E+04	0.30
26	0.053	0.110	0.001346	13.1666	5.38	0.17	0.14	0.0387	5.58E+04	0.31
27	0.059	0.118	0.001499	14.6572	5.67	0.18	0.15	0.0415	5.89E+04	0.31
28	0.061	0.126	0.001549	15.1540	5.77	0.20	0.17	0.0443	5.99E+04	0.32
29	0.068	0.132	0.001727	16.8930	6.09	0.21	0.18	0.0465	6.33E+04	0.30
30	0.072	0.139	0.001829	17.8867	6.27	0.22	0.19	0.0489	6.51E+04	0.30
31	0.079	0.148	0.002007	19.6257	6.56	0.23	0.20	0.0521	6.82E+04	0.30
32	0.082	0.153	0.002083	20.3710	6.69	0.24	0.21	0.0539	6.95E+04	0.30
33	0.090	0.161	0.002286	22.3584	7.01	0.25	0.22	0.0567	7.28E+04	0.29
34	0.098	0.173	0.002489	24.3458	7.31	0.27	0.24	0.0609	7.59E+04	0.29
35	0.100	0.182	0.002540	24.8426	7.39	0.28	0.24	0.0641	7.67E+04	0.29
36	0.109	0.187	0.002769	27.0785	7.71	0.29	0.25	0.0658	8.01E+04	0.27
37	0.113	0.195	0.002870	28.0722	7.85	0.31	0.27	0.0686	8.15E+04	0.27
38	0.119	0.204	0.003023	29.5628	8.06	0.32	0.28	0.0718	8.37E+04	0.27
39	0.129	0.214	0.003277	32.0470	8.39	0.34	0.30	0.0753	8.71E+04	0.27
40	0.138	0.224	0.003505	34.2829	8.68	0.35	0.31	0.0788	9.01E+04	0.26
42	0.149	0.240	0.003785	37.0155	9.01	0.38	0.33	0.0845	9.36E+04	0.25
44	0.161	0.259	0.004089	39.9967	9.37	0.41	0.36	0.0912	9.73E+04	0.26
46	0.181	0.278	0.004597	44.9652	9.94	0.44	0.39	0.0978	1.03E+05	0.25
48	0.197	0.295	0.005004	48.9400	10.37	0.46	0.40	0.1038	1.08E+05	0.24
50	0.218	0.311	0.005537	54.1570	10.90	0.49	0.43	0.1095	1.13E+05	0.23

Drag Quantifcation --- Original Aerobody, No Boom, With Tape --- Trial 4

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78	kPa
T	298.6	K
ρ air	0.911	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.006	0.020	0.000152	1.4906	1.81	0.03	0.01	0.0070	1.88E+04	0.22
11	0.009	0.025	0.000229	2.2358	2.22	0.04	0.02	0.0088	2.30E+04	0.25
12	0.010	0.029	0.000254	2.4843	2.34	0.05	0.03	0.0102	2.43E+04	0.30
13	0.011	0.035	0.000279	2.7327	2.45	0.05	0.03	0.0123	2.54E+04	0.37
14	0.013	0.039	0.000330	3.2295	2.66	0.06	0.04	0.0137	2.77E+04	0.37
15	0.018	0.046	0.000457	4.4717	3.13	0.07	0.05	0.0162	3.25E+04	0.34
16	0.019	0.053	0.000483	4.7201	3.22	0.08	0.06	0.0187	3.34E+04	0.39
17	0.020	0.055	0.000508	4.9685	3.30	0.09	0.07	0.0194	3.43E+04	0.38
18	0.022	0.067	0.000559	5.4654	3.46	0.10	0.08	0.0236	3.60E+04	0.45
19	0.027	0.069	0.000686	6.7075	3.84	0.11	0.09	0.0243	3.99E+04	0.38
20	0.031	0.074	0.000787	7.7012	4.11	0.12	0.10	0.0260	4.27E+04	0.36
21	0.038	0.081	0.000965	9.4402	4.55	0.13	0.11	0.0285	4.73E+04	0.33
22	0.039	0.088	0.000991	9.6886	4.61	0.14	0.12	0.0310	4.79E+04	0.35
23	0.041	0.092	0.001041	10.1855	4.73	0.14	0.11	0.0324	4.91E+04	0.32
24	0.048	0.099	0.001219	11.9245	5.12	0.16	0.14	0.0348	5.31E+04	0.33
25	0.051	0.108	0.001295	12.6698	5.27	0.17	0.14	0.0380	5.48E+04	0.32
26	0.054	0.115	0.001372	13.4150	5.43	0.18	0.15	0.0405	5.64E+04	0.32
27	0.060	0.124	0.001524	14.9056	5.72	0.19	0.16	0.0436	5.94E+04	0.32
28	0.062	0.131	0.001575	15.4024	5.82	0.21	0.18	0.0461	6.04E+04	0.33
29	0.068	0.140	0.001727	16.8930	6.09	0.22	0.19	0.0493	6.33E+04	0.32
30	0.071	0.148	0.001803	17.6383	6.22	0.23	0.20	0.0521	6.46E+04	0.33
31	0.078	0.151	0.001981	19.3773	6.52	0.24	0.21	0.0531	6.77E+04	0.31
32	0.083	0.156	0.002108	20.6194	6.73	0.24	0.21	0.0549	6.99E+04	0.30
33	0.090	0.165	0.002286	22.3584	7.01	0.26	0.23	0.0581	7.28E+04	0.30
34	0.095	0.174	0.002413	23.6005	7.20	0.27	0.24	0.0612	7.48E+04	0.30
35	0.100	0.186	0.002540	24.8426	7.39	0.29	0.25	0.0655	7.67E+04	0.29
36	0.109	0.191	0.002769	27.0785	7.71	0.30	0.26	0.0672	8.01E+04	0.28
37	0.112	0.197	0.002845	27.8238	7.82	0.31	0.27	0.0693	8.12E+04	0.28
38	0.120	0.203	0.003048	29.8112	8.09	0.32	0.28	0.0714	8.40E+04	0.27
39	0.128	0.213	0.003251	31.7986	8.36	0.33	0.29	0.0750	8.68E+04	0.27
40	0.136	0.224	0.003454	33.7860	8.61	0.35	0.31	0.0788	8.95E+04	0.27
42	0.149	0.241	0.003785	37.0155	9.01	0.38	0.33	0.0848	9.36E+04	0.26
44	0.162	0.261	0.004115	40.2451	9.40	0.41	0.36	0.0919	9.76E+04	0.26
46	0.181	0.277	0.004597	44.9652	9.94	0.43	0.38	0.0975	1.03E+05	0.25
48	0.198	0.296	0.005029	49.1884	10.39	0.46	0.40	0.1042	1.08E+05	0.24
50	0.218	0.312	0.005537	54.1570	10.90	0.49	0.43	0.1098	1.13E+05	0.23

Drag Quantifcation --- Attached Cusp, With Boom, No Tape --- Trial 1

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78.1	kPa
T	298.6	K
ρ air	0.913	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.009	0.020	0.000229	2.2358	2.21	0.05	0.03	0.0123	2.30E+04	0.45
11	0.010	0.025	0.000254	2.4843	2.33	0.06	0.04	0.0141	2.43E+04	0.50
12	0.013	0.028	0.000330	3.2295	2.66	0.07	0.05	0.0151	2.77E+04	0.42
13	0.015	0.032	0.000381	3.7264	2.86	0.07	0.05	0.0165	2.97E+04	0.42
14	0.019	0.037	0.000483	4.7201	3.22	0.08	0.06	0.0183	3.35E+04	0.38
15	0.021	0.041	0.000533	5.2170	3.38	0.09	0.07	0.0197	3.52E+04	0.38
16	0.024	0.045	0.000610	5.9622	3.61	0.09	0.07	0.0211	3.76E+04	0.36
17	0.027	0.050	0.000686	6.7075	3.83	0.10	0.08	0.0229	3.99E+04	0.35
18	0.030	0.055	0.000762	7.4528	4.04	0.11	0.09	0.0246	4.21E+04	0.35
19	0.032	0.059	0.000813	7.9496	4.17	0.12	0.10	0.0260	4.34E+04	0.35
20	0.035	0.063	0.000889	8.6949	4.36	0.12	0.10	0.0275	4.54E+04	0.34
21	0.039	0.068	0.000991	9.6886	4.61	0.13	0.11	0.0292	4.80E+04	0.33
22	0.044	0.075	0.001125	11.0053	4.91	0.14	0.12	0.0317	5.11E+04	0.32
23	0.046	0.080	0.001168	11.4276	5.00	0.15	0.12	0.0334	5.21E+04	0.30
24	0.050	0.085	0.001270	12.4213	5.22	0.16	0.14	0.0352	5.43E+04	0.32
25	0.052	0.092	0.001321	12.9182	5.32	0.17	0.14	0.0377	5.54E+04	0.31
26	0.058	0.098	0.001473	14.4087	5.62	0.18	0.15	0.0398	5.85E+04	0.29
27	0.062	0.105	0.001575	15.4024	5.81	0.19	0.16	0.0422	6.05E+04	0.30
28	0.067	0.113	0.001692	16.5452	6.02	0.20	0.17	0.0451	6.27E+04	0.30
29	0.070	0.117	0.001778	17.3899	6.17	0.21	0.18	0.0465	6.43E+04	0.29
30	0.074	0.124	0.001880	18.3836	6.35	0.22	0.19	0.0489	6.61E+04	0.30
31	0.082	0.131	0.002083	20.3710	6.68	0.23	0.20	0.0514	6.95E+04	0.28
32	0.090	0.138	0.002286	22.3584	7.00	0.24	0.21	0.0539	7.29E+04	0.27
33	0.098	0.145	0.002489	24.3458	7.30	0.25	0.22	0.0563	7.60E+04	0.26
34	0.103	0.153	0.002616	25.5879	7.49	0.26	0.23	0.0591	7.79E+04	0.26
35	0.111	0.163	0.002819	27.5753	7.77	0.28	0.24	0.0626	8.09E+04	0.25
36	0.117	0.171	0.002972	29.0659	7.98	0.29	0.25	0.0655	8.31E+04	0.25
37	0.121	0.180	0.003073	30.0596	8.11	0.31	0.27	0.0686	8.45E+04	0.26
38	0.128	0.185	0.003251	31.7986	8.35	0.31	0.27	0.0704	8.69E+04	0.25
39	0.135	0.195	0.003429	33.5376	8.57	0.33	0.29	0.0739	8.92E+04	0.25
40	0.147	0.203	0.003734	36.5187	8.94	0.34	0.30	0.0767	9.31E+04	0.24
42	0.154	0.223	0.003912	38.2577	9.15	0.37	0.32	0.0838	9.53E+04	0.24
44	0.174	0.245	0.004420	43.2262	9.73	0.41	0.36	0.0915	1.01E+05	0.24
46	0.190	0.268	0.004826	47.2010	10.17	0.44	0.39	0.0996	1.06E+05	0.24
48	0.203	0.290	0.005156	50.4306	10.51	0.48	0.42	0.1073	1.09E+05	0.24
50	0.221	0.313	0.005613	54.9023	10.97	0.51	0.45	0.1154	1.14E+05	0.24

Drag Quantifcation --- Attached Cusp, With Boom, No Tape --- Trial 2

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78.1	kPa
T	298.6	K
ρ air	0.913	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.010	0.024	0.000254	2.4843	2.33	0.06	0.04	0.0137	2.43E+04	0.71
11	0.012	0.027	0.000305	2.9811	2.56	0.07	0.05	0.0148	2.66E+04	0.64
12	0.014	0.031	0.000356	3.4780	2.76	0.07	0.05	0.0162	2.87E+04	0.60
13	0.014	0.034	0.000356	3.4780	2.76	0.08	0.06	0.0172	2.87E+04	0.64
14	0.019	0.039	0.000483	4.7201	3.22	0.08	0.06	0.0190	3.35E+04	0.52
15	0.021	0.043	0.000533	5.2170	3.38	0.09	0.07	0.0204	3.52E+04	0.50
16	0.024	0.048	0.000610	5.9622	3.61	0.10	0.08	0.0222	3.76E+04	0.48
17	0.027	0.051	0.000686	6.7075	3.83	0.10	0.08	0.0232	3.99E+04	0.45
18	0.030	0.058	0.000762	7.4528	4.04	0.11	0.09	0.0257	4.21E+04	0.44
19	0.031	0.061	0.000787	7.7012	4.11	0.12	0.10	0.0267	4.28E+04	0.45
20	0.035	0.067	0.000889	8.6949	4.36	0.13	0.11	0.0289	4.54E+04	0.43
21	0.039	0.071	0.000991	9.6886	4.61	0.13	0.11	0.0303	4.80E+04	0.40
22	0.043	0.078	0.001092	10.6823	4.84	0.15	0.13	0.0327	5.04E+04	0.39
23	0.046	0.084	0.001168	11.4276	5.00	0.16	0.13	0.0348	5.21E+04	0.39
24	0.050	0.090	0.001270	12.4213	5.22	0.16	0.14	0.0370	5.43E+04	0.38
25	0.055	0.095	0.001397	13.6635	5.47	0.17	0.14	0.0387	5.70E+04	0.36
26	0.060	0.101	0.001524	14.9056	5.71	0.18	0.15	0.0408	5.95E+04	0.35
27	0.065	0.108	0.001651	16.1477	5.95	0.19	0.16	0.0433	6.19E+04	0.34
28	0.069	0.115	0.001753	17.1414	6.13	0.20	0.17	0.0458	6.38E+04	0.34
29	0.072	0.120	0.001829	17.8867	6.26	0.21	0.18	0.0475	6.52E+04	0.34
30	0.078	0.126	0.001981	19.3773	6.52	0.22	0.19	0.0496	6.78E+04	0.33
31	0.083	0.134	0.002108	20.6194	6.72	0.23	0.20	0.0524	7.00E+04	0.33
32	0.090	0.141	0.002286	22.3584	7.00	0.24	0.21	0.0549	7.29E+04	0.32
33	0.097	0.148	0.002464	24.0974	7.27	0.26	0.23	0.0574	7.56E+04	0.31
34	0.101	0.156	0.002565	25.0911	7.41	0.27	0.24	0.0602	7.72E+04	0.31
35	0.111	0.164	0.002819	27.5753	7.77	0.28	0.24	0.0630	8.09E+04	0.29
36	0.119	0.173	0.003023	29.5628	8.05	0.29	0.25	0.0662	8.38E+04	0.29
37	0.126	0.180	0.003200	31.3017	8.28	0.31	0.27	0.0686	8.62E+04	0.28
38	0.130	0.189	0.003302	32.2954	8.41	0.32	0.28	0.0718	8.76E+04	0.29
39	0.137	0.196	0.003480	34.0344	8.63	0.33	0.29	0.0743	8.99E+04	0.28
40	0.143	0.206	0.003632	35.5250	8.82	0.35	0.31	0.0778	9.18E+04	0.28
42	0.155	0.226	0.003937	38.5061	9.18	0.38	0.33	0.0848	9.56E+04	0.28
44	0.172	0.247	0.004369	42.7294	9.67	0.41	0.36	0.0922	1.01E+05	0.28
46	0.188	0.270	0.004775	46.7042	10.11	0.45	0.40	0.1003	1.05E+05	0.28
48	0.202	0.291	0.005131	50.1821	10.48	0.48	0.42	0.1077	1.09E+05	0.28
50	0.220	0.314	0.005588	54.6538	10.94	0.52	0.46	0.1158	1.14E+05	0.27

Drag Quantifcation --- Attached Cusp, With Boom, No Tape --- Trial 3

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78.1	kPa
T	298.6	K
ρ air	0.913	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.009	0.017	0.000229	2.2358	2.21	0.03	0.01	0.0060	2.30E+04	0.34
11	0.010	0.021	0.000254	2.4843	2.33	0.03	0.01	0.0074	2.43E+04	0.38
12	0.013	0.024	0.000330	3.2295	2.66	0.04	0.02	0.0084	2.77E+04	0.34
13	0.016	0.028	0.000406	3.9748	2.95	0.04	0.02	0.0099	3.07E+04	0.32
14	0.017	0.033	0.000432	4.2233	3.04	0.05	0.03	0.0116	3.17E+04	0.35
15	0.020	0.037	0.000508	4.9685	3.30	0.06	0.04	0.0130	3.43E+04	0.34
16	0.021	0.041	0.000533	5.2170	3.38	0.06	0.04	0.0144	3.52E+04	0.36
17	0.026	0.046	0.000660	6.4591	3.76	0.07	0.05	0.0162	3.92E+04	0.32
18	0.030	0.052	0.000762	7.4528	4.04	0.08	0.06	0.0183	4.21E+04	0.32
19	0.031	0.056	0.000787	7.7012	4.11	0.09	0.07	0.0197	4.28E+04	0.33
20	0.033	0.061	0.000838	8.1981	4.24	0.10	0.08	0.0215	4.41E+04	0.34
21	0.037	0.067	0.000940	9.1918	4.49	0.10	0.08	0.0236	4.67E+04	0.33
22	0.040	0.071	0.001016	9.9371	4.67	0.11	0.09	0.0250	4.86E+04	0.32
23	0.045	0.078	0.001143	11.1792	4.95	0.12	0.09	0.0275	5.15E+04	0.32
24	0.048	0.082	0.001219	11.9245	5.11	0.13	0.11	0.0289	5.32E+04	0.31
25	0.053	0.088	0.001346	13.1666	5.37	0.14	0.11	0.0310	5.59E+04	0.30
26	0.058	0.095	0.001473	14.4087	5.62	0.15	0.12	0.0334	5.85E+04	0.30
27	0.061	0.102	0.001549	15.1540	5.76	0.16	0.13	0.0359	6.00E+04	0.30
28	0.067	0.109	0.001702	16.6446	6.04	0.17	0.14	0.0384	6.29E+04	0.30
29	0.071	0.114	0.001803	17.6383	6.22	0.18	0.15	0.0401	6.47E+04	0.29
30	0.075	0.119	0.001905	18.6320	6.39	0.19	0.16	0.0419	6.65E+04	0.29
31	0.081	0.126	0.002057	20.1225	6.64	0.20	0.17	0.0443	6.91E+04	0.28
32	0.089	0.136	0.002261	22.1100	6.96	0.21	0.18	0.0479	7.24E+04	0.28
33	0.097	0.143	0.002464	24.0974	7.27	0.22	0.19	0.0503	7.56E+04	0.27
34	0.099	0.151	0.002515	24.5942	7.34	0.24	0.21	0.0531	7.64E+04	0.28
35	0.109	0.159	0.002769	27.0785	7.70	0.25	0.21	0.0560	8.02E+04	0.27
36	0.115	0.167	0.002921	28.5690	7.91	0.26	0.22	0.0588	8.24E+04	0.26
37	0.120	0.175	0.003048	29.8112	8.08	0.27	0.23	0.0616	8.41E+04	0.27
38	0.127	0.183	0.003226	31.5502	8.31	0.29	0.25	0.0644	8.65E+04	0.26
39	0.133	0.191	0.003378	33.0407	8.51	0.30	0.26	0.0672	8.86E+04	0.26
40	0.142	0.201	0.003607	35.2766	8.79	0.31	0.27	0.0707	9.15E+04	0.26
42	0.152	0.223	0.003861	37.7608	9.09	0.35	0.30	0.0785	9.47E+04	0.27
44	0.171	0.244	0.004343	42.4809	9.65	0.38	0.33	0.0859	1.00E+05	0.26
46	0.187	0.267	0.004750	46.4558	10.09	0.42	0.37	0.0940	1.05E+05	0.26
48	0.201	0.288	0.005105	49.9337	10.46	0.45	0.39	0.1014	1.09E+05	0.26
50	0.218	0.311	0.005537	54.1570	10.89	0.49	0.43	0.1095	1.13E+05	0.26

Drag Quantifcation --- Attached Cusp, With Boom, No Tape --- Trial 4

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78.1	kPa
T	298.6	K
ρ air	0.913	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.010	0.024	0.000254	2.4843	2.33	0.04	0.02	0.0084	2.43E+04	0.44
11	0.011	0.027	0.000279	2.7327	2.45	0.04	0.02	0.0095	2.55E+04	0.45
12	0.012	0.031	0.000305	2.9811	2.56	0.05	0.03	0.0109	2.66E+04	0.47
13	0.015	0.034	0.000381	3.7264	2.86	0.05	0.03	0.0120	2.97E+04	0.41
14	0.017	0.038	0.000432	4.2233	3.04	0.06	0.04	0.0134	3.17E+04	0.41
15	0.019	0.043	0.000483	4.7201	3.22	0.07	0.05	0.0151	3.35E+04	0.41
16	0.021	0.048	0.000533	5.2170	3.38	0.08	0.06	0.0169	3.52E+04	0.42
17	0.023	0.051	0.000584	5.7138	3.54	0.08	0.06	0.0180	3.68E+04	0.40
18	0.028	0.058	0.000711	6.9559	3.90	0.09	0.07	0.0204	4.06E+04	0.38
19	0.030	0.062	0.000762	7.4528	4.04	0.10	0.08	0.0218	4.21E+04	0.38
20	0.034	0.067	0.000864	8.4465	4.30	0.10	0.08	0.0236	4.48E+04	0.36
21	0.038	0.072	0.000965	9.4402	4.55	0.11	0.09	0.0253	4.73E+04	0.35
22	0.041	0.078	0.001041	10.1855	4.72	0.12	0.10	0.0275	4.92E+04	0.35
23	0.045	0.083	0.001143	11.1792	4.95	0.13	0.10	0.0292	5.15E+04	0.34
24	0.049	0.088	0.001245	12.1729	5.16	0.14	0.12	0.0310	5.38E+04	0.33
25	0.052	0.195	0.001321	12.9182	5.32	0.31	0.28	0.0686	5.54E+04	0.68
26	0.057	0.100	0.001448	14.1603	5.57	0.16	0.13	0.0352	5.80E+04	0.32
27	0.060	0.107	0.001524	14.9056	5.71	0.17	0.14	0.0377	5.95E+04	0.33
28	0.064	0.115	0.001626	15.8993	5.90	0.18	0.15	0.0405	6.14E+04	0.33
29	0.070	0.121	0.001778	17.3899	6.17	0.19	0.16	0.0426	6.43E+04	0.32
30	0.073	0.127	0.001854	18.1351	6.30	0.20	0.17	0.0447	6.56E+04	0.32
31	0.080	0.134	0.002032	19.8741	6.60	0.21	0.18	0.0472	6.87E+04	0.31
32	0.087	0.140	0.002210	21.6131	6.88	0.22	0.19	0.0493	7.16E+04	0.29
33	0.093	0.149	0.002362	23.1037	7.11	0.23	0.20	0.0524	7.41E+04	0.29
34	0.100	0.156	0.002540	24.8426	7.38	0.24	0.21	0.0549	7.68E+04	0.28
35	0.108	0.165	0.002743	26.8301	7.67	0.26	0.22	0.0581	7.98E+04	0.28
36	0.116	0.174	0.002946	28.8175	7.95	0.27	0.23	0.0612	8.27E+04	0.27
37	0.122	0.182	0.003099	30.3080	8.15	0.28	0.24	0.0641	8.48E+04	0.27
38	0.130	0.190	0.003302	32.2954	8.41	0.30	0.26	0.0669	8.76E+04	0.27
39	0.137	0.196	0.003480	34.0344	8.63	0.31	0.27	0.0690	8.99E+04	0.26
40	0.142	0.207	0.003607	35.2766	8.79	0.32	0.28	0.0729	9.15E+04	0.27
42	0.157	0.230	0.003988	39.0030	9.24	0.36	0.31	0.0810	9.62E+04	0.27
44	0.173	0.251	0.004394	42.9778	9.70	0.39	0.34	0.0883	1.01E+05	0.26
46	0.187	0.273	0.004750	46.4558	10.09	0.43	0.38	0.0961	1.05E+05	0.27
48	0.200	0.294	0.005080	49.6853	10.43	0.46	0.40	0.1035	1.09E+05	0.27
50	0.222	0.317	0.005639	55.1507	10.99	0.50	0.44	0.1116	1.14E+05	0.26

Drag Quantifcation --- Attached Cusp, With Boom and Tape --- Trial 1

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	77.6	kPa
T	298.8	K
ρ air	0.906	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.008	0.019	0.000203	1.9874	2.09	0.05	0.03	0.0120	2.16E+04	0.48
11	0.009	0.022	0.000229	2.2358	2.22	0.06	0.04	0.0130	2.30E+04	0.49
12	0.010	0.026	0.000254	2.4843	2.34	0.06	0.04	0.0144	2.42E+04	0.51
13	0.012	0.029	0.000305	2.9811	2.57	0.07	0.05	0.0155	2.65E+04	0.47
14	0.013	0.033	0.000330	3.2295	2.67	0.08	0.06	0.0169	2.76E+04	0.49
15	0.017	0.038	0.000432	4.2233	3.05	0.08	0.06	0.0187	3.15E+04	0.43
16	0.018	0.044	0.000457	4.4717	3.14	0.09	0.07	0.0208	3.25E+04	0.47
17	0.020	0.048	0.000508	4.9685	3.31	0.10	0.08	0.0222	3.42E+04	0.46
18	0.020	0.053	0.000508	4.9685	3.31	0.11	0.09	0.0239	3.42E+04	0.50
19	0.021	0.058	0.000533	5.2170	3.39	0.11	0.09	0.0257	3.51E+04	0.52
20	0.023	0.064	0.000584	5.7138	3.55	0.12	0.10	0.0278	3.67E+04	0.52
21	0.026	0.068	0.000660	6.4591	3.78	0.13	0.11	0.0292	3.90E+04	0.49
22	0.029	0.075	0.000737	7.2044	3.99	0.14	0.12	0.0317	4.12E+04	0.49
23	0.032	0.078	0.000813	7.9496	4.19	0.15	0.12	0.0327	4.33E+04	0.42
24	0.036	0.084	0.000914	8.9434	4.44	0.16	0.14	0.0348	4.59E+04	0.44
25	0.040	0.089	0.001016	9.9371	4.68	0.16	0.13	0.0366	4.84E+04	0.39
26	0.042	0.095	0.001067	10.4339	4.80	0.17	0.14	0.0387	4.96E+04	0.39
27	0.048	0.102	0.001219	11.9245	5.13	0.18	0.15	0.0412	5.30E+04	0.37
28	0.052	0.108	0.001321	12.9182	5.34	0.19	0.16	0.0433	5.52E+04	0.36
29	0.058	0.113	0.001473	14.4087	5.64	0.20	0.17	0.0451	5.83E+04	0.34
30	0.063	0.119	0.001600	15.6509	5.88	0.21	0.18	0.0472	6.07E+04	0.33
31	0.069	0.126	0.001753	17.1414	6.15	0.22	0.19	0.0496	6.35E+04	0.32
32	0.074	0.132	0.001880	18.3836	6.37	0.23	0.20	0.0517	6.58E+04	0.31
33	0.080	0.139	0.002032	19.8741	6.62	0.24	0.21	0.0542	6.84E+04	0.31
34	0.086	0.146	0.002184	21.3647	6.87	0.25	0.22	0.0567	7.09E+04	0.30
35	0.094	0.154	0.002388	23.3521	7.18	0.26	0.22	0.0595	7.42E+04	0.28
36	0.100	0.162	0.002540	24.8426	7.41	0.28	0.24	0.0623	7.65E+04	0.28
37	0.107	0.170	0.002718	26.5816	7.66	0.29	0.25	0.0651	7.91E+04	0.27
38	0.112	0.179	0.002845	27.8238	7.84	0.30	0.26	0.0683	8.10E+04	0.27
39	0.120	0.189	0.003048	29.8112	8.11	0.32	0.28	0.0718	8.38E+04	0.27
40	0.128	0.196	0.003251	31.7986	8.38	0.33	0.29	0.0743	8.66E+04	0.26
42	0.139	0.216	0.003531	34.5313	8.73	0.36	0.31	0.0813	9.02E+04	0.26
44	0.152	0.237	0.003861	37.7608	9.13	0.39	0.34	0.0887	9.43E+04	0.26
46	0.171	0.259	0.004343	42.4809	9.68	0.43	0.38	0.0964	1.00E+05	0.26
48	0.186	0.283	0.004724	46.2073	10.10	0.47	0.41	0.1049	1.04E+05	0.25
50	0.209	0.305	0.005309	51.9211	10.71	0.50	0.44	0.1126	1.11E+05	0.25

Drag Quantifcation --- Attached Cusp, With Boom and Tape --- Trial 2

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	77.6	kPa
T	298.8	K
ρ air	0.906	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.010	0.021	0.000254	2.4843	2.34	0.06	0.04	0.0127	2.42E+04	0.66
11	0.012	0.025	0.000305	2.9811	2.57	0.06	0.04	0.0141	2.65E+04	0.61
12	0.018	0.028	0.000457	4.4717	3.14	0.07	0.05	0.0151	3.25E+04	0.44
13	0.020	0.031	0.000508	4.9685	3.31	0.07	0.05	0.0162	3.42E+04	0.42
14	0.021	0.036	0.000533	5.2170	3.39	0.08	0.06	0.0180	3.51E+04	0.44
15	0.023	0.039	0.000584	5.7138	3.55	0.08	0.06	0.0190	3.67E+04	0.43
16	0.026	0.044	0.000660	6.4591	3.78	0.09	0.07	0.0208	3.90E+04	0.41
17	0.030	0.049	0.000762	7.4528	4.06	0.10	0.08	0.0225	4.19E+04	0.39
18	0.032	0.053	0.000813	7.9496	4.19	0.11	0.09	0.0239	4.33E+04	0.39
19	0.036	0.060	0.000914	8.9434	4.44	0.12	0.10	0.0264	4.59E+04	0.38
20	0.036	0.064	0.000914	8.9434	4.44	0.12	0.10	0.0278	4.59E+04	0.40
21	0.042	0.069	0.001067	10.4339	4.80	0.13	0.11	0.0296	4.96E+04	0.36
22	0.046	0.075	0.001168	11.4276	5.02	0.14	0.12	0.0317	5.19E+04	0.36
23	0.050	0.080	0.001270	12.4213	5.24	0.15	0.12	0.0334	5.41E+04	0.35
24	0.053	0.085	0.001346	13.1666	5.39	0.16	0.14	0.0352	5.57E+04	0.34
25	0.060	0.090	0.001524	14.9056	5.74	0.16	0.13	0.0370	5.93E+04	0.32
26	0.063	0.096	0.001600	15.6509	5.88	0.17	0.14	0.0391	6.07E+04	0.32
27	0.068	0.102	0.001727	16.8930	6.11	0.18	0.15	0.0412	6.31E+04	0.31
28	0.072	0.109	0.001829	17.8867	6.28	0.19	0.16	0.0436	6.49E+04	0.31
29	0.076	0.114	0.001930	18.8804	6.46	0.20	0.17	0.0454	6.67E+04	0.31
30	0.081	0.120	0.002057	20.1225	6.66	0.21	0.18	0.0475	6.89E+04	0.30
31	0.087	0.126	0.002210	21.6131	6.91	0.22	0.19	0.0496	7.14E+04	0.30
32	0.093	0.133	0.002362	23.1037	7.14	0.23	0.20	0.0521	7.38E+04	0.29
33	0.099	0.139	0.002515	24.5942	7.37	0.24	0.21	0.0542	7.61E+04	0.28
34	0.105	0.146	0.002667	26.0848	7.59	0.25	0.22	0.0567	7.84E+04	0.28
35	0.111	0.155	0.002819	27.5753	7.80	0.27	0.23	0.0598	8.06E+04	0.28
36	0.118	0.163	0.002997	29.3143	8.04	0.28	0.24	0.0626	8.31E+04	0.28
37	0.122	0.172	0.003099	30.3080	8.18	0.29	0.25	0.0658	8.45E+04	0.28
38	0.130	0.179	0.003302	32.2954	8.44	0.30	0.26	0.0683	8.72E+04	0.27
39	0.136	0.188	0.003454	33.7860	8.64	0.32	0.28	0.0714	8.92E+04	0.27
40	0.141	0.196	0.003581	35.0281	8.79	0.33	0.29	0.0743	9.08E+04	0.27
42	0.158	0.214	0.004013	39.2514	9.31	0.36	0.31	0.0806	9.62E+04	0.26
44	0.171	0.235	0.004343	42.4809	9.68	0.39	0.34	0.0880	1.00E+05	0.27
46	0.184	0.258	0.004674	45.7105	10.05	0.43	0.38	0.0961	1.04E+05	0.27
48	0.201	0.277	0.005105	49.9337	10.50	0.46	0.40	0.1028	1.08E+05	0.26
50	0.220	0.305	0.005588	54.6538	10.98	0.50	0.44	0.1126	1.13E+05	0.27

Drag Quantifcation --- Attached Cusp, With Boom and Tape --- Trial 3

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	77.6	kPa
T	298.8	K
ρ air	0.906	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.011	0.021	0.000279	2.7327	2.46	0.03	0.01	0.0074	2.54E+04	0.35
11	0.012	0.026	0.000305	2.9811	2.57	0.04	0.02	0.0092	2.65E+04	0.39
12	0.017	0.028	0.000432	4.2233	3.05	0.04	0.02	0.0099	3.15E+04	0.30
13	0.020	0.033	0.000508	4.9685	3.31	0.05	0.03	0.0116	3.42E+04	0.30
14	0.021	0.036	0.000533	5.2170	3.39	0.06	0.04	0.0127	3.51E+04	0.31
15	0.022	0.039	0.000559	5.4654	3.47	0.06	0.04	0.0137	3.59E+04	0.32
16	0.025	0.045	0.000635	6.2107	3.70	0.07	0.05	0.0158	3.83E+04	0.33
17	0.029	0.050	0.000737	7.2044	3.99	0.08	0.06	0.0176	4.12E+04	0.31
18	0.032	0.054	0.000813	7.9496	4.19	0.08	0.06	0.0190	4.33E+04	0.31
19	0.035	0.059	0.000889	8.6949	4.38	0.09	0.07	0.0208	4.53E+04	0.31
20	0.039	0.065	0.000991	9.6886	4.62	0.10	0.08	0.0229	4.78E+04	0.30
21	0.041	0.070	0.001041	10.1855	4.74	0.11	0.09	0.0246	4.90E+04	0.31
22	0.045	0.075	0.001143	11.1792	4.97	0.12	0.10	0.0264	5.13E+04	0.30
23	0.049	0.079	0.001245	12.1729	5.18	0.12	0.09	0.0278	5.36E+04	0.29
24	0.052	0.083	0.001321	12.9182	5.34	0.13	0.11	0.0292	5.52E+04	0.29
25	0.058	0.090	0.001473	14.4087	5.64	0.14	0.11	0.0317	5.83E+04	0.28
26	0.061	0.095	0.001549	15.1540	5.78	0.15	0.12	0.0334	5.97E+04	0.28
27	0.067	0.102	0.001702	16.6446	6.06	0.16	0.13	0.0359	6.26E+04	0.28
28	0.070	0.109	0.001778	17.3899	6.20	0.17	0.14	0.0384	6.40E+04	0.28
29	0.074	0.114	0.001880	18.3836	6.37	0.18	0.15	0.0401	6.58E+04	0.28
30	0.080	0.120	0.002032	19.8741	6.62	0.19	0.16	0.0422	6.84E+04	0.27
31	0.086	0.126	0.002184	21.3647	6.87	0.20	0.17	0.0443	7.09E+04	0.27
32	0.091	0.132	0.002311	22.6068	7.06	0.21	0.18	0.0465	7.30E+04	0.26
33	0.097	0.139	0.002464	24.0974	7.29	0.22	0.19	0.0489	7.53E+04	0.26
34	0.103	0.146	0.002616	25.5879	7.52	0.23	0.20	0.0514	7.76E+04	0.26
35	0.110	0.154	0.002794	27.3269	7.77	0.24	0.20	0.0542	8.02E+04	0.26
36	0.117	0.163	0.002972	29.0659	8.01	0.26	0.22	0.0574	8.27E+04	0.25
37	0.121	0.170	0.003073	30.0596	8.15	0.27	0.23	0.0598	8.42E+04	0.26
38	0.128	0.180	0.003251	31.7986	8.38	0.28	0.24	0.0634	8.66E+04	0.26
39	0.134	0.188	0.003404	33.2891	8.57	0.29	0.25	0.0662	8.86E+04	0.26
40	0.141	0.198	0.003581	35.0281	8.79	0.31	0.27	0.0697	9.08E+04	0.26
42	0.157	0.216	0.003988	39.0030	9.28	0.34	0.29	0.0760	9.59E+04	0.25
44	0.171	0.236	0.004343	42.4809	9.68	0.37	0.32	0.0831	1.00E+05	0.25
46	0.184	0.261	0.004674	45.7105	10.05	0.41	0.36	0.0919	1.04E+05	0.26
48	0.199	0.279	0.005055	49.4369	10.45	0.44	0.38	0.0982	1.08E+05	0.26
50	0.221	0.301	0.005613	54.9023	11.01	0.47	0.41	0.1059	1.14E+05	0.25

Drag Quantifcation --- Attached Cusp, With Boom and Tape --- Trial 4

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	77.6	kPa
T	298.8	K
ρ air	0.906	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.010	0.019	0.000254	2.4843	2.34	0.03	0.01	0.0067	2.42E+04	0.35
11	0.012	0.023	0.000305	2.9811	2.57	0.04	0.02	0.0081	2.65E+04	0.35
12	0.017	0.026	0.000432	4.2233	3.05	0.04	0.02	0.0092	3.15E+04	0.28
13	0.020	0.030	0.000508	4.9685	3.31	0.05	0.03	0.0106	3.42E+04	0.27
14	0.020	0.034	0.000508	4.9685	3.31	0.05	0.03	0.0120	3.42E+04	0.31
15	0.022	0.038	0.000559	5.4654	3.47	0.06	0.04	0.0134	3.59E+04	0.31
16	0.025	0.043	0.000635	6.2107	3.70	0.07	0.05	0.0151	3.83E+04	0.31
17	0.029	0.048	0.000737	7.2044	3.99	0.08	0.06	0.0169	4.12E+04	0.30
18	0.031	0.052	0.000787	7.7012	4.12	0.08	0.06	0.0183	4.26E+04	0.31
19	0.034	0.057	0.000864	8.4465	4.32	0.09	0.07	0.0201	4.46E+04	0.31
20	0.039	0.065	0.000991	9.6886	4.62	0.10	0.08	0.0229	4.78E+04	0.30
21	0.042	0.069	0.001067	10.4339	4.80	0.11	0.09	0.0243	4.96E+04	0.30
22	0.045	0.073	0.001143	11.1792	4.97	0.11	0.09	0.0257	5.13E+04	0.30
23	0.050	0.078	0.001270	12.4213	5.24	0.12	0.09	0.0275	5.41E+04	0.28
24	0.051	0.082	0.001295	12.6698	5.29	0.13	0.11	0.0289	5.46E+04	0.29
25	0.056	0.090	0.001422	13.9119	5.54	0.14	0.11	0.0317	5.72E+04	0.29
26	0.061	0.096	0.001549	15.1540	5.78	0.15	0.12	0.0338	5.97E+04	0.29
27	0.067	0.101	0.001702	16.6446	6.06	0.16	0.13	0.0355	6.26E+04	0.27
28	0.071	0.107	0.001803	17.6383	6.24	0.17	0.14	0.0377	6.45E+04	0.27
29	0.075	0.112	0.001905	18.6320	6.41	0.18	0.15	0.0394	6.63E+04	0.27
30	0.080	0.118	0.002032	19.8741	6.62	0.18	0.15	0.0415	6.84E+04	0.27
31	0.085	0.125	0.002159	21.1163	6.83	0.20	0.17	0.0440	7.05E+04	0.27
32	0.091	0.129	0.002311	22.6068	7.06	0.20	0.17	0.0454	7.30E+04	0.26
33	0.096	0.138	0.002438	23.8489	7.26	0.22	0.19	0.0486	7.50E+04	0.26
34	0.101	0.144	0.002565	25.0911	7.44	0.23	0.20	0.0507	7.69E+04	0.26
35	0.110	0.153	0.002794	27.3269	7.77	0.24	0.20	0.0539	8.02E+04	0.25
36	0.117	0.161	0.002972	29.0659	8.01	0.25	0.21	0.0567	8.27E+04	0.25
37	0.120	0.169	0.003048	29.8112	8.11	0.26	0.22	0.0595	8.38E+04	0.26
38	0.129	0.179	0.003277	32.0470	8.41	0.28	0.24	0.0630	8.69E+04	0.25
39	0.132	0.189	0.003353	32.7923	8.51	0.30	0.26	0.0665	8.79E+04	0.26
40	0.140	0.196	0.003556	34.7797	8.76	0.31	0.27	0.0690	9.05E+04	0.26
42	0.156	0.215	0.003962	38.7545	9.25	0.34	0.29	0.0757	9.55E+04	0.25
44	0.170	0.237	0.004318	42.2325	9.66	0.37	0.32	0.0834	9.97E+04	0.25
46	0.183	0.260	0.004648	45.4620	10.02	0.41	0.36	0.0915	1.03E+05	0.26
48	0.201	0.280	0.005105	49.9337	10.50	0.44	0.38	0.0986	1.08E+05	0.25
50	0.220	0.305	0.005588	54.6538	10.98	0.48	0.42	0.1073	1.13E+05	0.25

Drag Quantifcation --- Attached Cusp, No Boom, No Tape --- Trial 1

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	77.4	kPa
T	298.6	K
ρ air	0.904	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Rod Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.004	0.017	0.000102	0.9937	1.48	0.05	0.02	0.03	0.0113	1.53E+04	0.88
11	0.005	0.020	0.000127	1.2421	1.66	0.05	0.02	0.03	0.0123	1.71E+04	0.81
12	0.012	0.023	0.000305	2.9811	2.57	0.06	0.02	0.04	0.0134	2.65E+04	0.38
13	0.014	0.026	0.000356	3.4780	2.77	0.06	0.02	0.04	0.0144	2.86E+04	0.37
14	0.016	0.029	0.000406	3.9748	2.97	0.07	0.02	0.05	0.0155	3.06E+04	0.36
15	0.019	0.032	0.000483	4.7201	3.23	0.07	0.02	0.05	0.0165	3.33E+04	0.33
16	0.020	0.035	0.000508	4.9685	3.32	0.08	0.02	0.06	0.0176	3.42E+04	0.34
17	0.022	0.039	0.000559	5.4654	3.48	0.08	0.02	0.06	0.0190	3.58E+04	0.34
18	0.027	0.044	0.000686	6.7075	3.85	0.09	0.02	0.07	0.0208	3.97E+04	0.31
19	0.030	0.048	0.000762	7.4528	4.06	0.10	0.02	0.08	0.0222	4.19E+04	0.31
20	0.032	0.051	0.000813	7.9496	4.19	0.10	0.02	0.08	0.0232	4.32E+04	0.30
21	0.035	0.054	0.000889	8.6949	4.39	0.11	0.02	0.09	0.0243	4.52E+04	0.29
22	0.039	0.058	0.000991	9.6886	4.63	0.11	0.02	0.09	0.0257	4.77E+04	0.28
23	0.043	0.061	0.001092	10.6823	4.86	0.12	0.03	0.09	0.0267	5.01E+04	0.24
24	0.049	0.066	0.001245	12.1729	5.19	0.13	0.02	0.11	0.0285	5.35E+04	0.25
25	0.051	0.070	0.001295	12.6698	5.29	0.13	0.03	0.10	0.0299	5.46E+04	0.24
26	0.055	0.078	0.001397	13.6635	5.50	0.15	0.03	0.12	0.0327	5.67E+04	0.24
27	0.060	0.085	0.001524	14.9056	5.74	0.16	0.03	0.13	0.0352	5.92E+04	0.25
28	0.064	0.090	0.001626	15.8993	5.93	0.16	0.03	0.13	0.0370	6.11E+04	0.24
29	0.070	0.095	0.001778	17.3899	6.20	0.17	0.03	0.14	0.0387	6.39E+04	0.24
30	0.073	0.098	0.001854	18.1351	6.33	0.18	0.03	0.15	0.0398	6.53E+04	0.23
31	0.080	0.102	0.002032	19.8741	6.63	0.18	0.03	0.15	0.0412	6.83E+04	0.22
32	0.087	0.107	0.002210	21.6131	6.91	0.19	0.03	0.16	0.0429	7.13E+04	0.22
33	0.091	0.114	0.002311	22.6068	7.07	0.20	0.03	0.17	0.0454	7.29E+04	0.22
34	0.098	0.119	0.002489	24.3458	7.34	0.21	0.03	0.18	0.0472	7.56E+04	0.21
35	0.102	0.125	0.002591	25.3395	7.49	0.22	0.04	0.18	0.0493	7.72E+04	0.20
36	0.109	0.132	0.002769	27.0785	7.74	0.23	0.04	0.19	0.0517	7.98E+04	0.20
37	0.118	0.138	0.002997	29.3143	8.05	0.24	0.04	0.20	0.0539	8.30E+04	0.20
38	0.121	0.145	0.003073	30.0596	8.15	0.25	0.04	0.21	0.0563	8.41E+04	0.20
39	0.129	0.151	0.003277	32.0470	8.42	0.26	0.04	0.22	0.0584	8.68E+04	0.20
40	0.137	0.159	0.003480	34.0344	8.68	0.27	0.04	0.23	0.0612	8.94E+04	0.20
42	0.151	0.174	0.003835	37.5124	9.11	0.30	0.05	0.25	0.0665	9.39E+04	0.19
44	0.166	0.193	0.004216	41.2388	9.55	0.33	0.05	0.28	0.0732	9.85E+04	0.19
46	0.184	0.212	0.004674	45.7105	10.06	0.36	0.05	0.31	0.0799	1.04E+05	0.19
48	0.200	0.227	0.005080	49.6853	10.48	0.38	0.06	0.32	0.0852	1.08E+05	0.19
50	0.217	0.247	0.005512	53.9085	10.92	0.41	0.06	0.35	0.0922	1.13E+05	0.19

Drag Quantifcation --- Attached Cusp, No Boom, No Tape --- Trial 2

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	77.4	kPa
T	298.6	K
ρ air	0.904	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Rod Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.004	0.020	0.000102	0.9937	1.48	0.05	0.02	0.03	0.0123	1.53E+04	1.01
11	0.005	0.021	0.000127	1.2421	1.66	0.06	0.02	0.04	0.0127	1.71E+04	0.85
12	0.006	0.022	0.000152	1.4906	1.82	0.06	0.02	0.04	0.0130	1.87E+04	0.74
13	0.007	0.030	0.000178	1.7390	1.96	0.07	0.02	0.05	0.0158	2.02E+04	0.84
14	0.008	0.034	0.000203	1.9874	2.10	0.08	0.02	0.06	0.0172	2.16E+04	0.83
15	0.010	0.038	0.000254	2.4843	2.34	0.08	0.02	0.06	0.0187	2.42E+04	0.73
16	0.011	0.042	0.000279	2.7327	2.46	0.09	0.02	0.07	0.0201	2.53E+04	0.73
17	0.012	0.045	0.000305	2.9811	2.57	0.09	0.02	0.07	0.0211	2.65E+04	0.72
18	0.014	0.048	0.000356	3.4780	2.77	0.10	0.02	0.08	0.0222	2.86E+04	0.65
19	0.018	0.051	0.000457	4.4717	3.15	0.10	0.02	0.08	0.0232	3.24E+04	0.54
20	0.021	0.053	0.000533	5.2170	3.40	0.11	0.02	0.09	0.0239	3.50E+04	0.48
21	0.025	0.055	0.000635	6.2107	3.71	0.11	0.02	0.09	0.0246	3.82E+04	0.42
22	0.029	0.065	0.000737	7.2044	3.99	0.13	0.02	0.11	0.0282	4.12E+04	0.42
23	0.031	0.070	0.000787	7.7012	4.13	0.13	0.03	0.10	0.0299	4.25E+04	0.39
24	0.037	0.074	0.000940	9.1918	4.51	0.14	0.02	0.12	0.0313	4.65E+04	0.38
25	0.040	0.077	0.001016	9.9371	4.69	0.14	0.03	0.11	0.0324	4.83E+04	0.33
26	0.043	0.081	0.001092	10.6823	4.86	0.15	0.03	0.12	0.0338	5.01E+04	0.33
27	0.049	0.085	0.001245	12.1729	5.19	0.16	0.03	0.13	0.0352	5.35E+04	0.30
28	0.052	0.095	0.001321	12.9182	5.35	0.17	0.03	0.14	0.0387	5.51E+04	0.32
29	0.060	0.098	0.001524	14.9056	5.74	0.18	0.03	0.15	0.0398	5.92E+04	0.29
30	0.068	0.101	0.001727	16.8930	6.11	0.18	0.03	0.15	0.0408	6.30E+04	0.26
31	0.072	0.106	0.001829	17.8867	6.29	0.19	0.03	0.16	0.0426	6.48E+04	0.26
32	0.075	0.109	0.001905	18.6320	6.42	0.19	0.03	0.16	0.0436	6.62E+04	0.25
33	0.079	0.118	0.002007	19.6257	6.59	0.21	0.03	0.18	0.0468	6.79E+04	0.26
34	0.086	0.122	0.002184	21.3647	6.88	0.21	0.03	0.18	0.0482	7.09E+04	0.25
35	0.090	0.127	0.002286	22.3584	7.03	0.22	0.04	0.18	0.0500	7.25E+04	0.24
36	0.099	0.131	0.002515	24.5942	7.38	0.23	0.04	0.19	0.0514	7.60E+04	0.22
37	0.104	0.135	0.002642	25.8364	7.56	0.23	0.04	0.19	0.0528	7.79E+04	0.22
38	0.113	0.147	0.002870	28.0722	7.88	0.25	0.04	0.21	0.0570	8.12E+04	0.22
39	0.118	0.154	0.002997	29.3143	8.05	0.26	0.04	0.22	0.0595	8.30E+04	0.22
40	0.127	0.161	0.003226	31.5502	8.35	0.28	0.04	0.24	0.0619	8.61E+04	0.22
42	0.142	0.176	0.003607	35.2766	8.83	0.30	0.05	0.25	0.0672	9.11E+04	0.20
44	0.153	0.191	0.003886	38.0093	9.17	0.32	0.05	0.27	0.0725	9.45E+04	0.21
46	0.166	0.202	0.004216	41.2388	9.55	0.34	0.05	0.29	0.0764	9.85E+04	0.20
48	0.187	0.213	0.004750	46.4558	10.14	0.36	0.06	0.30	0.0802	1.04E+05	0.18
50	0.204	0.221	0.005182	50.6790	10.59	0.37	0.06	0.31	0.0831	1.09E+05	0.18

Drag Quantifcation --- Attached Cusp, No Boom, No Tape --- Trial 3

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	77.4	kPa
T	298.6	K
ρ air	0.904	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Rod Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.005	0.017	0.000127	1.2421	1.66	0.03	0.02	0.01	0.0060	1.71E+04	0.15
11	0.006	0.018	0.000152	1.4906	1.82	0.03	0.02	0.01	0.0063	1.87E+04	0.16
12	0.007	0.022	0.000178	1.7390	1.96	0.03	0.02	0.01	0.0077	2.02E+04	0.24
13	0.008	0.026	0.000203	1.9874	2.10	0.04	0.02	0.02	0.0092	2.16E+04	0.30
14	0.012	0.030	0.000305	2.9811	2.57	0.05	0.02	0.03	0.0106	2.65E+04	0.26
15	0.018	0.034	0.000457	4.4717	3.15	0.05	0.02	0.03	0.0120	3.24E+04	0.21
16	0.021	0.037	0.000533	5.2170	3.40	0.06	0.02	0.04	0.0130	3.50E+04	0.21
17	0.023	0.041	0.000584	5.7138	3.56	0.06	0.02	0.04	0.0144	3.66E+04	0.22
18	0.026	0.044	0.000660	6.4591	3.78	0.07	0.02	0.05	0.0155	3.90E+04	0.22
19	0.031	0.049	0.000787	7.7012	4.13	0.08	0.02	0.06	0.0172	4.25E+04	0.21
20	0.033	0.052	0.000838	8.1981	4.26	0.08	0.02	0.06	0.0183	4.39E+04	0.22
21	0.038	0.057	0.000965	9.4402	4.57	0.09	0.02	0.07	0.0201	4.71E+04	0.21
22	0.040	0.062	0.001016	9.9371	4.69	0.10	0.02	0.08	0.0218	4.83E+04	0.22
23	0.042	0.065	0.001067	10.4339	4.80	0.10	0.03	0.07	0.0229	4.95E+04	0.20
24	0.050	0.069	0.001270	12.4213	5.24	0.11	0.02	0.09	0.0243	5.40E+04	0.21
25	0.053	0.072	0.001346	13.1666	5.40	0.11	0.03	0.08	0.0253	5.56E+04	0.18
26	0.057	0.079	0.001448	14.1603	5.60	0.12	0.03	0.09	0.0278	5.77E+04	0.19
27	0.061	0.083	0.001549	15.1540	5.79	0.13	0.03	0.10	0.0292	5.97E+04	0.19
28	0.065	0.090	0.001651	16.1477	5.98	0.14	0.03	0.11	0.0317	6.16E+04	0.20
29	0.070	0.094	0.001778	17.3899	6.20	0.15	0.03	0.12	0.0331	6.39E+04	0.19
30	0.075	0.097	0.001905	18.6320	6.42	0.15	0.03	0.12	0.0341	6.62E+04	0.19
31	0.082	0.103	0.002083	20.3710	6.71	0.16	0.03	0.13	0.0363	6.92E+04	0.19
32	0.089	0.109	0.002261	22.1100	6.99	0.17	0.03	0.14	0.0384	7.21E+04	0.18
33	0.093	0.115	0.002362	23.1037	7.15	0.18	0.03	0.15	0.0405	7.37E+04	0.19
34	0.100	0.120	0.002540	24.8426	7.41	0.19	0.03	0.16	0.0422	7.64E+04	0.18
35	0.104	0.126	0.002642	25.8364	7.56	0.20	0.04	0.16	0.0443	7.79E+04	0.18
36	0.110	0.131	0.002794	27.3269	7.78	0.21	0.04	0.17	0.0461	8.01E+04	0.17
37	0.127	0.139	0.003226	31.5502	8.35	0.22	0.04	0.18	0.0489	8.61E+04	0.16
38	0.128	0.145	0.003251	31.7986	8.39	0.23	0.04	0.19	0.0510	8.65E+04	0.17
39	0.132	0.151	0.003353	32.7923	8.52	0.24	0.04	0.20	0.0531	8.78E+04	0.17
40	0.140	0.157	0.003556	34.7797	8.77	0.25	0.04	0.21	0.0553	9.04E+04	0.17
42	0.151	0.176	0.003835	37.5124	9.11	0.28	0.05	0.23	0.0619	9.39E+04	0.17
44	0.168	0.194	0.004267	41.7356	9.61	0.30	0.05	0.25	0.0683	9.90E+04	0.18
46	0.185	0.212	0.004699	45.9589	10.08	0.33	0.05	0.28	0.0746	1.04E+05	0.18
48	0.201	0.230	0.005105	49.9337	10.51	0.36	0.06	0.30	0.0810	1.08E+05	0.17
50	0.221	0.246	0.005613	54.9023	11.02	0.39	0.06	0.33	0.0866	1.14E+05	0.17

Drag Quantifcation --- Attached Cusp, No Boom, No Tape --- Trial 4

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78	kPa
T	298.6	K
ρ air	0.911	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Rod Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.004	0.016	0.000102	0.9937	1.48	0.03	0.02	0.01	0.0056	1.53E+04	0.15
11	0.008	0.019	0.000203	1.9874	2.09	0.03	0.02	0.01	0.0067	2.17E+04	0.14
12	0.012	0.023	0.000305	2.9811	2.56	0.04	0.02	0.02	0.0081	2.66E+04	0.16
13	0.014	0.026	0.000356	3.4780	2.76	0.04	0.02	0.02	0.0092	2.87E+04	0.17
14	0.017	0.029	0.000432	4.2233	3.04	0.05	0.02	0.03	0.0102	3.16E+04	0.17
15	0.020	0.032	0.000508	4.9685	3.30	0.05	0.02	0.03	0.0113	3.43E+04	0.18
16	0.021	0.037	0.000533	5.2170	3.38	0.06	0.02	0.04	0.0130	3.52E+04	0.21
17	0.024	0.039	0.000610	5.9622	3.62	0.06	0.02	0.04	0.0137	3.76E+04	0.20
18	0.027	0.044	0.000686	6.7075	3.84	0.07	0.02	0.05	0.0155	3.99E+04	0.21
19	0.030	0.048	0.000762	7.4528	4.04	0.08	0.02	0.06	0.0169	4.20E+04	0.21
20	0.033	0.053	0.000838	8.1981	4.24	0.08	0.02	0.06	0.0187	4.41E+04	0.22
21	0.036	0.056	0.000914	8.9434	4.43	0.09	0.02	0.07	0.0197	4.60E+04	0.22
22	0.040	0.059	0.001016	9.9371	4.67	0.09	0.02	0.07	0.0208	4.85E+04	0.21
23	0.042	0.063	0.001067	10.4339	4.79	0.10	0.03	0.07	0.0222	4.97E+04	0.19
24	0.048	0.066	0.001219	11.9245	5.12	0.10	0.02	0.08	0.0232	5.31E+04	0.20
25	0.052	0.071	0.001321	12.9182	5.33	0.11	0.03	0.08	0.0250	5.53E+04	0.18
26	0.056	0.077	0.001422	13.9119	5.53	0.12	0.03	0.09	0.0271	5.74E+04	0.19
27	0.061	0.085	0.001549	15.1540	5.77	0.13	0.03	0.10	0.0299	5.99E+04	0.20
28	0.066	0.092	0.001676	16.3961	6.00	0.14	0.03	0.11	0.0324	6.23E+04	0.20
29	0.072	0.095	0.001829	17.8867	6.27	0.15	0.03	0.12	0.0334	6.51E+04	0.19
30	0.078	0.099	0.001981	19.3773	6.52	0.16	0.03	0.13	0.0348	6.77E+04	0.19
31	0.080	0.104	0.002032	19.8741	6.61	0.16	0.03	0.13	0.0366	6.86E+04	0.19
32	0.086	0.109	0.002184	21.3647	6.85	0.17	0.03	0.14	0.0384	7.11E+04	0.19
33	0.091	0.113	0.002311	22.6068	7.04	0.18	0.03	0.15	0.0398	7.32E+04	0.19
34	0.097	0.118	0.002464	24.0974	7.27	0.18	0.03	0.15	0.0415	7.56E+04	0.19
35	0.105	0.125	0.002667	26.0848	7.57	0.20	0.04	0.16	0.0440	7.86E+04	0.17
36	0.110	0.131	0.002794	27.3269	7.75	0.21	0.04	0.17	0.0461	8.05E+04	0.17
37	0.118	0.137	0.002997	29.3143	8.02	0.21	0.04	0.17	0.0482	8.33E+04	0.17
38	0.122	0.145	0.003099	30.3080	8.16	0.23	0.04	0.19	0.0510	8.47E+04	0.18
39	0.130	0.151	0.003302	32.2954	8.42	0.24	0.04	0.20	0.0531	8.75E+04	0.18
40	0.139	0.157	0.003531	34.5313	8.71	0.25	0.04	0.21	0.0553	9.04E+04	0.17
42	0.150	0.175	0.003810	37.2640	9.04	0.27	0.05	0.22	0.0616	9.40E+04	0.17
44	0.167	0.194	0.004242	41.4872	9.54	0.30	0.05	0.25	0.0683	9.91E+04	0.18
46	0.183	0.211	0.004648	45.4620	9.99	0.33	0.05	0.28	0.0743	1.04E+05	0.18
48	0.201	0.229	0.005105	49.9337	10.47	0.36	0.06	0.30	0.0806	1.09E+05	0.17
50	0.218	0.247	0.005537	54.1570	10.90	0.39	0.06	0.33	0.0869	1.13E+05	0.17

Drag Quantifcation --- Original Aerobody, No Boom, With Tape --- Trial 1

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78	kPa
T	298.6	K
ρ air	0.911	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.007	0.002	0.000178	1.7390	1.95	0.03	0.01	0.0060	2.03E+04	0.11
11	0.009	0.005	0.000229	2.2358	2.22	0.03	0.01	0.0070	2.30E+04	0.15
12	0.010	0.008	0.000254	2.4843	2.34	0.04	0.02	0.0081	2.43E+04	0.19
13	0.011	0.009	0.000279	2.7327	2.45	0.04	0.02	0.0084	2.54E+04	0.19
14	0.014	0.011	0.000356	3.4780	2.76	0.04	0.02	0.0092	2.87E+04	0.17
15	0.016	0.017	0.000406	3.9748	2.95	0.05	0.03	0.0113	3.07E+04	0.22
16	0.018	0.022	0.000457	4.4717	3.13	0.06	0.04	0.0130	3.25E+04	0.25
17	0.021	0.026	0.000533	5.2170	3.38	0.06	0.04	0.0144	3.52E+04	0.25
18	0.023	0.033	0.000584	5.7138	3.54	0.08	0.06	0.0169	3.68E+04	0.28
19	0.026	0.039	0.000660	6.4591	3.77	0.08	0.06	0.0190	3.91E+04	0.29
20	0.031	0.045	0.000787	7.7012	4.11	0.09	0.07	0.0211	4.27E+04	0.28
21	0.034	0.051	0.000864	8.4465	4.31	0.10	0.08	0.0232	4.47E+04	0.29
22	0.038	0.058	0.000965	9.4402	4.55	0.11	0.09	0.0257	4.73E+04	0.29
23	0.042	0.067	0.001067	10.4339	4.79	0.13	0.10	0.0289	4.97E+04	0.27
24	0.046	0.072	0.001168	11.4276	5.01	0.14	0.12	0.0306	5.20E+04	0.29
25	0.049	0.082	0.001245	12.1729	5.17	0.15	0.12	0.0341	5.37E+04	0.29
26	0.052	0.087	0.001321	12.9182	5.33	0.16	0.13	0.0359	5.53E+04	0.29
27	0.059	0.095	0.001499	14.6572	5.67	0.17	0.14	0.0387	5.89E+04	0.28
28	0.063	0.102	0.001600	15.6509	5.86	0.18	0.15	0.0412	6.09E+04	0.28
29	0.070	0.110	0.001778	17.3899	6.18	0.20	0.17	0.0440	6.42E+04	0.28
30	0.075	0.118	0.001905	18.6320	6.40	0.21	0.18	0.0468	6.64E+04	0.28
31	0.079	0.124	0.002007	19.6257	6.56	0.22	0.19	0.0489	6.82E+04	0.28
32	0.086	0.131	0.002184	21.3647	6.85	0.23	0.20	0.0514	7.11E+04	0.27
33	0.089	0.139	0.002261	22.1100	6.97	0.24	0.21	0.0542	7.24E+04	0.28
34	0.098	0.148	0.002489	24.3458	7.31	0.26	0.23	0.0574	7.59E+04	0.27
35	0.101	0.160	0.002565	25.0911	7.42	0.27	0.23	0.0616	7.71E+04	0.27
36	0.111	0.165	0.002819	27.5753	7.78	0.28	0.24	0.0634	8.08E+04	0.25
37	0.116	0.172	0.002946	28.8175	7.95	0.29	0.25	0.0658	8.26E+04	0.25
38	0.120	0.180	0.003048	29.8112	8.09	0.31	0.27	0.0686	8.40E+04	0.26
39	0.131	0.190	0.003327	32.5439	8.45	0.32	0.28	0.0722	8.78E+04	0.25
40	0.138	0.200	0.003505	34.2829	8.68	0.34	0.30	0.0757	9.01E+04	0.25
42	0.152	0.217	0.003861	37.7608	9.10	0.36	0.31	0.0817	9.46E+04	0.24
44	0.166	0.237	0.004216	41.2388	9.52	0.39	0.34	0.0887	9.88E+04	0.24
46	0.180	0.257	0.004572	44.7168	9.91	0.43	0.38	0.0957	1.03E+05	0.24
48	0.199	0.272	0.005055	49.4369	10.42	0.45	0.39	0.1010	1.08E+05	0.23
50	0.218	0.288	0.005537	54.1570	10.90	0.47	0.41	0.1066	1.13E+05	0.22

Drag Quantifcation --- Original Aerobody, No Boom, With Tape --- Trial 2

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78	kPa
T	298.6	K
ρ air	0.911	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.008	0.003	0.000203	1.9874	2.09	0.03	0.01	0.0063	2.17E+04	0.12
11	0.009	0.004	0.000229	2.2358	2.22	0.03	0.01	0.0067	2.30E+04	0.13
12	0.011	0.006	0.000279	2.7327	2.45	0.03	0.01	0.0074	2.54E+04	0.14
13	0.012	0.011	0.000305	2.9811	2.56	0.04	0.02	0.0092	2.66E+04	0.20
14	0.013	0.014	0.000330	3.2295	2.66	0.05	0.03	0.0102	2.77E+04	0.23
15	0.018	0.020	0.000457	4.4717	3.13	0.05	0.03	0.0123	3.25E+04	0.23
16	0.019	0.024	0.000483	4.7201	3.22	0.06	0.04	0.0137	3.34E+04	0.25
17	0.020	0.028	0.000508	4.9685	3.30	0.07	0.05	0.0151	3.43E+04	0.28
18	0.022	0.034	0.000559	5.4654	3.46	0.08	0.06	0.0172	3.60E+04	0.30
19	0.025	0.039	0.000635	6.2107	3.69	0.08	0.06	0.0190	3.84E+04	0.30
20	0.030	0.045	0.000762	7.4528	4.04	0.09	0.07	0.0211	4.20E+04	0.29
21	0.033	0.051	0.000838	8.1981	4.24	0.10	0.08	0.0232	4.41E+04	0.29
22	0.039	0.061	0.000991	9.6886	4.61	0.12	0.10	0.0267	4.79E+04	0.30
23	0.041	0.068	0.001041	10.1855	4.73	0.13	0.10	0.0292	4.91E+04	0.28
24	0.046	0.073	0.001168	11.4276	5.01	0.14	0.12	0.0310	5.20E+04	0.30
25	0.051	0.080	0.001295	12.6698	5.27	0.15	0.12	0.0334	5.48E+04	0.27
26	0.053	0.088	0.001346	13.1666	5.38	0.16	0.13	0.0363	5.58E+04	0.29
27	0.059	0.095	0.001499	14.6572	5.67	0.17	0.14	0.0387	5.89E+04	0.28
28	0.062	0.105	0.001575	15.4024	5.82	0.19	0.16	0.0422	6.04E+04	0.30
29	0.069	0.112	0.001753	17.1414	6.13	0.20	0.17	0.0447	6.37E+04	0.28
30	0.071	0.119	0.001803	17.6383	6.22	0.21	0.18	0.0472	6.46E+04	0.29
31	0.078	0.126	0.001981	19.3773	6.52	0.22	0.19	0.0496	6.77E+04	0.28
32	0.082	0.132	0.002083	20.3710	6.69	0.23	0.20	0.0517	6.95E+04	0.28
33	0.090	0.140	0.002286	22.3584	7.01	0.24	0.21	0.0546	7.28E+04	0.28
34	0.096	0.149	0.002438	23.8489	7.24	0.26	0.23	0.0577	7.52E+04	0.28
35	0.101	0.161	0.002565	25.0911	7.42	0.28	0.24	0.0619	7.71E+04	0.27
36	0.111	0.166	0.002819	27.5753	7.78	0.28	0.24	0.0637	8.08E+04	0.26
37	0.114	0.173	0.002896	28.3206	7.89	0.29	0.25	0.0662	8.19E+04	0.26
38	0.121	0.182	0.003073	30.0596	8.12	0.31	0.27	0.0693	8.44E+04	0.26
39	0.130	0.193	0.003302	32.2954	8.42	0.33	0.29	0.0732	8.75E+04	0.26
40	0.138	0.200	0.003505	34.2829	8.68	0.34	0.30	0.0757	9.01E+04	0.25
42	0.149	0.219	0.003785	37.0155	9.01	0.37	0.32	0.0824	9.36E+04	0.25
44	0.163	0.237	0.004140	40.4935	9.43	0.39	0.34	0.0887	9.79E+04	0.25
46	0.178	0.258	0.004521	44.2199	9.85	0.43	0.38	0.0961	1.02E+05	0.25
48	0.198	0.274	0.005029	49.1884	10.39	0.45	0.39	0.1017	1.08E+05	0.23
50	0.213	0.290	0.005410	52.9148	10.78	0.48	0.42	0.1073	1.12E+05	0.23

Drag Quantifcation --- Original Aerobody, No Boom, With Tape --- Trial 3

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78	kPa
T	298.6	K
ρ air	0.911	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.006	0.017	0.000152	1.4906	1.81	0.03	0.01	0.0060	1.88E+04	0.13
11	0.008	0.021	0.000203	1.9874	2.09	0.03	0.01	0.0074	2.17E+04	0.19
12	0.009	0.024	0.000229	2.2358	2.22	0.04	0.02	0.0084	2.30E+04	0.23
13	0.011	0.028	0.000279	2.7327	2.45	0.04	0.02	0.0099	2.54E+04	0.25
14	0.013	0.031	0.000330	3.2295	2.66	0.05	0.03	0.0109	2.77E+04	0.26
15	0.018	0.037	0.000457	4.4717	3.13	0.06	0.04	0.0130	3.25E+04	0.25
16	0.019	0.042	0.000483	4.7201	3.22	0.07	0.05	0.0148	3.34E+04	0.28
17	0.020	0.048	0.000508	4.9685	3.30	0.08	0.06	0.0169	3.43E+04	0.32
18	0.022	0.057	0.000559	5.4654	3.46	0.09	0.07	0.0201	3.60E+04	0.37
19	0.029	0.062	0.000737	7.2044	3.98	0.10	0.08	0.0218	4.13E+04	0.31
20	0.030	0.068	0.000762	7.4528	4.04	0.11	0.09	0.0239	4.20E+04	0.34
21	0.033	0.075	0.000838	8.1981	4.24	0.12	0.10	0.0264	4.41E+04	0.34
22	0.039	0.083	0.000991	9.6886	4.61	0.13	0.11	0.0292	4.79E+04	0.33
23	0.041	0.089	0.001041	10.1855	4.73	0.14	0.11	0.0313	4.91E+04	0.31
24	0.045	0.094	0.001143	11.1792	4.95	0.15	0.13	0.0331	5.15E+04	0.33
25	0.050	0.102	0.001270	12.4213	5.22	0.16	0.13	0.0359	5.42E+04	0.30
26	0.053	0.110	0.001346	13.1666	5.38	0.17	0.14	0.0387	5.58E+04	0.31
27	0.059	0.118	0.001499	14.6572	5.67	0.18	0.15	0.0415	5.89E+04	0.31
28	0.061	0.126	0.001549	15.1540	5.77	0.20	0.17	0.0443	5.99E+04	0.32
29	0.068	0.132	0.001727	16.8930	6.09	0.21	0.18	0.0465	6.33E+04	0.30
30	0.072	0.139	0.001829	17.8867	6.27	0.22	0.19	0.0489	6.51E+04	0.30
31	0.079	0.148	0.002007	19.6257	6.56	0.23	0.20	0.0521	6.82E+04	0.30
32	0.082	0.153	0.002083	20.3710	6.69	0.24	0.21	0.0539	6.95E+04	0.30
33	0.090	0.161	0.002286	22.3584	7.01	0.25	0.22	0.0567	7.28E+04	0.29
34	0.098	0.173	0.002489	24.3458	7.31	0.27	0.24	0.0609	7.59E+04	0.29
35	0.100	0.182	0.002540	24.8426	7.39	0.28	0.24	0.0641	7.67E+04	0.29
36	0.109	0.187	0.002769	27.0785	7.71	0.29	0.25	0.0658	8.01E+04	0.27
37	0.113	0.195	0.002870	28.0722	7.85	0.31	0.27	0.0686	8.15E+04	0.27
38	0.119	0.204	0.003023	29.5628	8.06	0.32	0.28	0.0718	8.37E+04	0.27
39	0.129	0.214	0.003277	32.0470	8.39	0.34	0.30	0.0753	8.71E+04	0.27
40	0.138	0.224	0.003505	34.2829	8.68	0.35	0.31	0.0788	9.01E+04	0.26
42	0.149	0.240	0.003785	37.0155	9.01	0.38	0.33	0.0845	9.36E+04	0.25
44	0.161	0.259	0.004089	39.9967	9.37	0.41	0.36	0.0912	9.73E+04	0.26
46	0.181	0.278	0.004597	44.9652	9.94	0.44	0.39	0.0978	1.03E+05	0.25
48	0.197	0.295	0.005004	48.9400	10.37	0.46	0.40	0.1038	1.08E+05	0.24
50	0.218	0.311	0.005537	54.1570	10.90	0.49	0.43	0.1095	1.13E+05	0.23

Drag Quantifcation --- Original Aerobody, No Boom, With Tape --- Trial 4

Calibration:		
	0.6387	V/N
	1.566	N/V
Conversions and atmo. data:		
	0.2248	lbf/N
P	78	kPa
T	298.6	K
ρ air	0.911	kg/m^3
ρ water	997	kg/m^3
μ	1.84E-05	kg/m*s
D	0.2098	m
A	0.0346	

Equations:

$$Re = \frac{\rho V D}{\mu}$$

$$F_D = \frac{1}{2}\rho V^2 C_D A$$

$$C_D = \frac{F_D}{0.5\rho V^2 A}$$

Frequency (hz)	delta H [in]	Voltage [V]	delta H [m]	del P	Wind Velocity [m/s]	Calculated Drag [N]	Net Drag [N]	Calculated Drag [lb_f]	Re-Mano	Drag Coefficient
10	0.006	0.020	0.000152	1.4906	1.81	0.03	0.01	0.0070	1.88E+04	0.22
11	0.009	0.025	0.000229	2.2358	2.22	0.04	0.02	0.0088	2.30E+04	0.25
12	0.010	0.029	0.000254	2.4843	2.34	0.05	0.03	0.0102	2.43E+04	0.30
13	0.011	0.035	0.000279	2.7327	2.45	0.05	0.03	0.0123	2.54E+04	0.37
14	0.013	0.039	0.000330	3.2295	2.66	0.06	0.04	0.0137	2.77E+04	0.37
15	0.018	0.046	0.000457	4.4717	3.13	0.07	0.05	0.0162	3.25E+04	0.34
16	0.019	0.053	0.000483	4.7201	3.22	0.08	0.06	0.0187	3.34E+04	0.39
17	0.020	0.055	0.000508	4.9685	3.30	0.09	0.07	0.0194	3.43E+04	0.38
18	0.022	0.067	0.000559	5.4654	3.46	0.10	0.08	0.0236	3.60E+04	0.45
19	0.027	0.069	0.000686	6.7075	3.84	0.11	0.09	0.0243	3.99E+04	0.38
20	0.031	0.074	0.000787	7.7012	4.11	0.12	0.10	0.0260	4.27E+04	0.36
21	0.038	0.081	0.000965	9.4402	4.55	0.13	0.11	0.0285	4.73E+04	0.33
22	0.039	0.088	0.000991	9.6886	4.61	0.14	0.12	0.0310	4.79E+04	0.35
23	0.041	0.092	0.001041	10.1855	4.73	0.14	0.11	0.0324	4.91E+04	0.32
24	0.048	0.099	0.001219	11.9245	5.12	0.16	0.14	0.0348	5.31E+04	0.33
25	0.051	0.108	0.001295	12.6698	5.27	0.17	0.14	0.0380	5.48E+04	0.32
26	0.054	0.115	0.001372	13.4150	5.43	0.18	0.15	0.0405	5.64E+04	0.32
27	0.060	0.124	0.001524	14.9056	5.72	0.19	0.16	0.0436	5.94E+04	0.32
28	0.062	0.131	0.001575	15.4024	5.82	0.21	0.18	0.0461	6.04E+04	0.33
29	0.068	0.140	0.001727	16.8930	6.09	0.22	0.19	0.0493	6.33E+04	0.32
30	0.071	0.148	0.001803	17.6383	6.22	0.23	0.20	0.0521	6.46E+04	0.33
31	0.078	0.151	0.001981	19.3773	6.52	0.24	0.21	0.0531	6.77E+04	0.31
32	0.083	0.156	0.002108	20.6194	6.73	0.24	0.21	0.0549	6.99E+04	0.30
33	0.090	0.165	0.002286	22.3584	7.01	0.26	0.23	0.0581	7.28E+04	0.30
34	0.095	0.174	0.002413	23.6005	7.20	0.27	0.24	0.0612	7.48E+04	0.30
35	0.100	0.186	0.002540	24.8426	7.39	0.29	0.25	0.0655	7.67E+04	0.29
36	0.109	0.191	0.002769	27.0785	7.71	0.30	0.26	0.0672	8.01E+04	0.28
37	0.112	0.197	0.002845	27.8238	7.82	0.31	0.27	0.0693	8.12E+04	0.28
38	0.120	0.203	0.003048	29.8112	8.09	0.32	0.28	0.0714	8.40E+04	0.27
39	0.128	0.213	0.003251	31.7986	8.36	0.33	0.29	0.0750	8.68E+04	0.27
40	0.136	0.224	0.003454	33.7860	8.61	0.35	0.31	0.0788	8.95E+04	0.27
42	0.149	0.241	0.003785	37.0155	9.01	0.38	0.33	0.0848	9.36E+04	0.26
44	0.162	0.261	0.004115	40.2451	9.40	0.41	0.36	0.0919	9.76E+04	0.26
46	0.181	0.277	0.004597	44.9652	9.94	0.43	0.38	0.0975	1.03E+05	0.25
48	0.198	0.296	0.005029	49.1884	10.39	0.46	0.40	0.1042	1.08E+05	0.24
50	0.218	0.312	0.005537	54.1570	10.90	0.49	0.43	0.1098	1.13E+05	0.23