

Experimental comparison of NACA airfoils and KFm-2 variants using wind tunnel
testing to analyze lift and drag characteristics

by

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Abstract

Kline-Fogleman airfoils were created in the hopes of creating an airplane that could handle turbulence, climb higher, and recover after stalling. Experimental research was conducted in order to better understand how the Kline-Fogleman step feature affects NACA airfoils; in particular, their lift, drag, and stall characteristics. A simplified airfoil theory can be used to determine lift, drag and pitching characteristics of standard airfoils. One goal of this work was to see how accurate this simple theory is when dealing with more complex airfoil profiles, and to see if an effective camber could be determined as a useful parameter or characteristic. Various airfoils (NACA 0012, KFm 0012, NACA 4412, and KFm 4412) were made utilizing the concept of rapid prototyping to determine the best settings and orientation for the final wings, which were designed and 3-D printed using ASA plastic. The testing was conducted in an Aerolab wind tunnel, which was instrumented with an electronic strain gauge balance and generated with a LabVIEW interface. The wind tunnel allowed for the opportunity to compare the calculated lift, drag and pitching moment, with experimental results that were obtained over a range of angles of attack and two different airspeeds. This project demonstrated the possibility of determining basic lift and drag values for more complex airfoil shapes that contain unique features like the KFm steps. No evidence was found to conclude that KFm airfoil provided better flight characteristics. A simplified theory calculated the effective camber height of the KFm airfoils to within 0.03 and 0.06 inches of the NACA variants' camber height. This caused the zero-lift angle of attack to be greater for the KFm wings versus the NACA wings.

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List of Abbreviations

CAD	Computer-Aided Design
KFm	Kline-Fogleman modified
KSU	Kansas State University
MNE	Mechanical and Nuclear Engineering
NACA	National Advisory Committee for Aeronautics
NGML	National Gas Machinery Laboratory
SAE	Society of Automotive Engineers

Nomenclature

α	Angle of Attack
α_{eff}	Effective Angle of Attack
α_{zl}	Zero Lift Angle of Attack
ρ	Density
A	Axial Force
A_c	Corrected Axial Force
A_{calc}	Calculated Axial Force
A_r	Raw Axial Force
A_t	True Axial Force
AR	Aspect Ratio
b	Wingspan
c	Chord Length
C_{ij}	Calibration Matrix Variable
C_D	Coefficient of Drag
C_d	Coefficient of Section Drag
C_L	Coefficient of Lift
C_l	Coefficient of Section Lift
D	Drag Force
g	Gravity
h	Maximum Camber Height
h_{Hg}	Height of Mercury
L	Lift Force

L/D	Lift to Drag Ratio
M	Moment
M_c	Corrected Moment
M_{calc}	Calculated Moment
M_{no}	Moment with no flow
M_r	Raw Moment
M_t	True Moment
N	Normal Force
N_c	Corrected Normal Force
N_{calc}	Calculated Normal Force
N_r	Raw Normal Force
N_t	True Normal Force
P	Pressure
q_∞	Dynamic Pressure
R	Reynolds Number
S	Planform Area
T	Temperature
V	Velocity
W	Weight

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Chapter 1 - Introduction and Background

1.1 Introduction

Ever since Orville and Wilbur Wright completed their first flight of 120 feet on December 17, 1903, engineers and scientists have been advancing the understanding of aerodynamics and innovating the world of aviation. The basic concept of propelled flight is that lift needs to be greater than gravity and thrust needs to be greater than drag. One of the biggest factors of creating lift and reducing drag is the design of the aircraft and the profile of its wings, specifically the shape of the wing and it's the airfoil profile.

1.1.1 Airfoil Basics

For this work, the two main aerodynamic airfoil parameters that will be focused on are the configuration geometry (the wing and airfoil shape) and angle of attack (α). Figure 1.1 shows the different terminology and their respective locations [1]. Figure 1.2 shows how the dimensions of the wing are measured and referred.

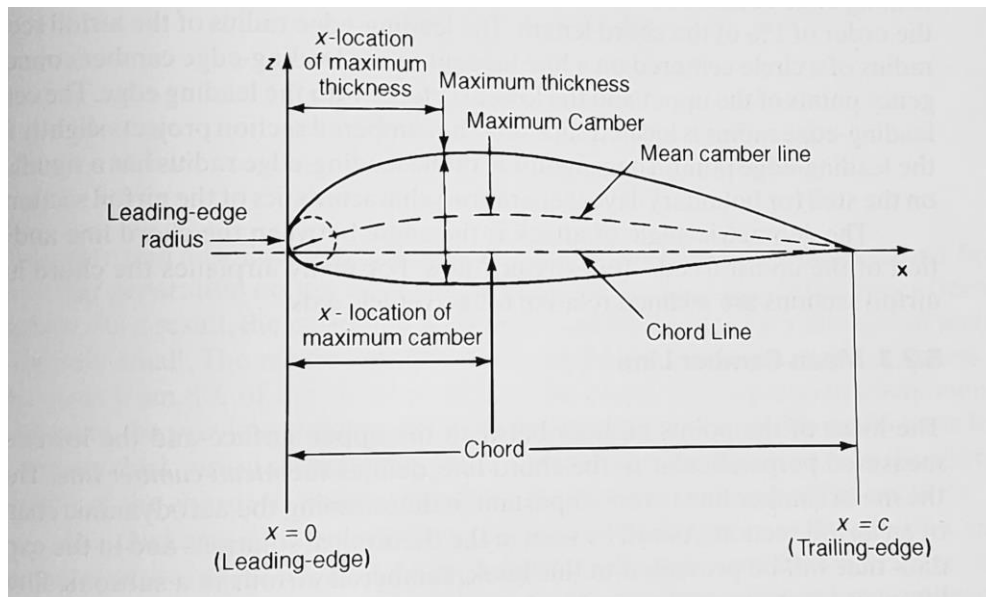


Figure 1.1 - Airfoil Geometry Nomenclature [1]

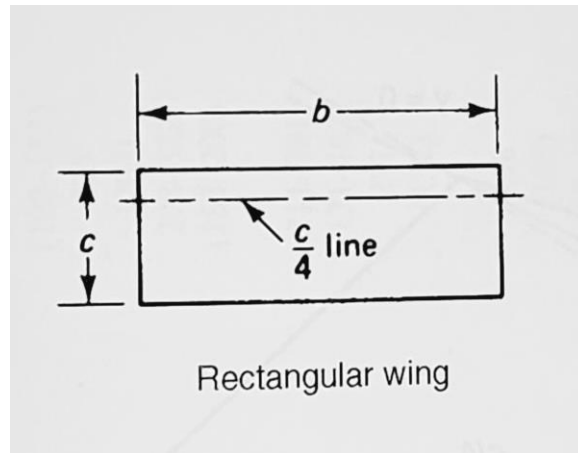


Figure 1.2 - Rectangular Wing Planform Area [1]

The angle of attack is the angle that is formed between the chord line and the flow direction. For an aircraft, this can be altered by the pilot pitching the nose of the plane up or down. For testing, this can be altered by rotating the orientation of the wing attached to a balance or sting to change the pitch of the airfoil. The angle of attack is important because the lift and drag forces of the airfoil or vehicle are dependent on this value.

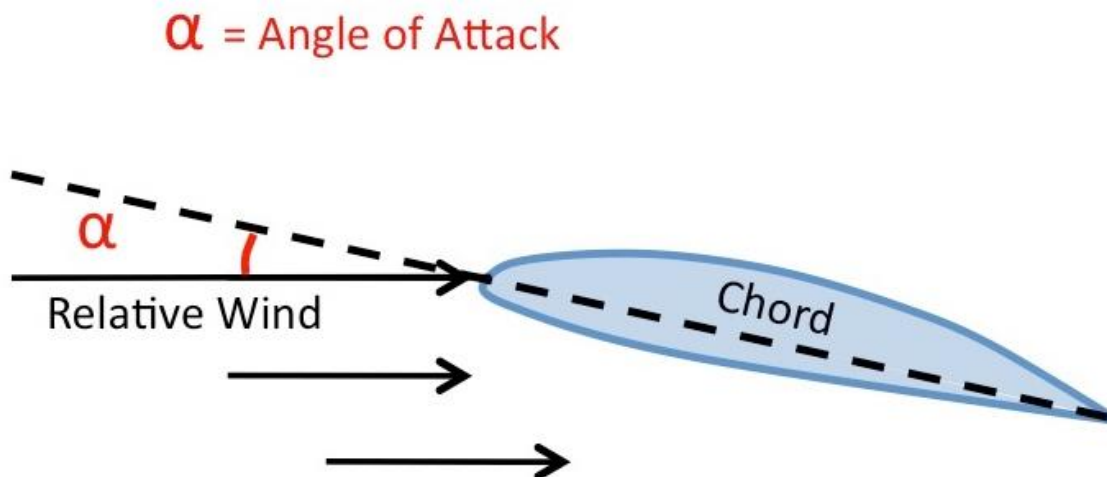


Figure 1.3 - Angle of Attack [2]

1.2 History of NACA & KFm Airfoils

1.2.1 National Advisory Committee for Aeronautics (NACA)

In 1915 the United States created the National Advisory Committee for Aeronautics (NACA) to oversee and promote aeronautical research [3]. Understanding flight dynamics and improving aircraft design were their main priorities. Many military and civilian aircraft have been designed with a standard reference of airfoils; the NACA airfoils. This system was developed in the 1930s and it provided a systematic way to design and refer to airfoils for their aerodynamic properties.

1.2.1.1 Classification of NACA

The NACA classification of airfoils that was used for this experiment was the NACA four—digit airfoil designation [4]. The standard format of this classification is NACA $X_1X_2X_3X_4$ where the X_i 's are different integers. The first integer, X_1 , indicates the maximum camber in terms of percent of the chord length. The second integer, X_2 , tells the distance from the leading edge to the maximum camber, expressed in tenths of the chord. The last two digits, X_3 and X_4 , indicate the maximum thickness of the airfoil in percent of the chord. For example, the NACA 4412 airfoil that was used for testing had a maximum camber of 4% (1st digit, X_1), the maximum camber was located at 40% of the chord (2nd digit, X_2) and has an overall thickness of 12% of the chord (3rd and 4th digits, X_3 and X_4).

1.2.2 Kline-Fogleman Modified (KFm)

The Kline-Fogleman modified airfoils were created by Richard Kline and Floyd Fogleman in the 1960s [5]. They were originally devised for the purpose of creating superior paper airplanes but have since attracted the interests of radio-controlled aircraft hobbyists and designers of small unmanned aerial vehicles [6]. One of the hopes for these airfoils is to fly for

long distances regardless of turbulence, to resist stalling, and to self-level into a glide [7]. The reasoning for the stepped profiles, as claimed by Kline and Fogleman, is to allow for a portion of the air to be displaced into the pockets so that the trapped vortex air becomes a part of the airfoil shape. This would allow the airfoil to maintain airflow over the surface and prevent the air from separating away from the airfoil.

Richard Kline wrote “The Ultimate Paper Airplane” where he describes the journey to creating a new airfoil set, the KFm set [5]. Richard Kline and Floyd Fogleman were eventually able to file for a patent pertaining to their stepped airfoils and patent no. 3,706,430 was granted in 1972.

1.2.2.1 Classification of KFm

Kline-Fogleman modified airfoils are numbered by the distinct cutout of the typical airfoil shape. If the cutout is located on the bottom of the airfoil, the airfoil is referred to as a KFm-1 airfoil and if the cutout is located on the top then it is a KFm-2 [8]. As shown in figure 1.4, there are numerous different profiles that KFm airfoils can take on, from having a single step cutout, multiple steps on the same side of the airfoil, and to having steps on both sides [9].

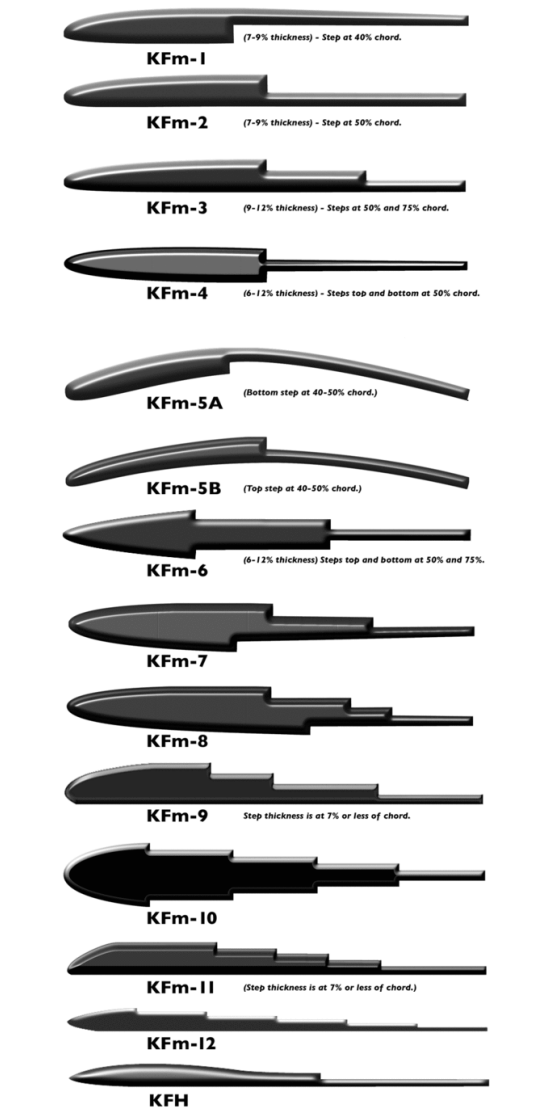


Figure 1.4 - KFm Family of Airfoils [10]

1.3 Aerodynamic Equations

Aerodynamic forces are produced when an airfoil is moved through a fluid or when air passes over an airfoil in a wind tunnel [11]. These forces can be separated into two components, lift perpendicular to the direction of the airflow and drag force which is parallel to the airflow direction [12]. Equations 1.1 to 1.12 show simple aerodynamic equations that convert airfoil parameters like chord length (c) and wingspan (b) to lift force (L) and coefficient of lift (C_L) [13]. When lift and drag are obtained through experimentation, it is possible to solve for the

effective chamber height (h). For equation 1.5, the effective angle of attack (α_{eff}) needs to be in units of degrees.

$$AR = \frac{b}{c} \quad \text{Equation 1.1}$$

$$S = b * c \quad \text{Equation 1.2}$$

$$\alpha_{zl} = -2 * \frac{h}{c} * \frac{180}{\pi} \quad \text{Equation 1.3}$$

$$\alpha_{eff} = \alpha - \alpha_{zl} = \alpha_{absolute} \quad \text{Equation 1.4}$$

$$C_L = \frac{2 * \pi^2}{180 * (1 + \frac{2}{AR})} * \alpha_{eff} \quad \text{Equation 1.5}$$

$$P_{atm} = \rho_{Hg} * g * h_{Hg} \quad \text{Equation 1.6}$$

$$R_{air} = \frac{R}{M_a} \quad \text{Equation 1.7}$$

$$\rho_{air} = \frac{P_{atm}}{R_{air} * T} \quad \text{Equation 1.8}$$

$$q_{\infty} = \frac{1}{2} * V^2 * \rho \quad \text{Equation 1.9}$$

$$C_L = \frac{L}{q_{\infty} * S} \quad \text{Equation 1.10}$$

$$C_D = C_d + \frac{C_L^2}{\pi * AR} \quad \text{Equation 1.11}$$

$$C_D = \frac{D}{q_{\infty} * S} \quad \text{Equation 1.12}$$

1.4 Scope & Structure of Work

The goal of this body of work is experimental in nature and involves the process of conducting experiments and collecting data. Theoretical analysis will be kept at a minimum and

only used to do simple comparison with the experimental results. The format of this paper will be adjusted accordingly. The chapters in this body of work will go over the basics of aerodynamics, 3-D printing, the process of prototyping, final airfoil construction, wind tunnel calibration, wind tunnel testing, data collection, and data analysis.

Chapter 2 - 3-D Airfoils

2.1 Computer Aided Design

Computer Aided Design (CAD) is a tool used by multiple industries to replace the process of hand drawing. Industries such as engineering, architecture, product design, and manufacturing utilize CAD to create precise drawings and technical illustrations [14]. Users are able to create two-dimensional drawings or three-dimensional models of their desired products. The benefits of CAD include enhanced accuracy, increased efficiency, improved visualization, adjustable parameters and simple comprehensive documentation. CAD also allows users to implement rapid prototyping strategies to seek innovation [15].

SolidWorks is a CAD software program widely used by engineers and product developers. It offers extensive features in three-dimensional modeling, allowing the user to create precise individual parts and then combine them into assemblies to visualize interactions. Using this tool gives professionals a chance to analyze their designs before the manufacturing process. SolidWorks is the main CAD software utilized by Kansas State University and was used to model the various airfoils for this experiment.

2.2 Selection of Airfoils

For the current experiments, KFM-2 variations of the selected NACA airfoils were used. These were identical to the NACA 0012 and the NACA 4412 except for the fact that these airfoils had steps that occurred at 50% of the chord length and 50% of the overall thickness. The wings used for testing had a finite AR of 3.75 but since the airfoil spanned the entire width of the wind tunnel, the airfoil provides information about the section characteristics due to the lack of a vortex system. Figures 2.1, 2.2, 2.3, and 2.4 show the entire airfoils and figures 2.5, 2.6, 2.7, and

2.8 show the wing profiles in blue. The chord line of each airfoil is in line with the sting insert and sting axis. Drawings for the four airfoils can be seen in appendix A.

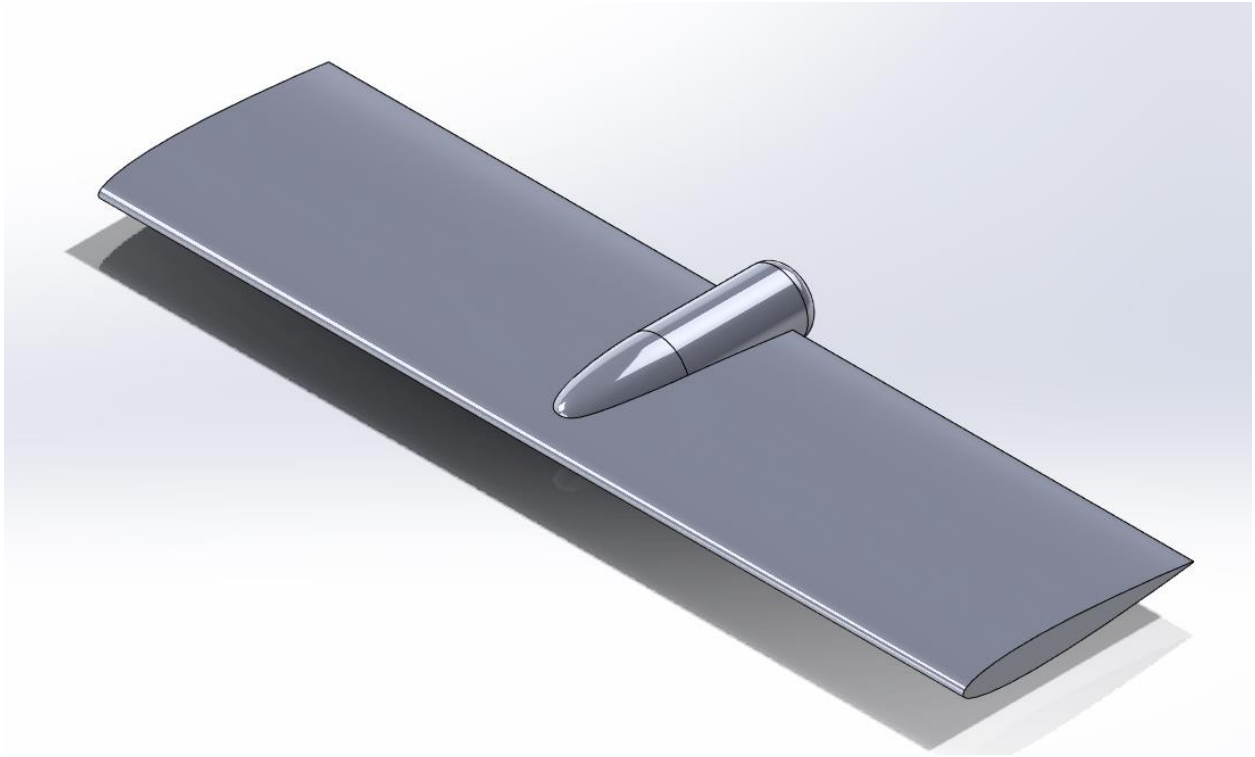


Figure 2.1 - NACA 0012 Airfoil

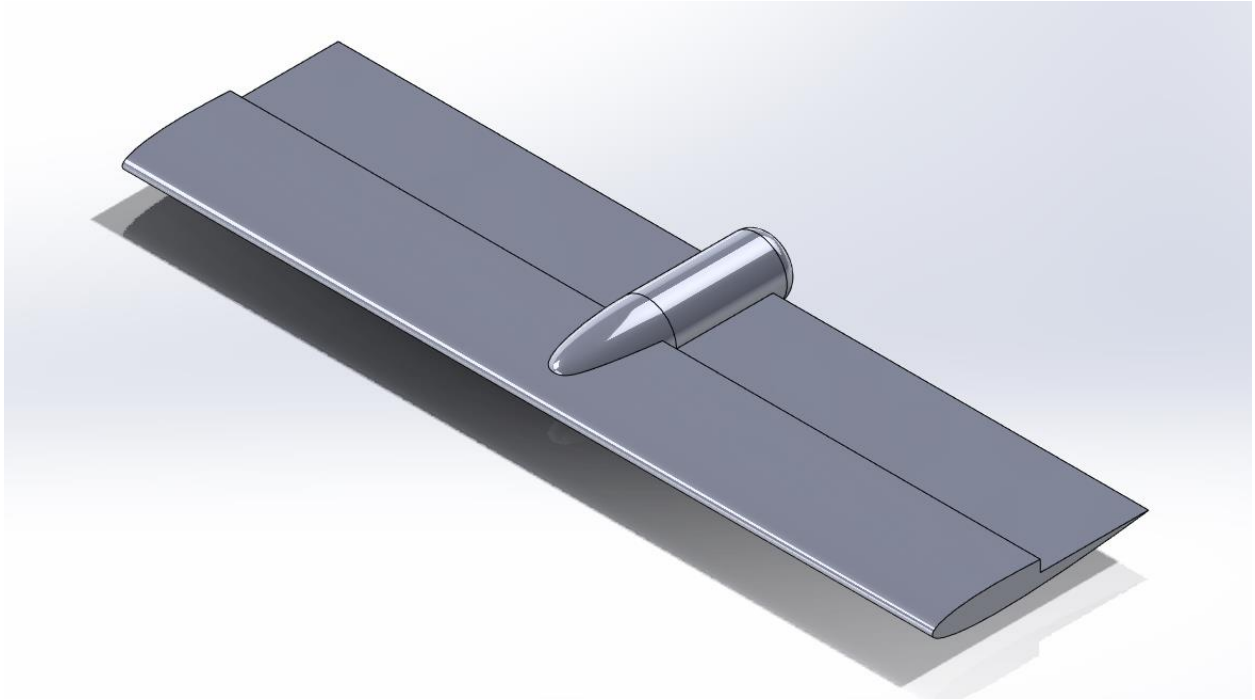


Figure 2.2 - KFm 0012 Airfoil

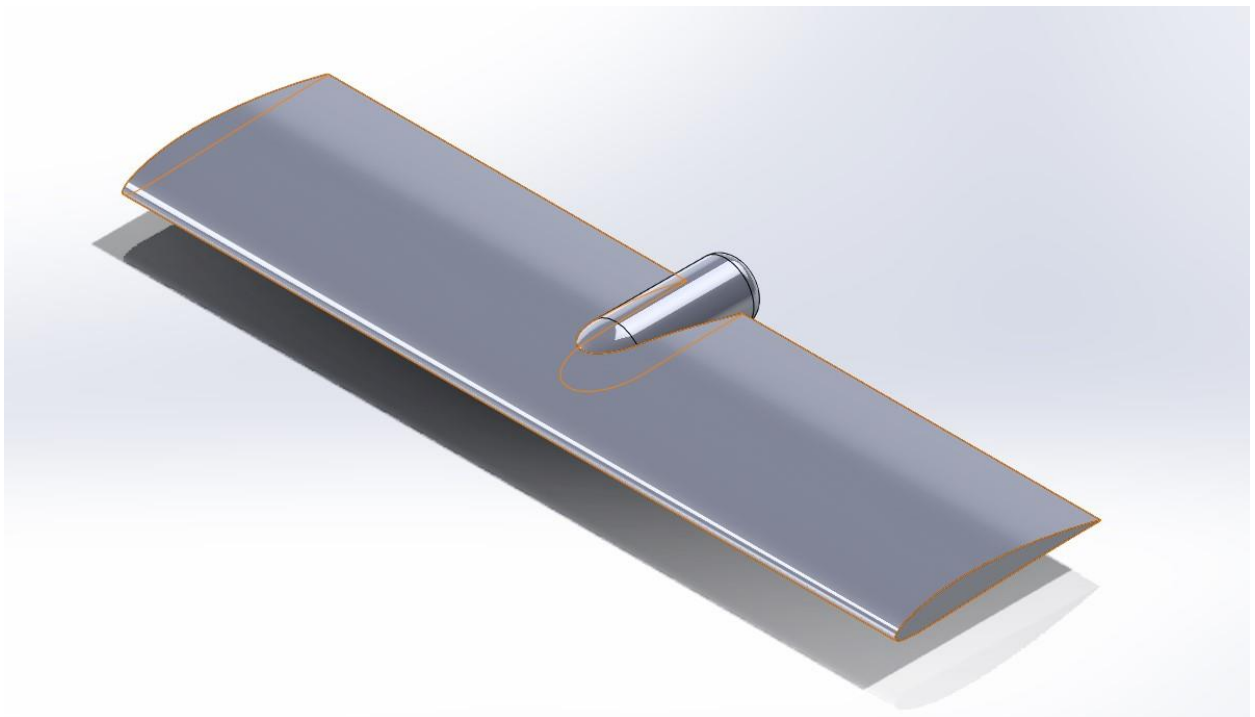


Figure 2.3 - NACA 4412 Airfoil

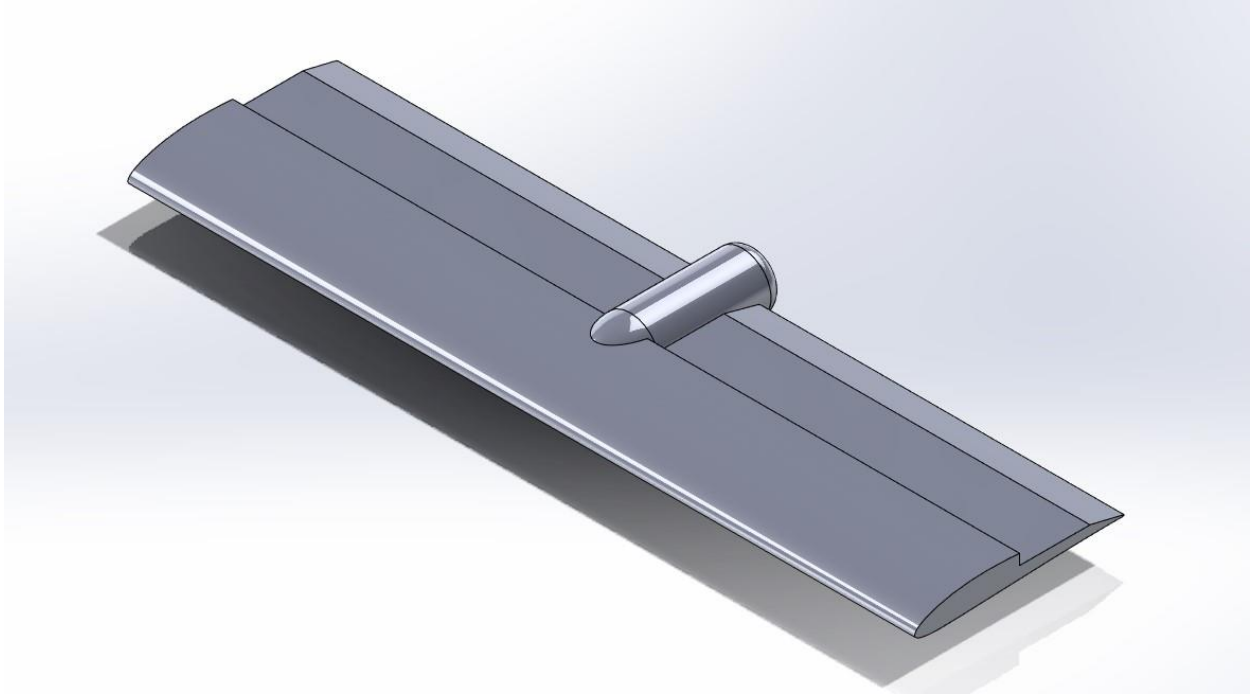


Figure 2.4 - KFm 4412 Airfoil

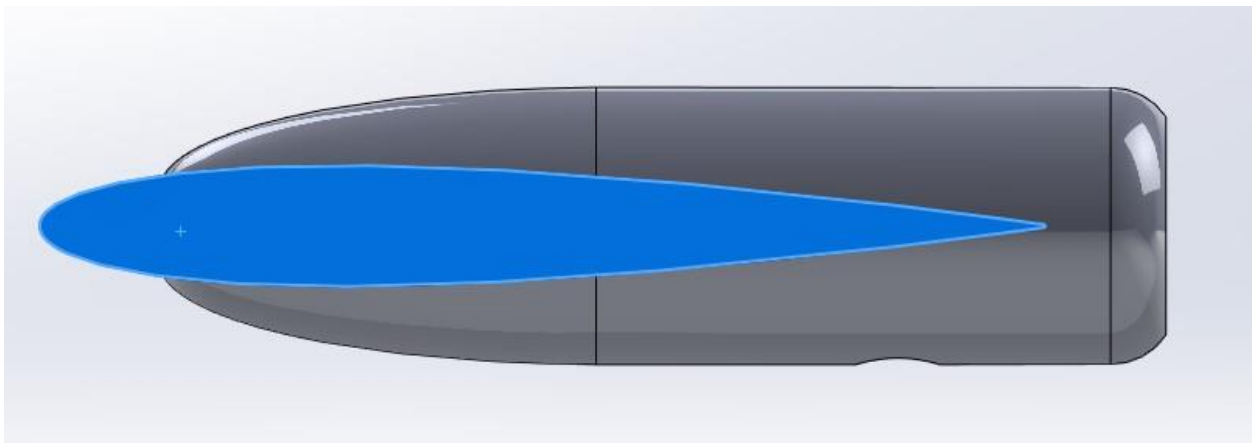


Figure 2.5 - NACA 0012 Profile

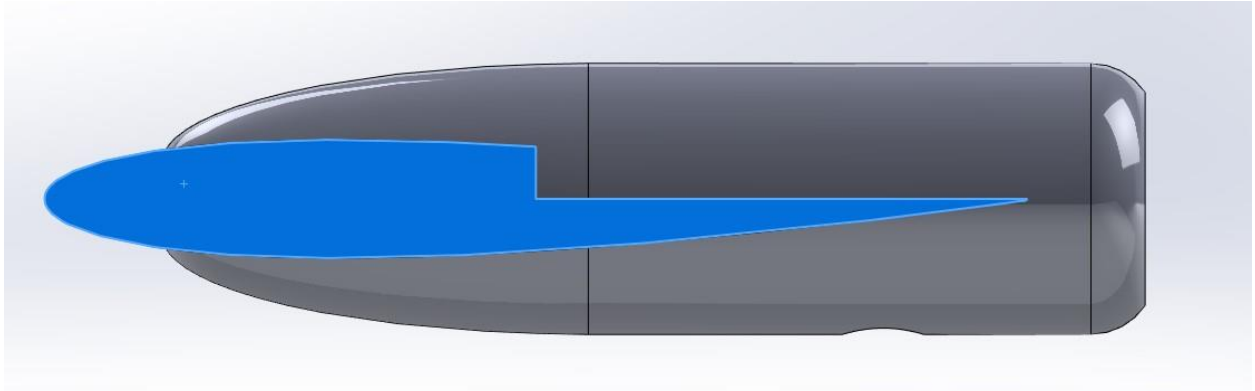


Figure 2.6 - KFm 0012 Profile

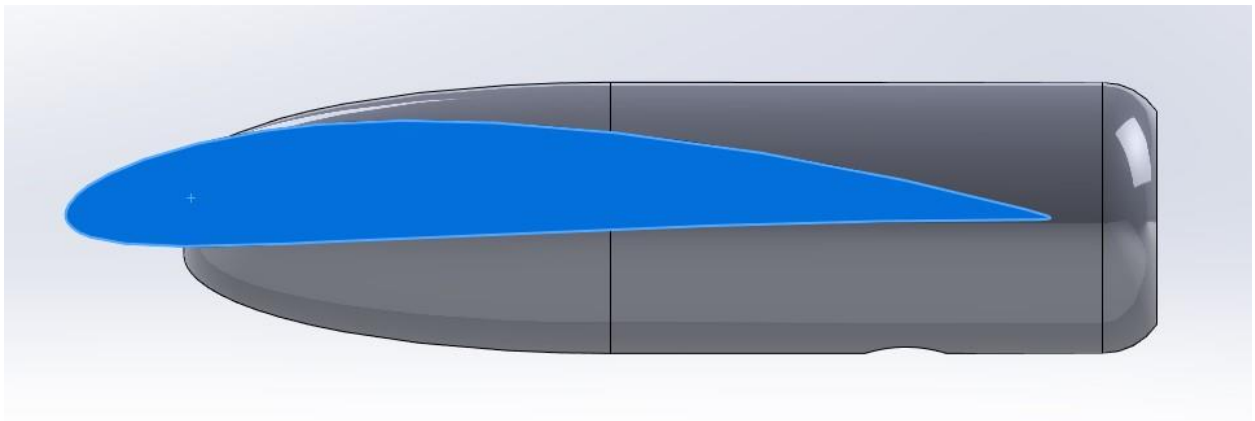


Figure 2.7 - NACA 4412 Profile

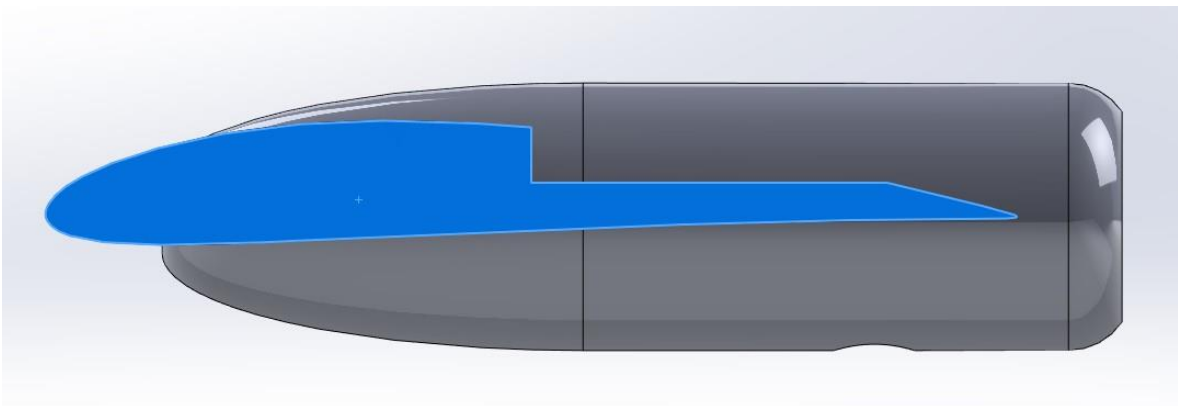


Figure 2.8 - KFm 4412 Profile

2.3 Sting Insert

In order for the airfoils to be attached to the sting (shown later in figure 3.4) inside of the wind tunnel, a sting insert (Figure 2.9) was created. This is an aluminum rod that gets fixed inside of the printed airfoils so they can be attached to the sting. The two important characteristics are the extruded cut so that it fits onto the sting and the set screw hole that allows the airfoil to be tightened for testing.



Figure 2.9 - Sting Insert

For the sting insert to be attached to an airfoil, a special addition had to be added to the airfoils. This is located in the center of the wingspan and in line with the chord line. Figure 2.10 shows an isolated insert pocket.

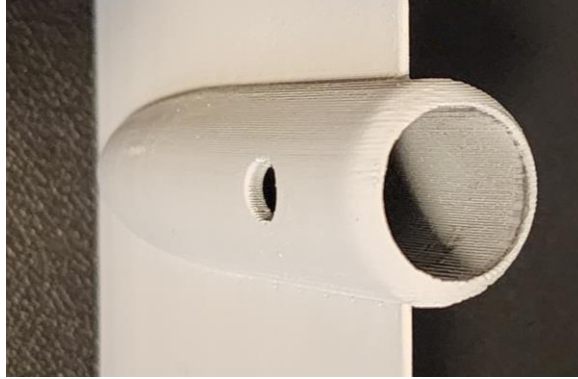


Figure 2.10 - Sting Insert Pocket

2.4 Maker Space Printing

Students in the Alan Levin Department of Mechanical and Nuclear Engineering (MNE) at Kansas State University have access to a room known as the MNE Maker Space. This space has a variety of tools for MNE students to use and gives the students access to 3-D printers. The 3-D printers in the MNE Maker Space are Original Prusa i3 MK3S with a 0.4-millimeter nozzle. These printers were utilized to do prototyping to make sure the correct dimensions were specified and to test different orientations.

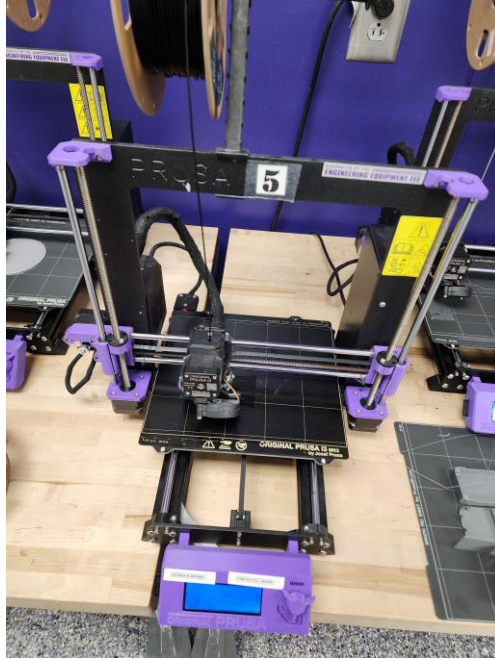


Figure 2.11 - MNE Maker Space 3-D Printers

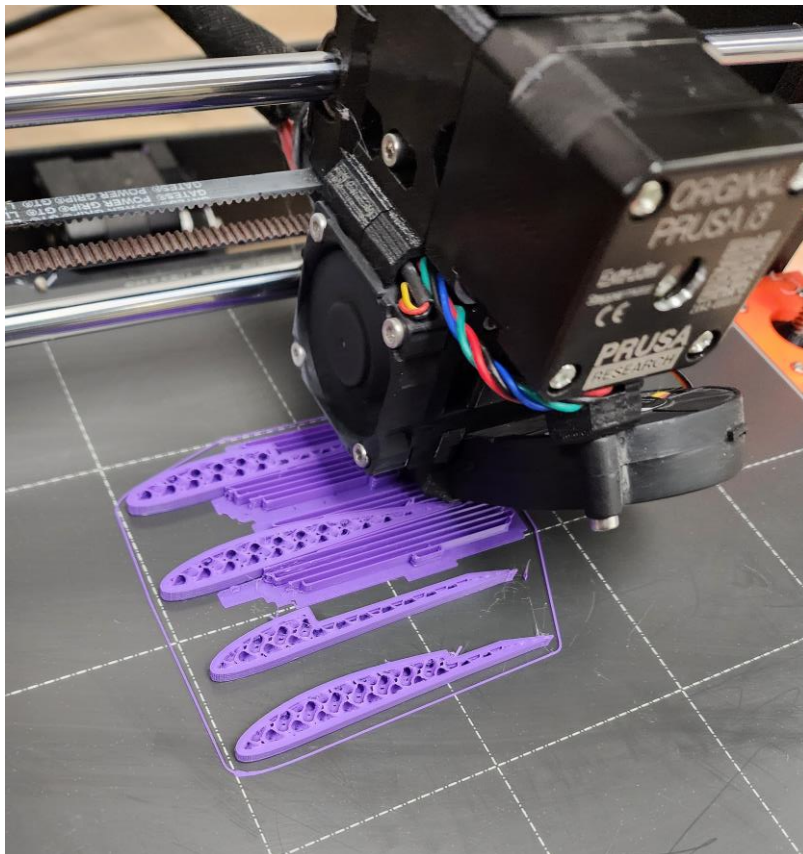


Figure 2.12. Test Printing

The biggest issues when creating the airfoils that were tested were the orientation and geometry of the prints [16]. Three main orientations were printed out in the MNE Maker Space and are as follows:

1. Lying flat on the printing surface (Figure 2.13)
2. Leading edge down on the printing surface (Figure 2.14)
 - a. The sting insert is shown in the figure to keep the airfoil from falling over.
3. Standing on its side on the printing surface (Figure 15)

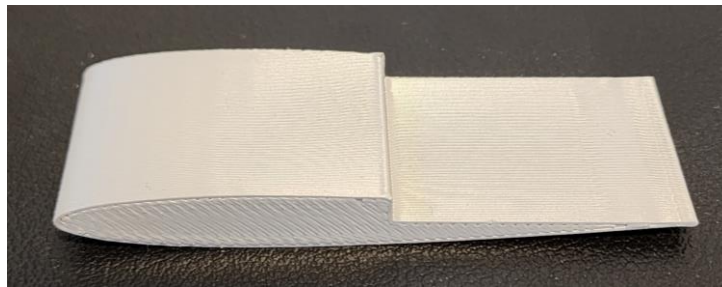


Figure 2.13 - Flat Printing Orientation

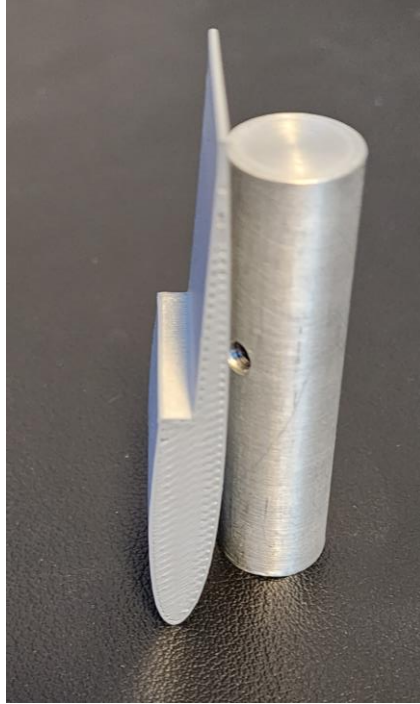


Figure 2.14 - Diving Printing Orientation

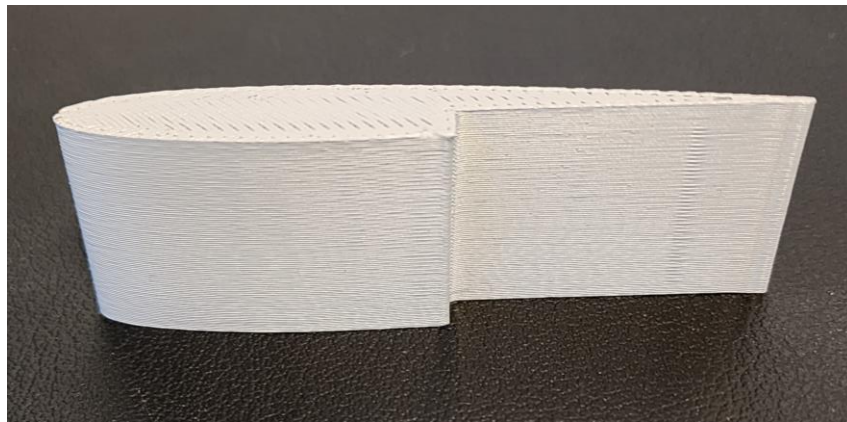


Figure 2.15 - Side Printing Orientation

The goal for this testing was to look at which orientation provided the most support for the print and more importantly which orientation provided the best print quality for this application. Printing orientation 2 was the least stable as a result of the orientation of curved edges. Orientation 3 provided the second most support since the contact with the printing platform was a flat surface. Orientation 1 provided the most support since it had the most area for

support to be attached to. Airfoils naturally have distinct curves at the leading edge which directly affect the flow of air around the airfoil. With that being a crucial part of the airfoils performance, careful consideration had to be given. Orientation 2 had the least smooth leading edge since it created a stepping profile. Orientation 1 had similar results due to the nature of the printing. Printing orientation 3 had the best result since the leading edge was uniform the entire length of the wingspan. In conclusion, printing the airfoils on their side provided the best foundation to create the airfoils.

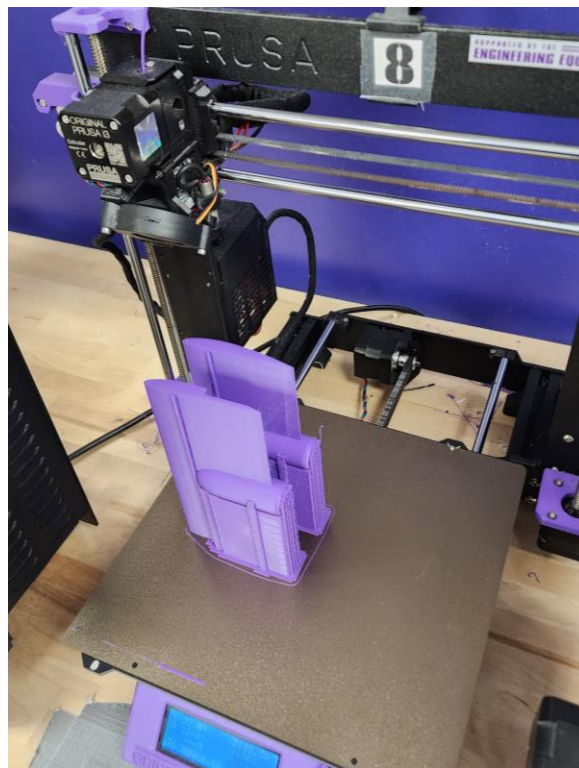


Figure 2.16 - Finished Test Print

2.5 Final Printing

In order to obtain airfoils that would span the entire width of the wind tunnel, a different printing setup needed to be used. A Stratasys Fortus 450mc 3-D production system (Figure 2.17) is available at Kansas State University. This printer prints two different materials simultaneously,

ASA Model filament and SR-30. The main 3-D print is made out of the ASA material and the supports are printed with the SR-30 material.



Figure 2.17 - Fortus 3-D Printer

The print contained all four airfoils (NACA 0012, NACA 4412, KFm 0012, KFm 4412) and two small test pieces to practice various finishes on. This process took 19 hours and 21 minutes while printing 1,130 layers. The material required was 26.6 in³ and 7.5 in³ for the main material and support material respectively. The printed airfoils can be seen in figure 2.18 and figure 2.19.

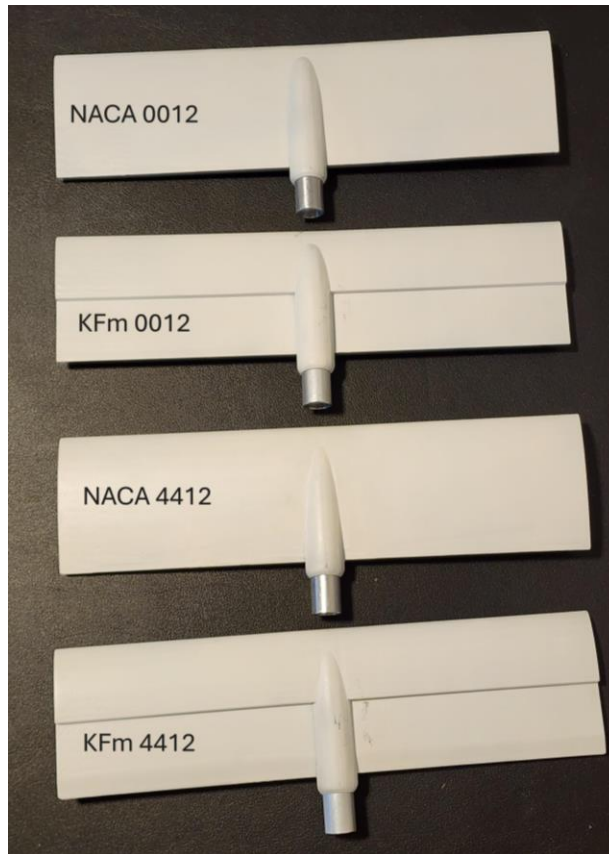


Figure 2.18 - All Four Airfoils

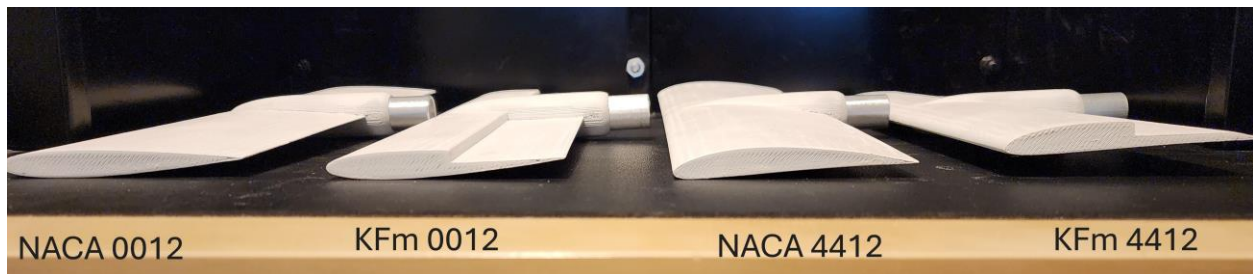


Figure 2.19 – End View of Wings

2.5.1 After Print Finishes

The Fortus printer prints the support material from SR-30, a soluble support material. The label of the support printing filament can be seen in figure 2.20. After the print is completed, the pieces were placed in a container (Figure 2.21) that contains a mixture of water and WaterWorks soluble concentrate P400SC, which is designed to dissolve 3-D printed supports made from SR-

30. The container is then heated to 70°C and the pieces are left in there until all of the support structures are dissolved. The airfoils and test pieces were kept in this solution for twelve hours to ensure all the supports were removed.



Figure 2.20 - Fortus Support Material



Figure 2.21 - Support Removal Apparatus

Even though the print quality from the Fortus printer was high quality, finishing touches were still required for the airfoils after the supports were removed. The airfoils were sanded with 220 grit sandpaper and then went over again with 320 grit sandpaper. This process was to remove any imperfections due to the printing and to make the surface area of the airfoils smoother [17]. As a final touch to the airfoil creation process, the four airfoils were coated with Krylon spray paint. As a final layer, the Krylon paint added another layer of smoothness as well as filling any gaps that could have been left behind by the printing and sanding. The various stages of the finishing process can be seen in figure 2.22, figure 2.23, figure 2.24, and, figure 2.25.

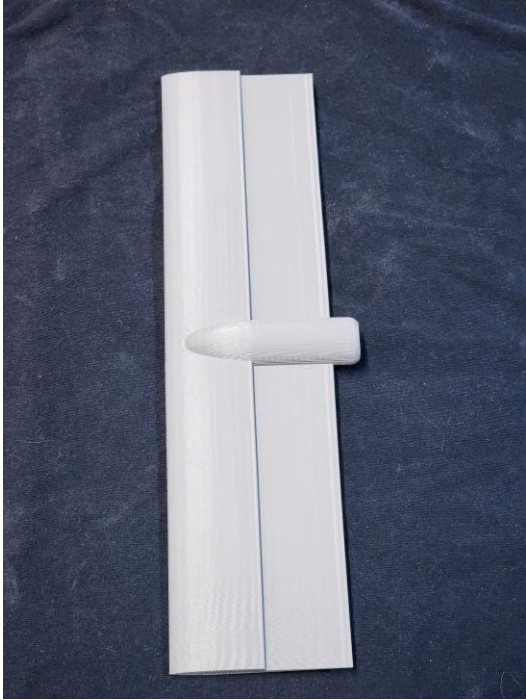


Figure 2.22 - Post Support Removal

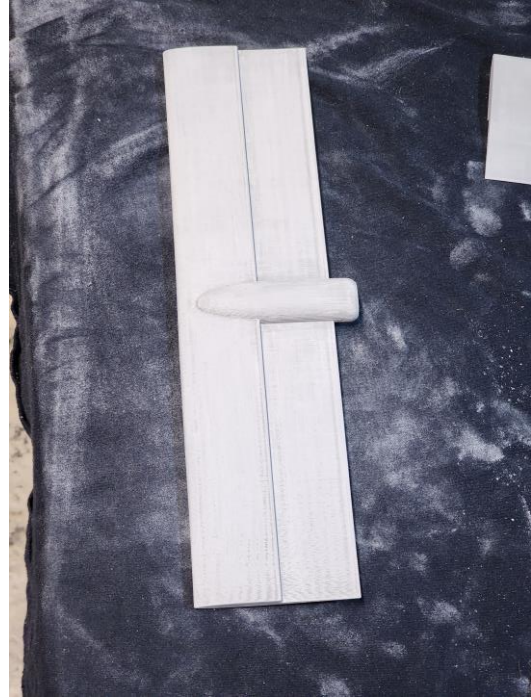


Figure 2.23 - Post 220 Grit

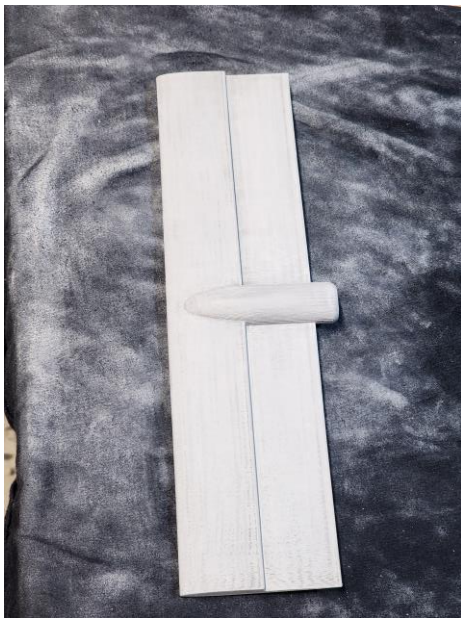


Figure 2.24 - Post 320 Grit



Figure 2.25 - Post Paint

Chapter 3 - Wind Tunnel Test Set Up

3.1 K-State's Wind Tunnel

3.1.1 Wind Tunnel History

The MNE Department's wind tunnel is currently located at the Natural Gas Machinery Laboratory (NGML) where it was recently moved from Ward Hall on the KSU campus. It has been used for various research and demonstration projects and in courses like aerodynamic and fluid mechanics. K-State's SAE Aero Design team has also used the wind tunnel to test out various aircraft models and wing profiles.



Figure 3.1 - Natural Gas Machinery Laboratory

3.1.2 Wind Tunnel Specifications

Kansas State University has an AEROLAB educational wind tunnel as seen in figure 3.2. It contains an electronic strain gage-based sting (balance) and has a turbulence level of less than 0.2%. While the turbulence could be measured and confirmed, it was beyond the scope of this work. This allows the wind tunnel to fall into the category of research grade equipment. The testing section (Figure 3.3) of the wind tunnel has dimensions of 24 inches long, 12 inches wide, and 12 inches tall. The sting, shown in Figure 3.4, can go from -30 degrees to 30 degrees. For these experiments, -16 and +22 degrees will be the range of angles used.



Figure 3.2 – AEROLAB Wind Tunnel



Figure 3.3 - Wind Tunnel Testing Section and Sting



Figure 3.4 - Sting

The wind tunnel can achieve air speeds of up to 145 mph. For this experiment two airspeeds will be tested: 50 mph and 70 mph $\pm$ 1 mph. The reason for this is that this change in air speed causes the dynamic pressure at 70 mph to be approximately double the dynamic pressure at 50 mph.

There are two main types of data that the wind tunnel collects, air flow data and sting balance data. The air flow data collects information about air moving through the tunnel. The three air measurements are wind speed in miles per hour (mph), pressure in pounds per square inch (psi) and angle relative to sting in degrees. The sting balance collects information about the physical or aerodynamic forces acting on the sting. The three measurements provided are normal force in pound force (lbf), axial force (lbf), and pitching moment in inch pound force (in-lbf). data collection is displayed on the user interface shown in figure 3.5 in white, green, and blue text respectively.



Figure 3.5 – AEROLAB LabVIEW User Interface

3.1.3 Wind Tunnel Calibration

Before the wind tunnel could be used for testing, it needed to be calibrated. For the purposes of the current experiments, three different calibration methods were used. One for the angle measurements and the other two for the normal force, axial force and moment readings.

3.1.3.1 Angle Calibration

In order to see how accurate the angle reading was on AEROLAB's user interface and to determine estimates of the measurement uncertainty, a calibration needed to be done. For this, a SmartTool level (Figure 3.6) was placed on top of the sting and the sting orientation was moved until the level displayed 0.0 degrees. After the system was zeroed, the sting was rotated towards the negative angles of attack. Once the level was at a whole integer (-1, -2, -3, etc.) the measurement the system showed was recorded. This went until a reading of -15 degrees was shown on the scale. The system was then incremented up until +15 degrees was shown. A graph

of the level's measurements and the system's measurements is shown in figure 3.7 and the differences in figure 3.8



Figure 3.6 - SmartTool Set-Up

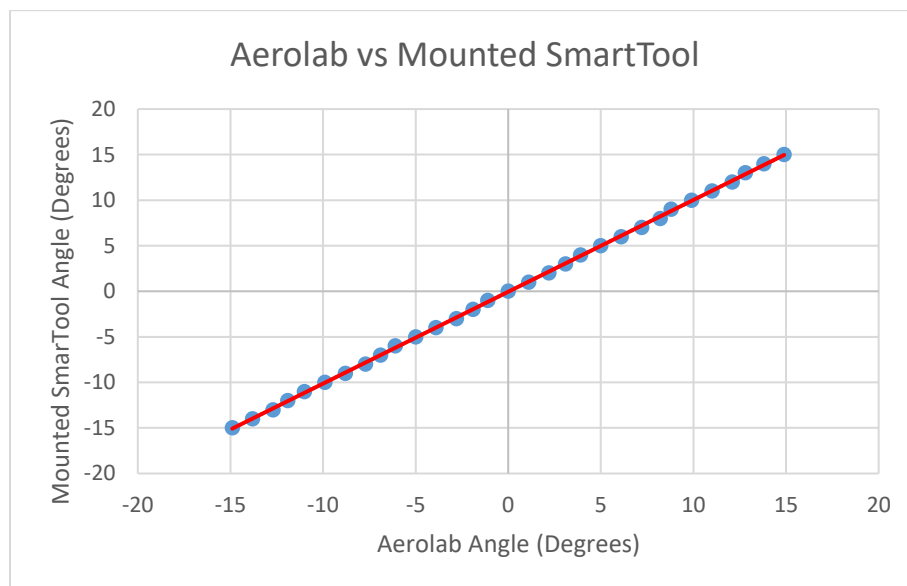


Figure 3.7 - Level vs. System

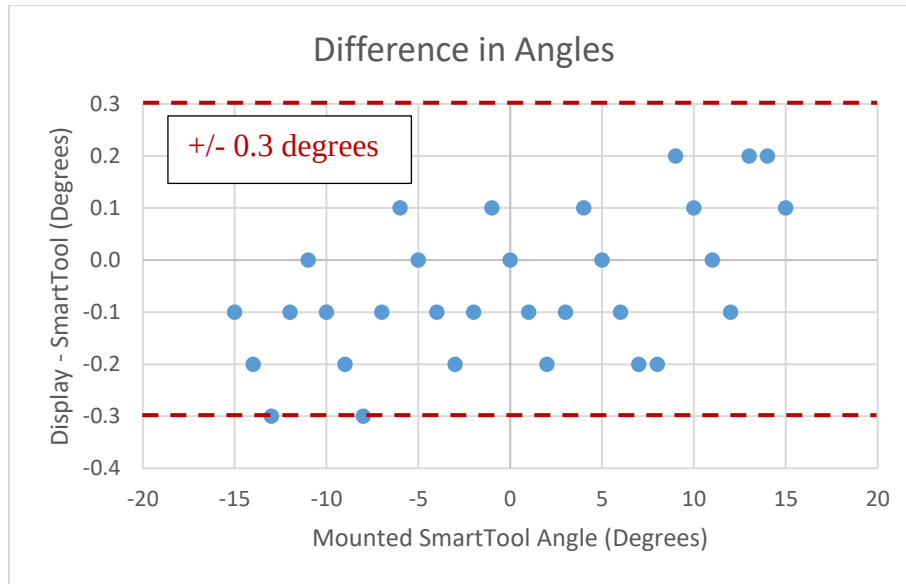


Figure 3.8 - Difference in Angles

After the measurements were taken, it was concluded that the uncertainty of the angle measurements was ± 0.3 degrees. The data collected for this calibration can be found in appendix B.

3.1.3.2 Sting Balance Calibration

To balance the sting and obtain the current calibration matrix for the sting measurements, a series of known weights were used in addition to a calibration sleeve to position the weights on the sting. The calibration sleeve has six different locations on it relating to various distances from the balance center. These locations are shown in figure 3.10. Position 1 is located 2.99 inches from the balance center, position 2 is 1.99 inches, position 3 is 0.99 of an inch, position 4 is -0.01 of an inch, position 5 is -1.01 inches and position 6 is -2.01. Weights are then hung at these locations using fishing line. The weights used in the calibration are 0.50168 lbf, 1.0056 lbf, 1.4879 lbf, and 1.9921 lbf. The sleeve has a weight of 0.146 lbf and this weight was also taken into account. A picture of the weights can be seen in figure 3.9 and the complete setup in figure 3.11.



Figure 3.9 - Calibration Weights & Sleeve



Figure 3.10 - Sting Balance Sleeve with Positions Marked



Figure 3.11 - Sting Balance Calibration Set-Up

Equations 3.1, 3.2, and, 3.3 show how the calculated values of normal force (N_{calc}), axial force (A_{calc}), and pitching moment (M_{calc}) were achieved. The X variable represents the positioning distance relative to the balance center. W is the weight of the specific weights that were attached and W_{total} is the sum of the weight and the sleeve.

$$N_{calc} = -W * \cos (\alpha) \quad \text{Equation 3.1}$$

$$A_{calc} = +W * \sin (\alpha) \quad \text{Equation 3.2}$$

$$M_{calc} = W_{total} * X * \cos (\alpha) \quad \text{Equation 3.3}$$

In order to account for the calibration of the sting measurements, a calibration matrix was created. This was done by doing multiple linear regressions with the calculated values and the values indicated from the output data (N_r , A_r , and M_r). The calibration matrix can be seen below in figure 3.12. The variable C_{ij} will be used to refer to specific values of the matrix with the i portion representing the column and the j portion representing the row. The equations to calculate the N_c , A_c , and M_c values can be seen in equations 3.4, 3.5, and 3.6.

C_{11}	C_{12}	C_{13}	0.98682	-0.00220	0.00245
C_{21}	C_{22}	C_{23}	0.00734	0.84959	-0.00142
C_{31}	C_{32}	C_{33}	-0.00547	0.17206	1.01056

Figure 3.12 - Calibration Matrix

$$N_c = N_r * C_{11} + A_r * C_{12} + M_r * C_{13} \quad \text{Equation 3.4}$$

$$A_c = N_r * C_{21} + A_r * C_{22} + M_r * C_{23} \quad \text{Equation 3.5}$$

$$M_c = N_r * C_{31} + A_r * C_{32} + M_r * C_{33} \quad \text{Equation 3.6}$$

Figure 3.13 shows the relationship between the calculated normal force and the normal force of the recorded data corrected by the calibration matrix (N_{calc} vs N_c). The figure also shows the trendline that is generated between the data points. The difference between the corrected values and the calculated values can be seen in figure 3.14. The same can be seen in figure 3.15

and figure 3.16 for the axial force and figure 3.17 and figure 3.18 for the pitching moment. The data that the AEROLAB LabVIEW program output for the calibration matrix can be seen in appendix B.

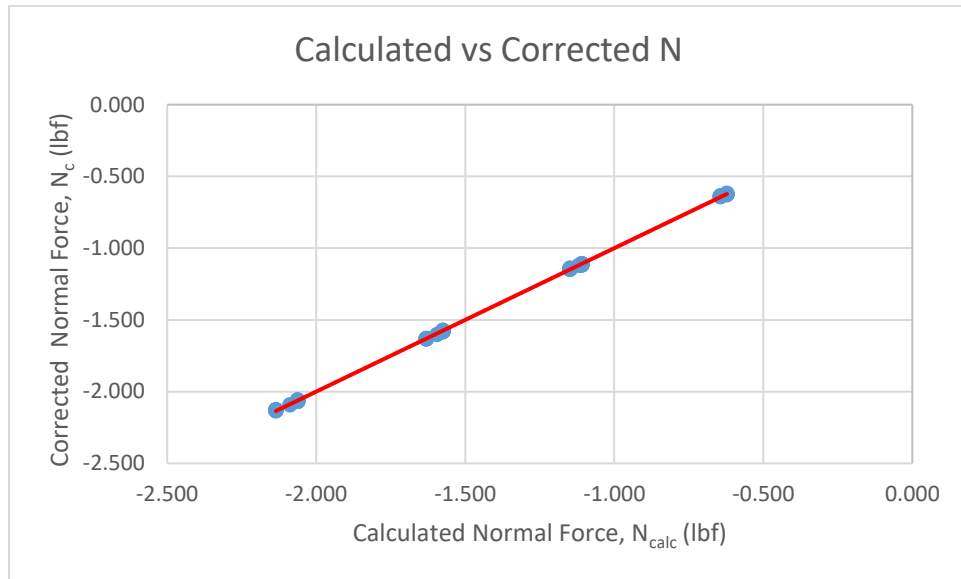


Figure 3.13 - Actual (Corrected) vs. Predicted (Calculated) Normal Force

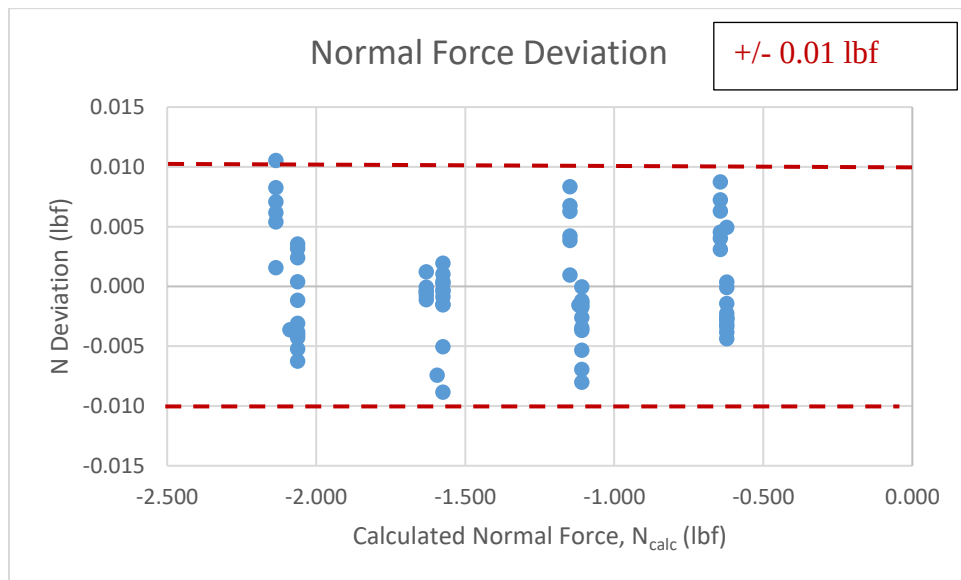


Figure 3.14 - Normal Force Deviation

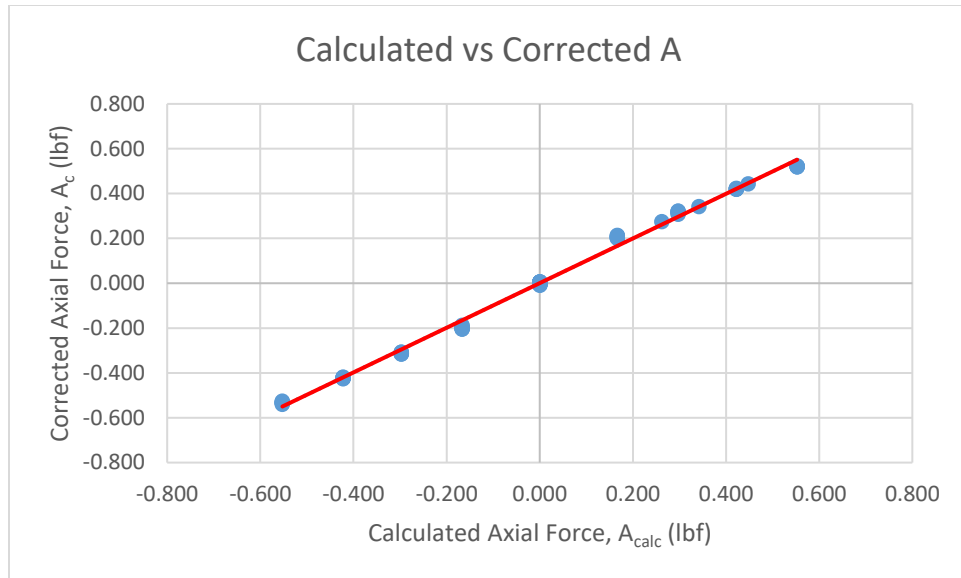


Figure 3.15 - Actual (Corrected) vs. Predicted (Calculated) Axial Force

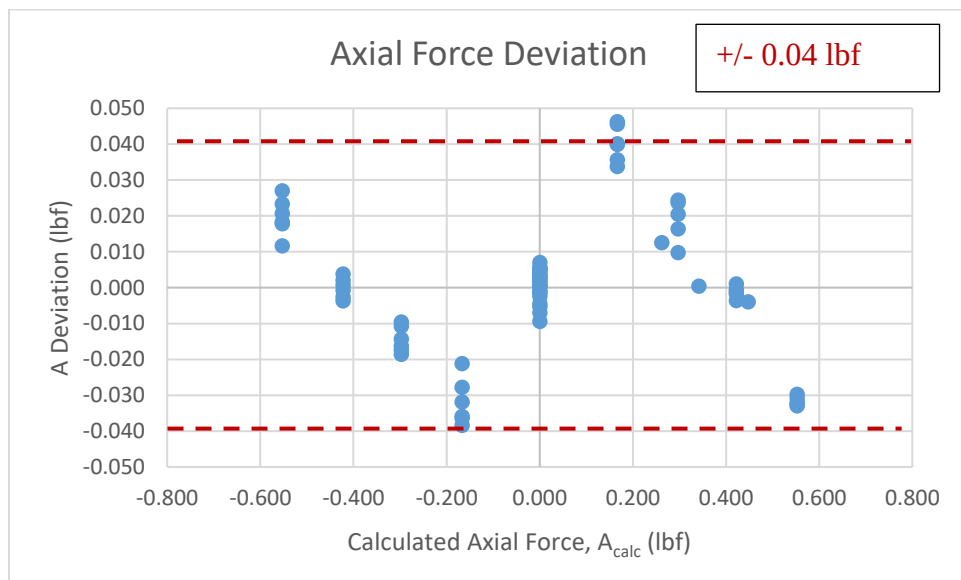


Figure 3.16 - Axial Force Deviation

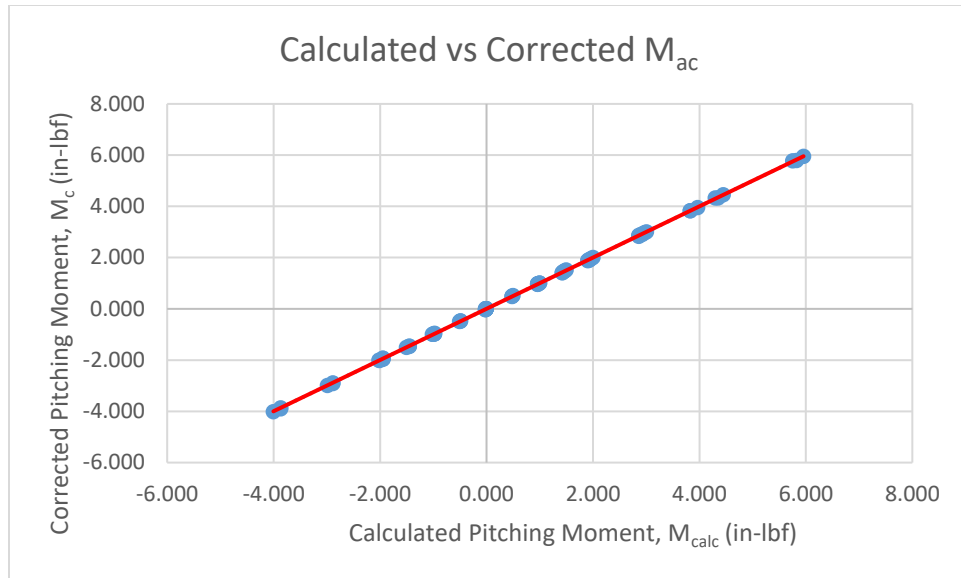


Figure 3.17 - Actual (Corrected) vs. Predicted (Calculated) Pitching Moment

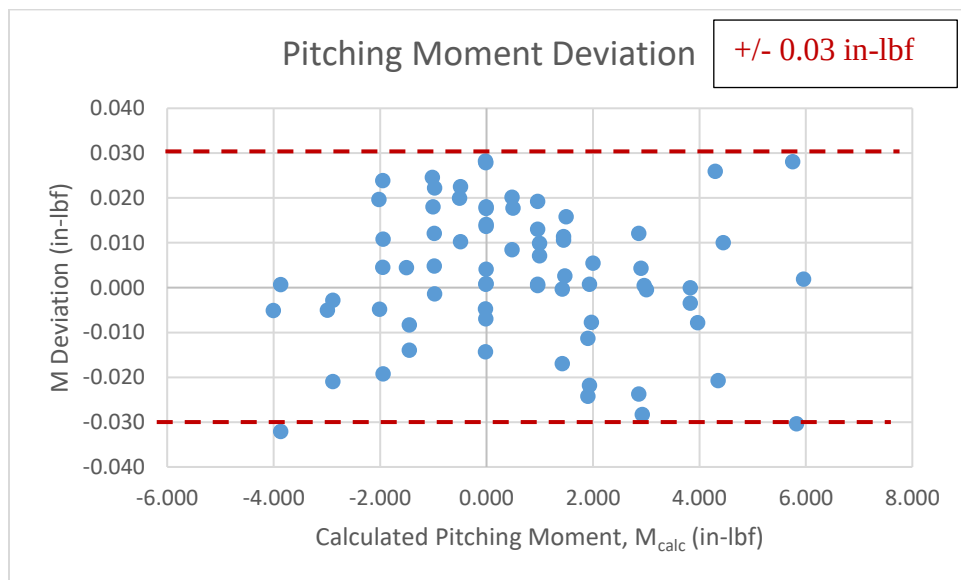


Figure 3.18 - Pitching Moment Deviation

3.1.3.3 Airfoil Weight Calibration

The last step taken to ensure calibrated and accurate measurements was to correct for the weight of the airfoils from the gathered data. To do this we need the weights of the models, which can be seen below, and the moment when the airfoil is on the sting at $\alpha = 0$ and no airflow

(M_{no}). These values are used in equations 3.7, 3.8, and, 3.9 to convert the corrected values into the true normal force (N_t), true axial force (A_t), and true pitching moment (M_t).

Airfoil	Weight, W (lbf)	M_{no} (in-lbf)
NACA 0012	0.302	-0.4935
KFm 0012	0.254	-0.4023
NACA 4412	0.295	-0.5013
KFm 4412	0.271	-0.4339

$$N_t = N_c + W * \cos(\alpha) \quad \text{Equation 3.7}$$

$$A_t = A_c - W * \sin(\alpha) \quad \text{Equation 3.8}$$

$$M_t = M_c + M_{no} * W * \cos(\alpha) \quad \text{Equation 3.9}$$

3.2 Testing Procedure

3.2.1 Testing Setup & Procedure

In order to get the wind tunnel at KSU operational, a few steps needed to be followed. The wind tunnel needed to be plugged in and the breakers that correspond with the outlet needed to be turned on. The motor controller (speed control box) located near the exit of the wind tunnel also needed to be turned on and started. The computer needs to be turned on and the AEROLAB LabVIEW program needs to be started. The SmartTool setup is then attached to the airfoil to zero out the angle then removed.

For the airfoil testing, the desired airfoil needs to be put onto the sting. A ruler is then taken to the leading edge of the airfoil to see how high the airfoil is from the testing section platform. This measurement is taken in multiple places along the leading edge to verify that the airfoil is level and not skewed. A piece of cardboard or paper is then inserted on each side of the

wing to ensure that the airfoil is not touching the viewing glass on either side. Once that is confirmed, the set screw is tightened to keep the airfoil on the sting and to prevent rotation. After the airfoil is secured, the viewing windows need to be shut. Once all those steps are completed, testing can commence. A photo of the NACA 0012 airfoil wing on the sting can be seen in figure 3.19 and a front view in figure 3.20.

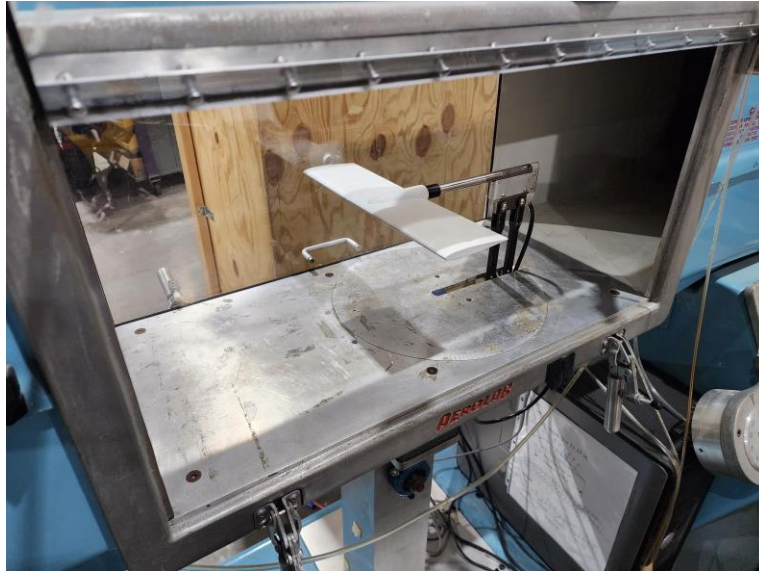


Figure 3.19 - Airfoil on Sting

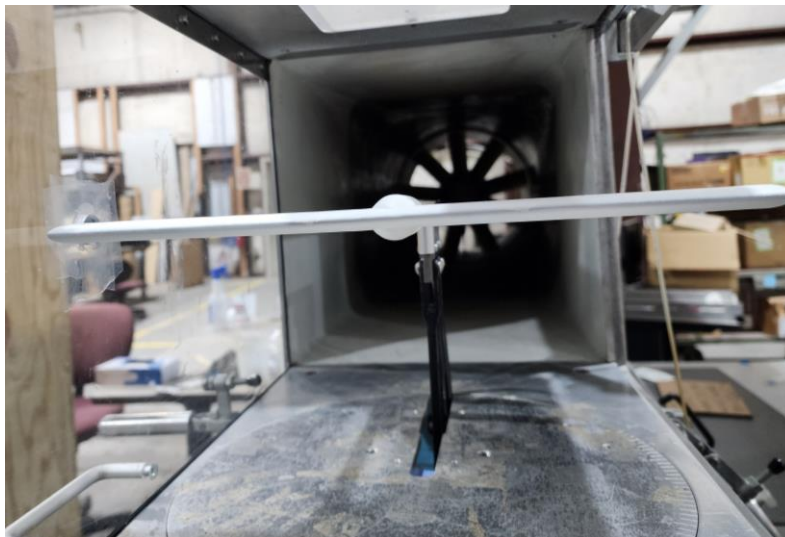


Figure 3.20 - Front View of Airfoil on Sting

3.2.3 Data Collection

For each of the four airfoils tested, 41 different sample sets were taken. The first 20 sets were taken at 50 mph and the second 20 at 70 mph. The sting was set to -16 degrees and increased by 2 degrees until 22 degrees was achieved taking measurements at every step. For each of the 41 sample sets, the system recorded 10 data sets with a delay of 100 milliseconds between the measurements resulting in 410 rows of data per airfoil. An additional set of measurements was taken for each airfoil at the start of all measurements. Those measurements were taken with no airspeed and at zero degrees. All of the data that was collected can be seen in appendix D.

Chapter 4 - Results and Analysis

4.1 Wind Tunnel Results Set Up

For analysis, each set of 10 measurements were averaged so that it is represented by one average data set for each angle. This will help account for outlying data points and fluctuations between values.

4.1.1 Repeatability

Two additional collections of data points were taken with a prototype Kfm 0012 airfoil to ensure accuracy and prove repeatability. Each collection of 30 sample sets were taken with the angle range of -15 degrees to +27 degrees using 3-degree increments. The same sample delay of 100 milliseconds was also used. These measurements were taken 14 days apart from one another. Figures 4.1 and 4.2 compare the differences of the normal force measurements at 50 mph and 70 mph, respectively. Figures 4.3 and 4.4 show the same thing with the axial force measurement, and figures 4.5 and 4.6 show the pitching moment measurements. Figures 4.7, 4.8, and 4.9 show the difference between the two sets of data in relation to normal force, axial force, and pitching moment as functions of angle of attack. One cause for the differences would be that the air temperature and pressure were not identical during the repeatability test as well as fluctuations in the testing environment of NGML. The temperature difference between the two days was 6-degree Fahrenheit and the difference of the barometer readings was 0.6 inHg. The two additional sets of Kfm 0012 measurements can be seen in appendix D tables D.5 and D.6. This test ensures that the results from two different points in time can produce relatively the same data in terms of shape and magnitude.

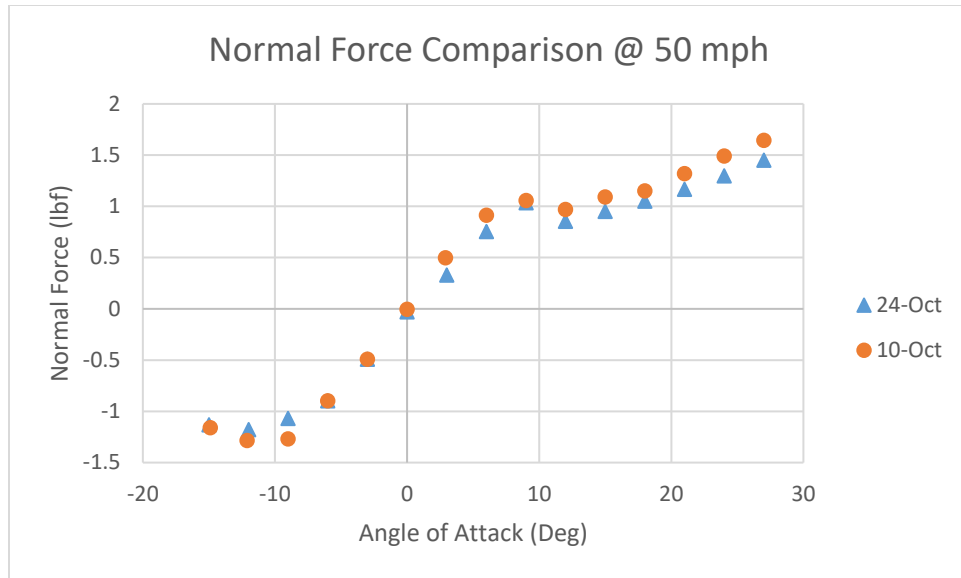


Figure 4.1. - Normal Force Comparison at 50 mph

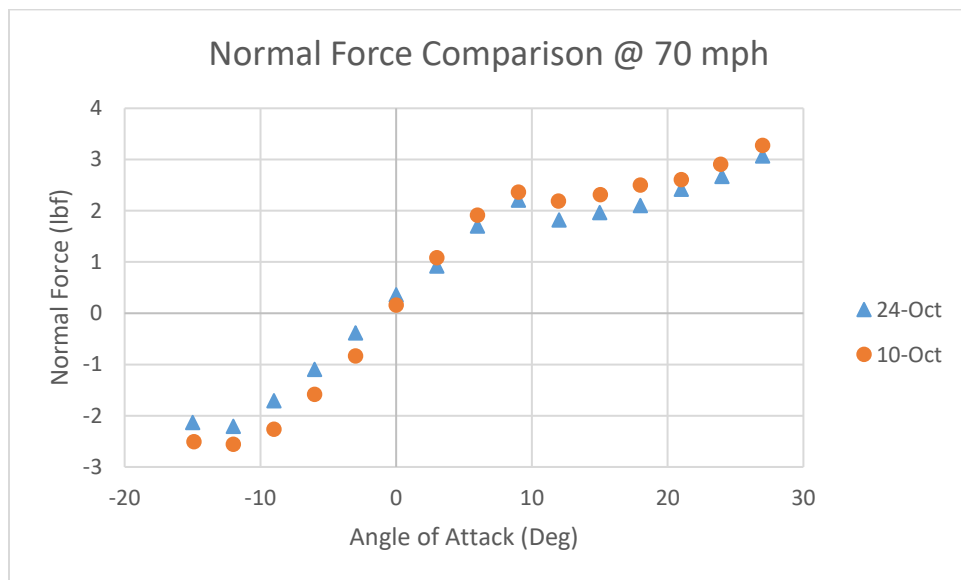


Figure 4.2. - Normal Force Comparison at 70 mph

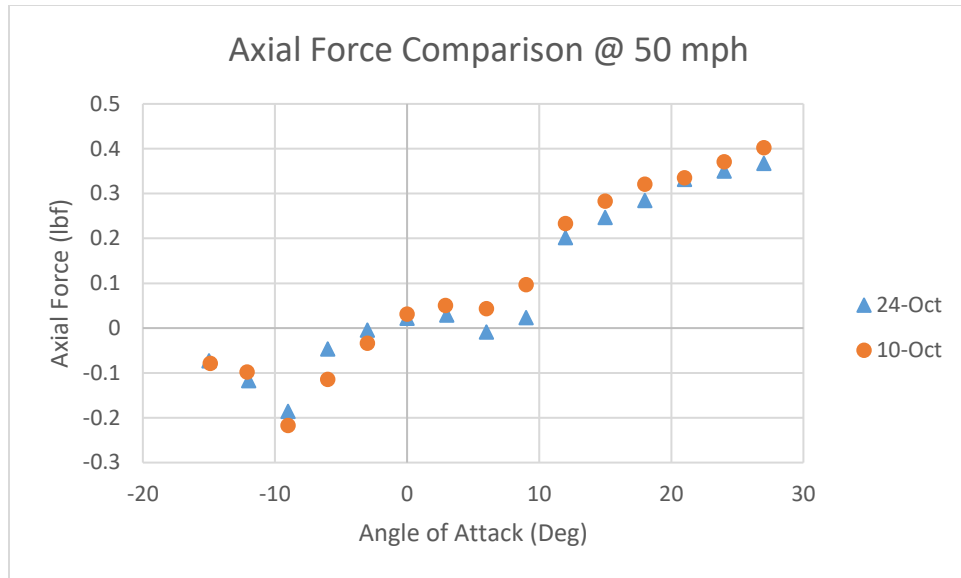


Figure 4.3. - Axial Force Comparison at 50 mph

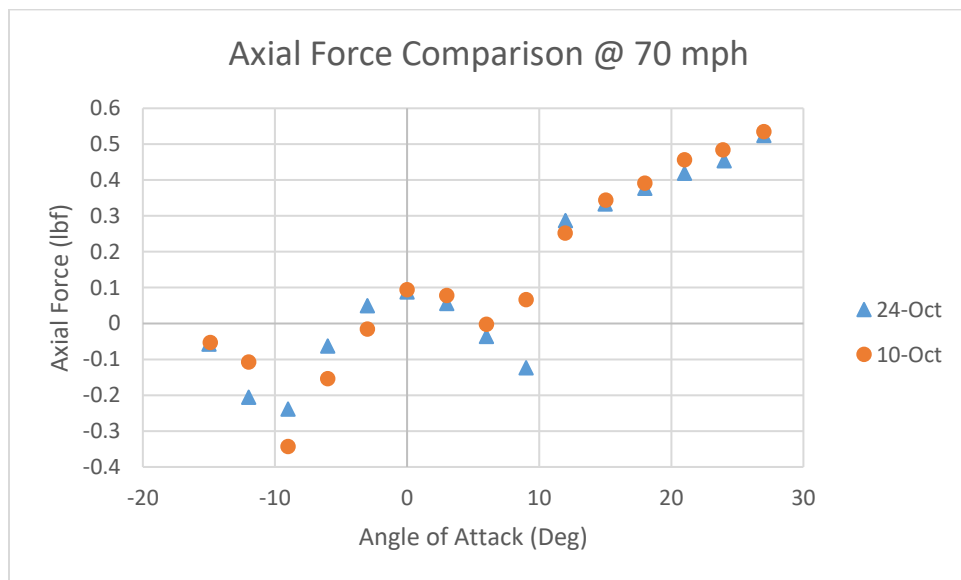


Figure 4.4. - Axial Force Comparison at 70 mph

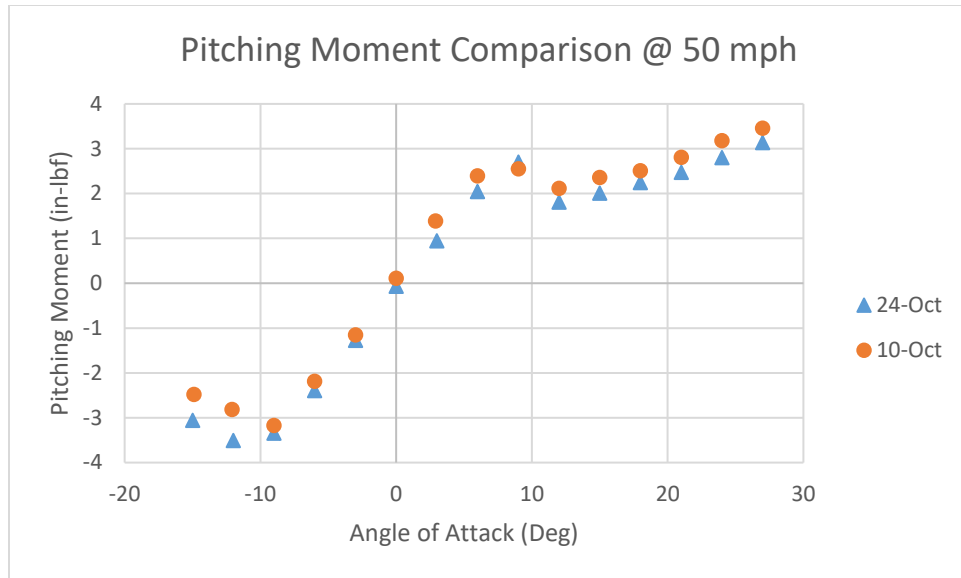


Figure 4.5. - Pitching Moment Calibration at 50 mph

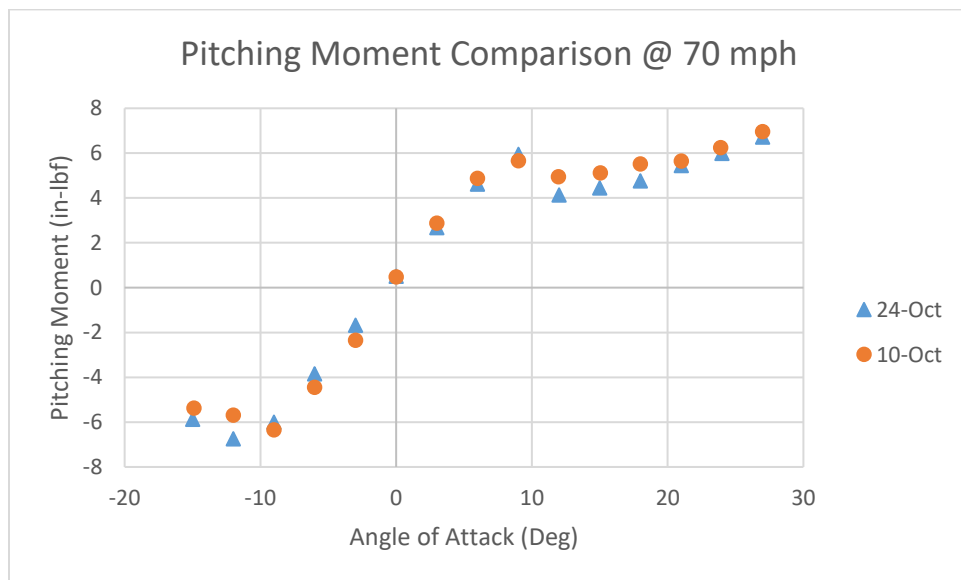


Figure 4.6. - Pitching Moment Calibration at 70 mph

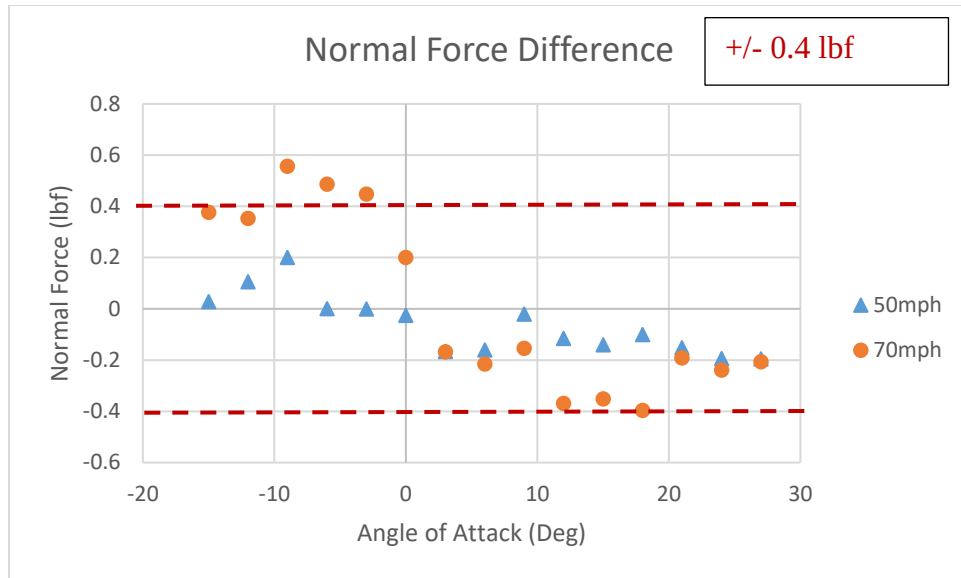


Figure 4.7. - Normal Force Difference

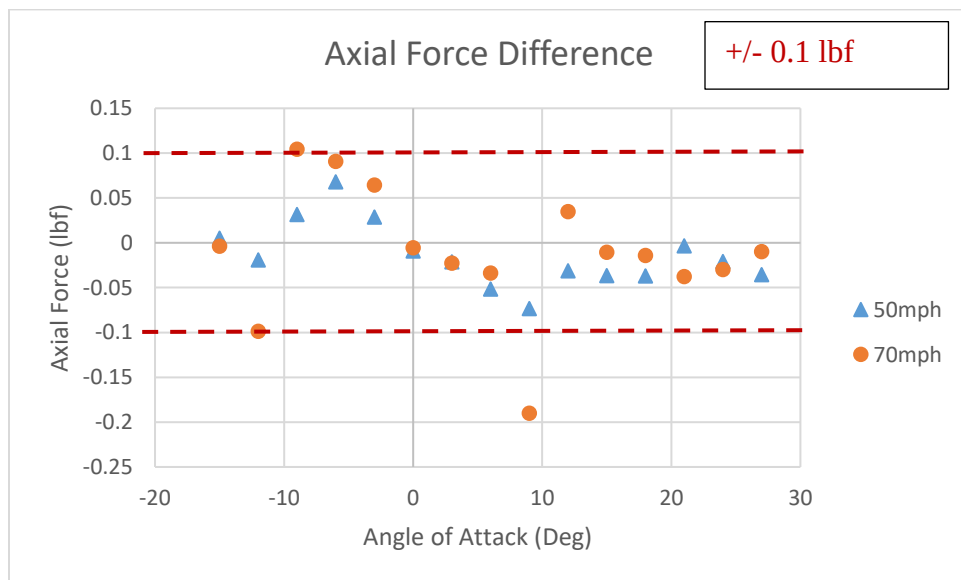


Figure 4.8 - Axial Force Difference

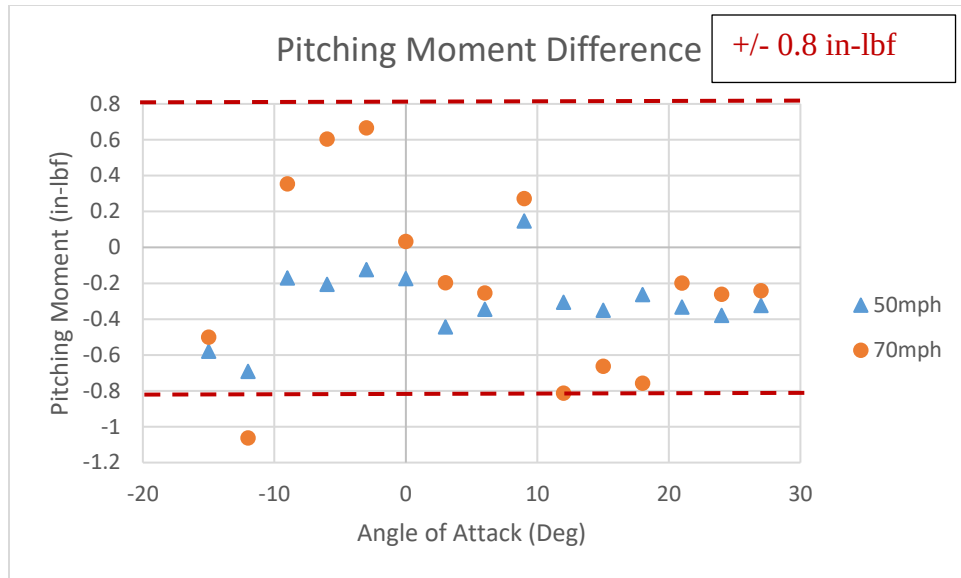


Figure 4.9 - Pitching Moment Difference

4.1.2 Sting to Aerodynamics

In order to convert the data collected from the sting, normal force and axial force, into lift and drag, equations 4.1 and 4.2 need to be used. This takes the normal and axial forces (N_t & A_t) that have been corrected by the calibration matrix and have had the influence of model weight removed. A diagram of the forces can be seen in figure 4.10.

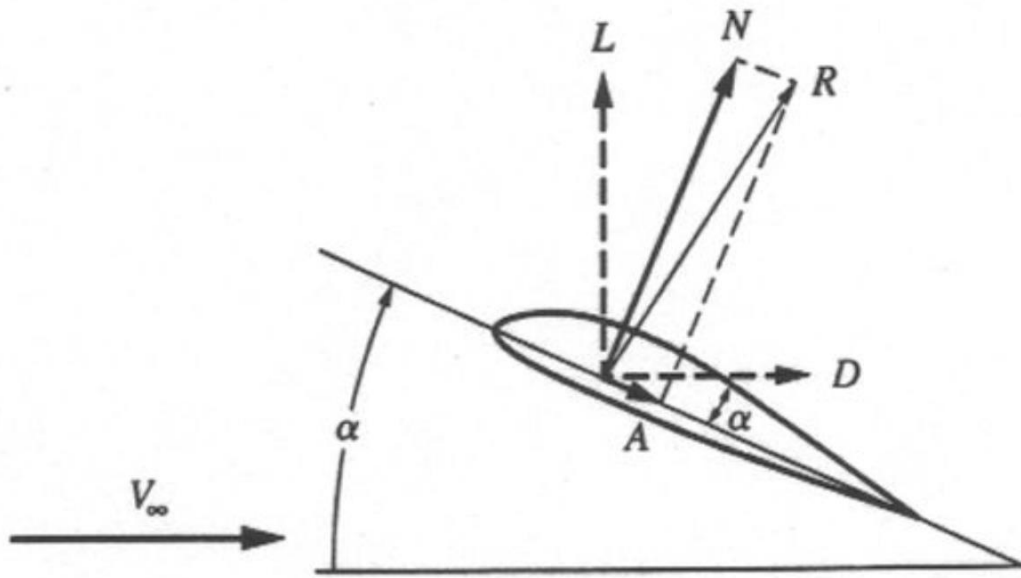


Figure 4.10 - Normal & Axial Forces vs. Lift & Drag Forces [18]

$$L = N_t * \cos(\alpha) - A_t * \sin(\alpha) \quad \text{Equation 4.1}$$

$$D = N_t * \sin(\alpha) + A_t * \cos(\alpha) \quad \text{Equation 4.2}$$

4.2 KFm vs. NACA

. The data for the four wings (NACA 0012, KFm 0012, NACA 4412, and KFm4412) were taken with an air temperature of 52.9 degrees Fahrenheit and a barometer reading of 29.15 inHg. The calculations of air density can be seen in appendix C and the tables for the calculated values of lift, drag, coefficient of lift, and coefficient of drag can be seen in appendix E.

4.2.1 0012 Comparison

4.2.1.1 0012 Lift & Coefficient

The graphs of lift force as a function of angle of attack for the 0012 airfoils can be seen in figure 4.11 for airspeed of 50 mph and figure 4.12 for 70 mph. For 50 mph, the NACA airfoil (orange circles) and the KFm airfoil (yellow squares) produce nearly the same amount of lift until the angle of attack reaches zero degrees. Then the NACA version starts to produce more lift

force for the remaining range of angles. For 70 mph, the NACA airfoil is consistently producing more airfoil compared to the KFm airfoil. Figures 4.13 and 4.14 show the coefficient of lift as a function of angle of attack.

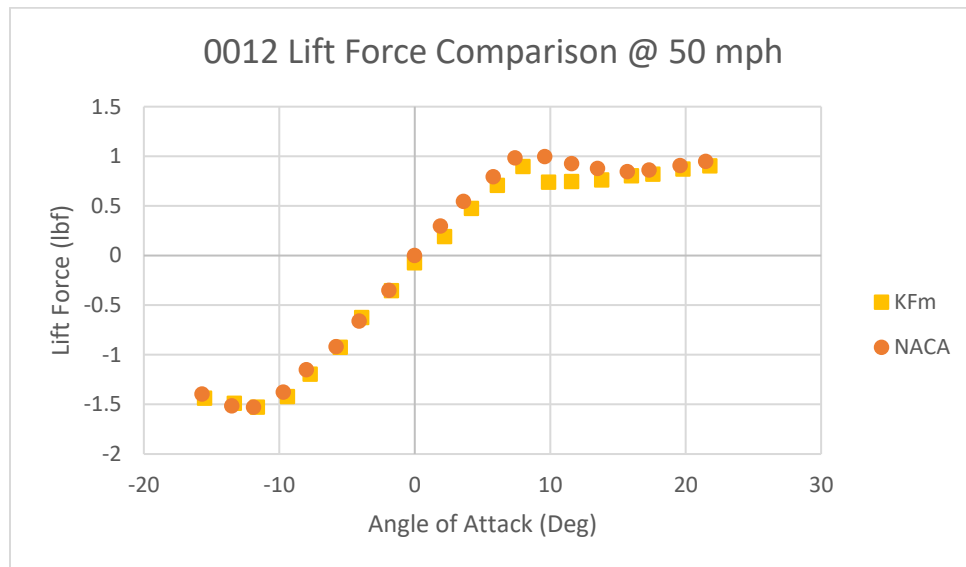


Figure 4.11 - 50 mph Lift Comparison of 0012

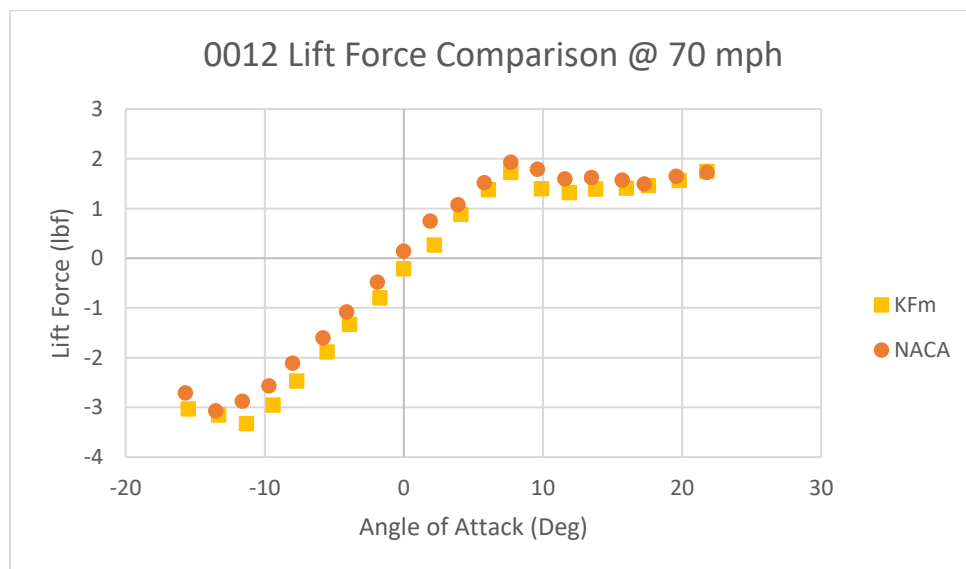


Figure 4.12 - 70 mph Lift Comparison of 0012

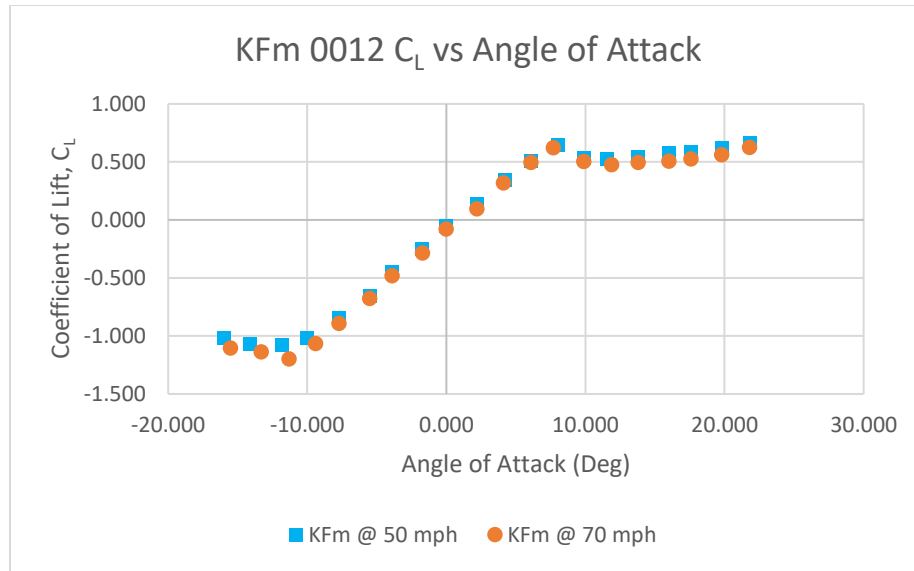


Figure 4.13 - Kfm 0012 Lift Coefficient Comparison

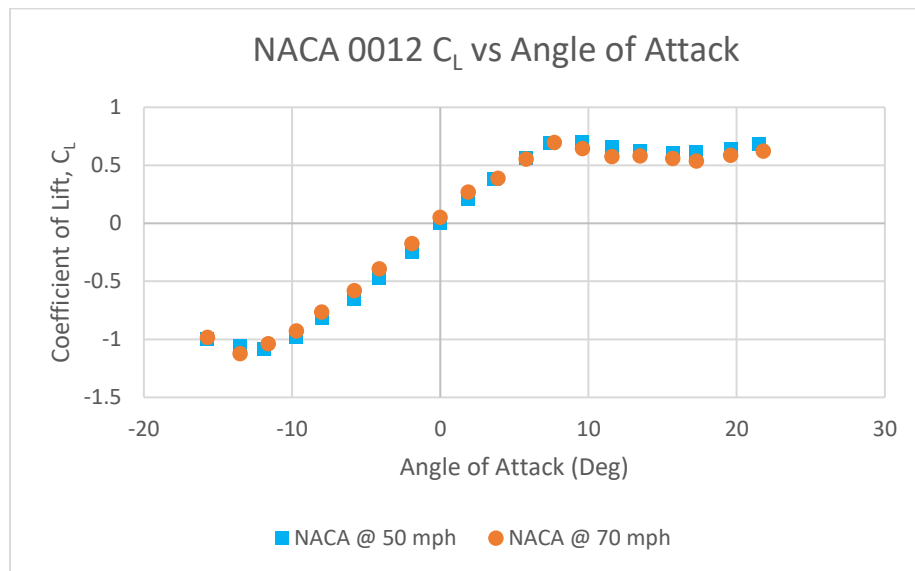


Figure 4.14 - NACA 0012 Lift Coefficient Comparison

4.2.1.2 0012 Drag & Coefficient

The graphs of drag force as a function of angle of attack for the 0012 airfoils can be seen in figure 4.15 for airspeed of 50 mph and figure 4.16 for 70 mph. The Kfm airfoils produced more drag for the entire angle of attack range for both 50 mph and 70 mph. Figures 4.17 and 4.18 show the coefficient of drag as a function of angle of attack.

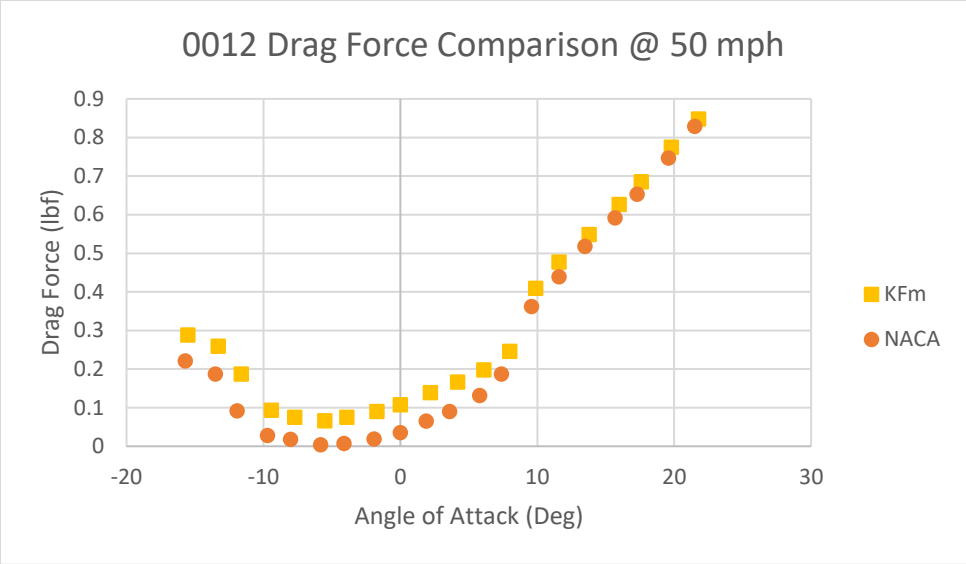


Figure 4.15 - 50 mph Drag Comparison of 0012

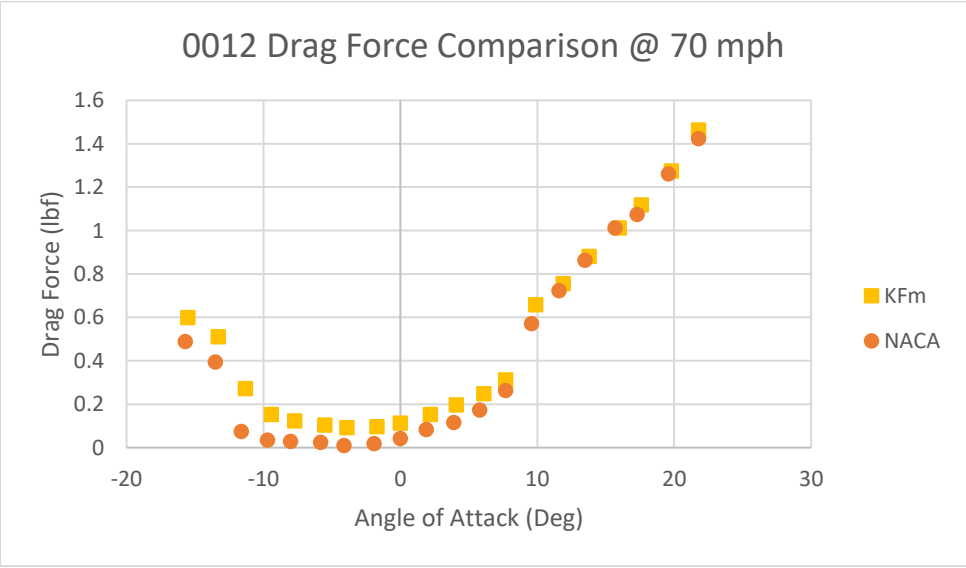


Figure 4.16 - 70 mph Drag Comparison of 0012

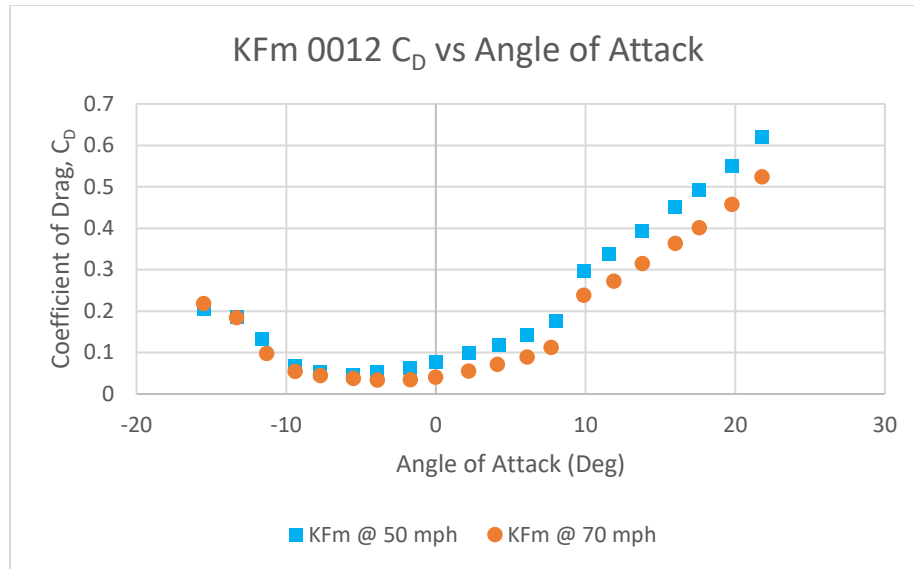


Figure 4.17 - KFm 0012 Drag Coefficient Comparison

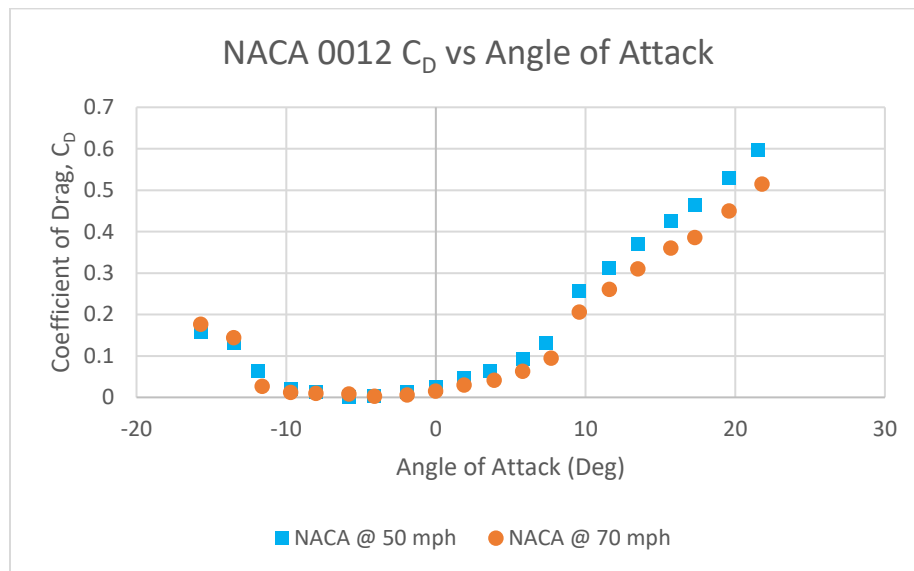


Figure 4.18 - NACA 0012 Drag Coefficient Comparison

4.2.1.3 0012 Results

With the NACA 0012 airfoil being symmetric, we would expect the lift force and drag force to be symmetrical at an angle of attack of zero degrees. This is the case for the lift force but is not the case for the drag force. While a global comparison of the data cannot be achieved, a relative comparison between the NACA and KFm airfoils can be made. As the airspeed

increases, so does the difference between the lift forces produced by the NACA and KFm airfoils and inversely, the lesser the difference between the created drag force. The graphs of coefficients show that the coefficients of lift and drag do not depend on the velocity of the air or the environmental factors like temperature and pressure. This is in line with the idea of the unitless coefficients of lift/drag, to be independent of the testing circumstances. The airfoils stalled at approximately the same angle for each 0012 airfoil, at approximately eight degrees. This goes against the theory of KFm airfoils resisting stalling when compared to more standard airfoils.

4.2.2 4412 Comparison

4.2.2.1 4412 Lift & Coefficient

The graphs of lift force as a function of angle of attack for the 4412 airfoils can be seen in figure 4.19 for airspeed of 50 mph and figure 4.20 for 70 mph. For both 50 and 70 mph, the NACA airfoil produced more lift force for the full range of angles. The figures also show that the zero-lift angle of attack is influenced by the step characteristic. For 70mph, the data for the lift force and coefficient of lift of the NACA airfoil showed an unusual characteristic of having an arcing shape. Having the step characteristics in the KFm airfoil, caused the zero-lift angle of attack to be greater than the standard NACA airfoil. Figures 21 and 4.22 show the coefficient of lift as a function of angle of attack.

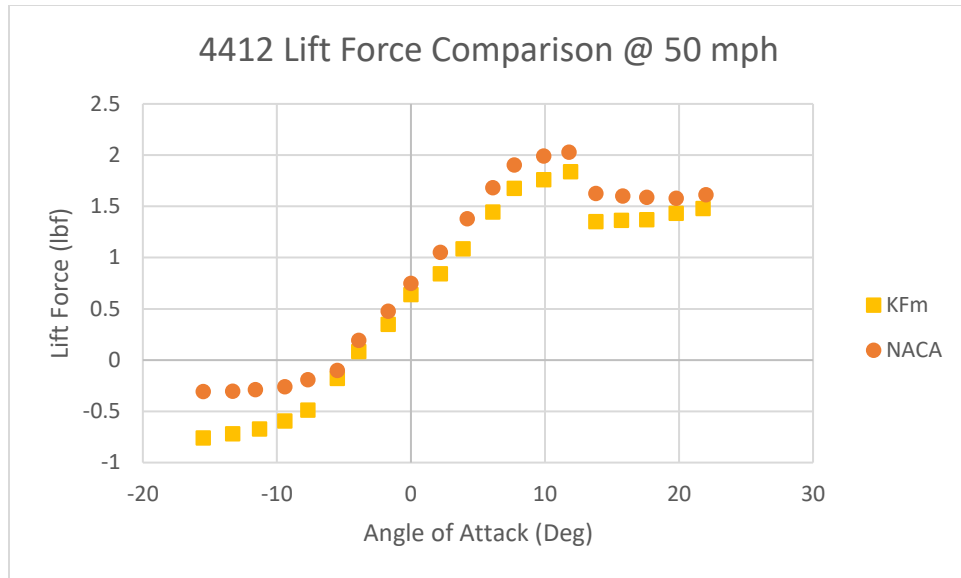


Figure 4.19 - 50 mph Lift Comparison of 4412

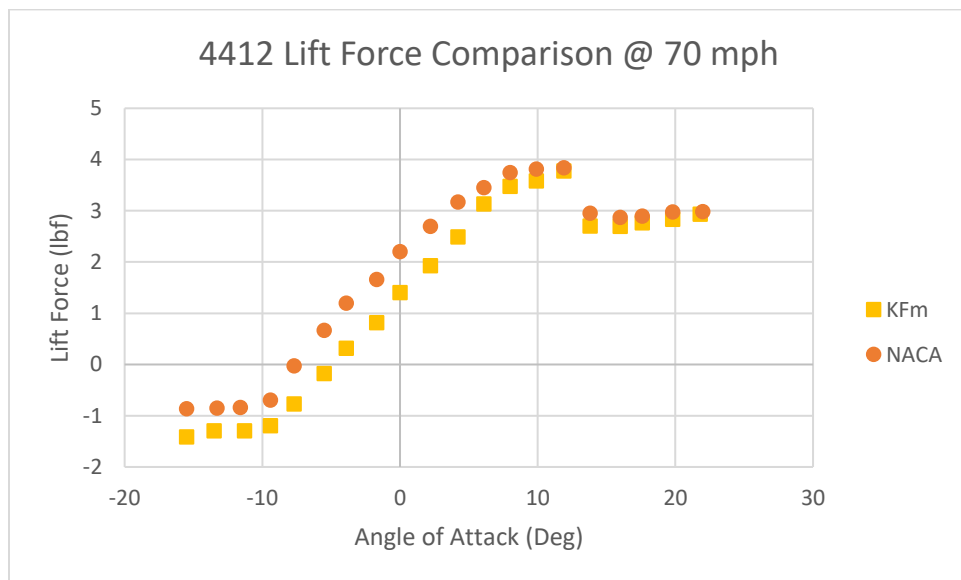


Figure 4.20 - 70 mph Lift Comparison of 4412

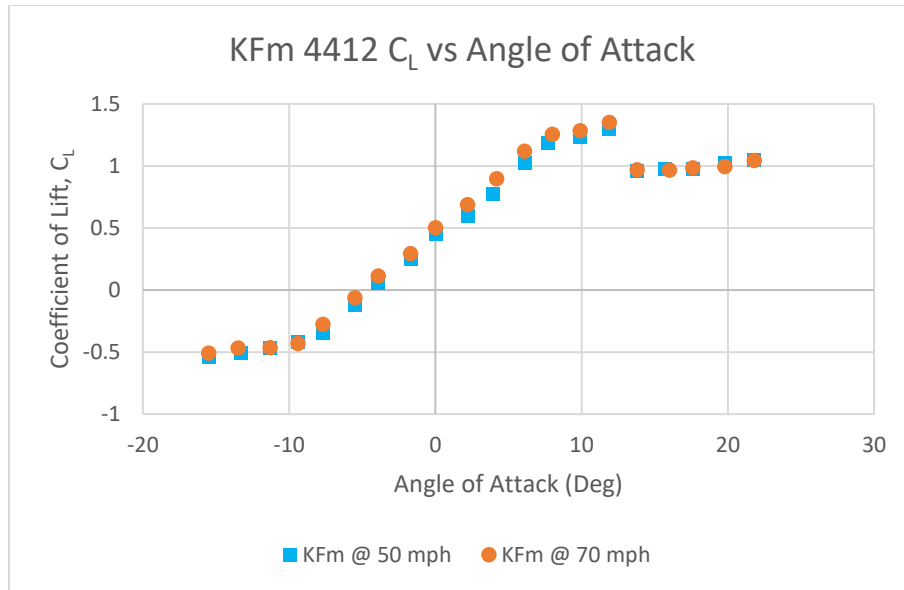


Figure 4.21 - KFm 4412 Lift Coefficient Comparison

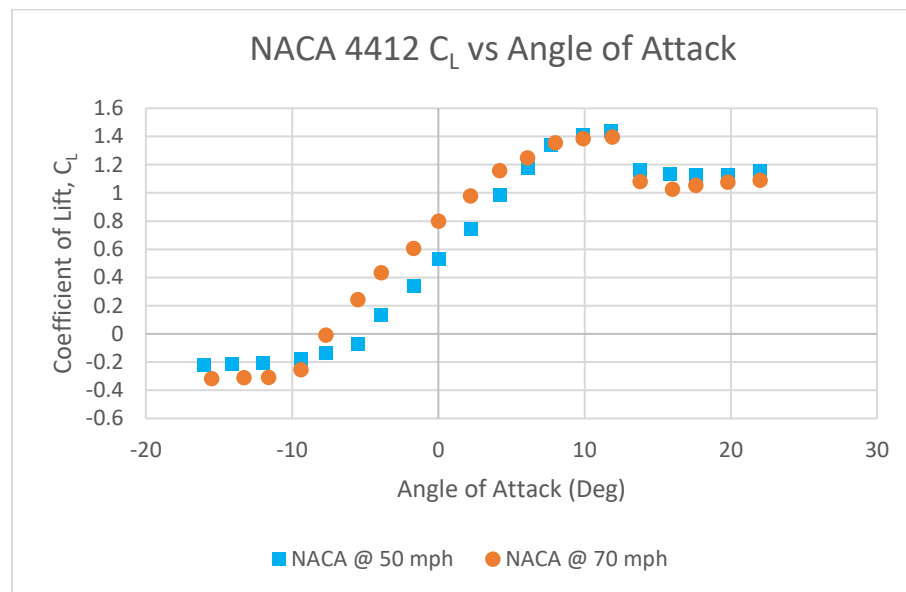


Figure 4.22 - NACA 4412 Lift Coefficient Comparison

4.2.2.2 4412 Drag & Coefficient

The graphs of drag force as a function of angle of attack for the 4412 airfoils can be seen in figure 4.23 for airspeed of 50 mph and figure 4.24 for 70 mph. The KFm airfoil consistently produced more drag force than the NACA airfoils. After stall occurred, the difference between

the drag force created between the KFm airfoil and the NACA airfoil was reduced, which resulted in a drag force that was more identical between the two. Figures 4.25 and 4.26 show the coefficient of drag as a function of angle of attack.

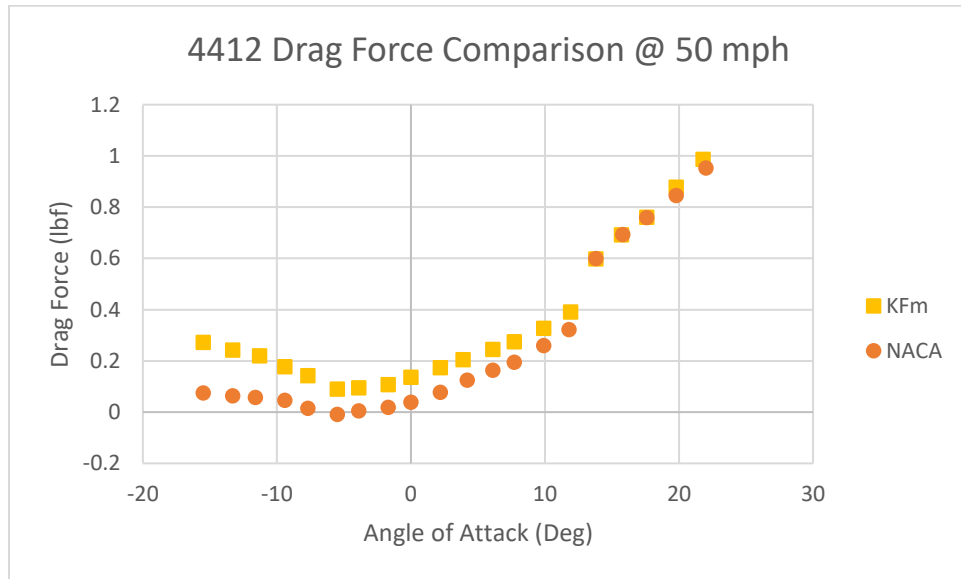


Figure 4.23 - 50 mph Drag Comparison of 4412

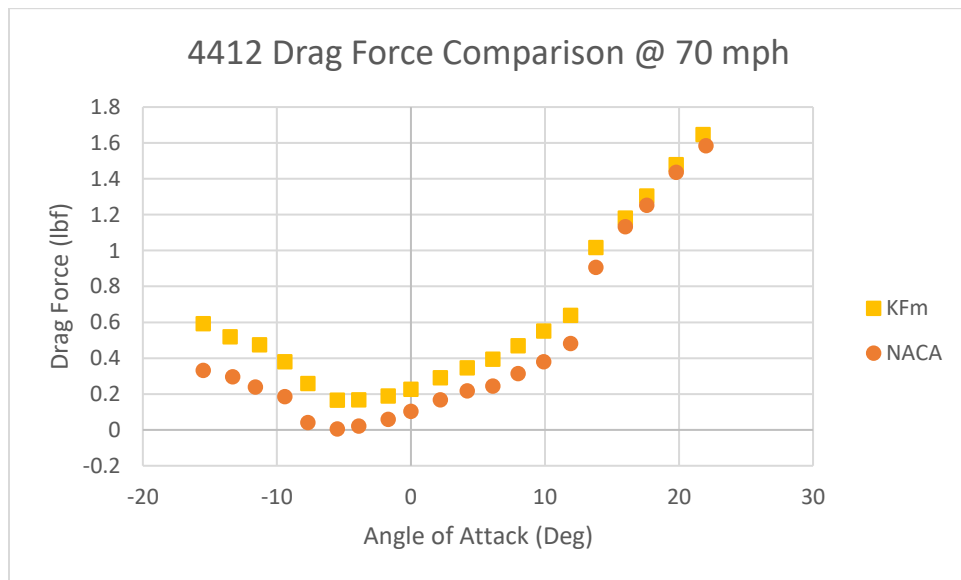


Figure 4.24 - 70 mph Drag Comparison of 4412

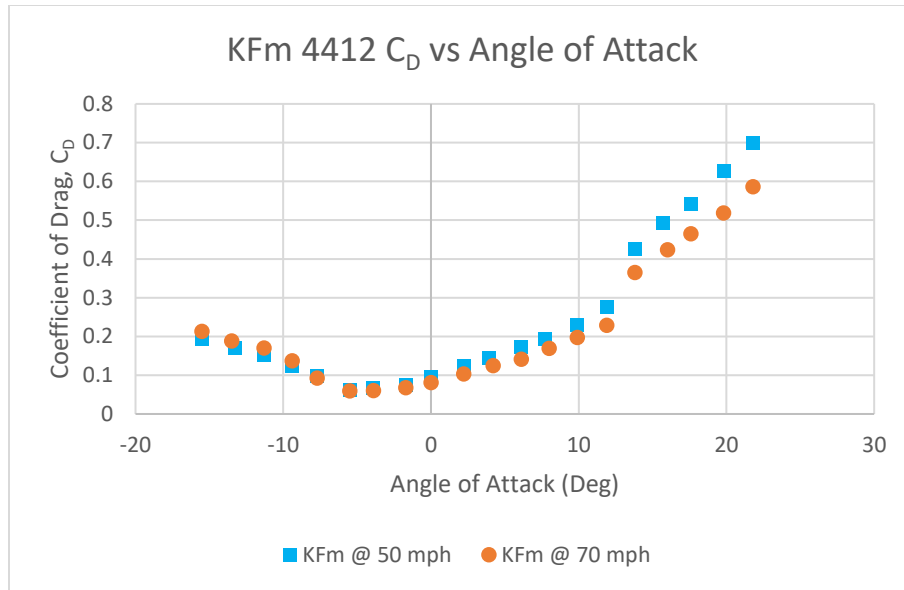


Figure 4.25 - KFm 4412 Drag Coefficient Comparison

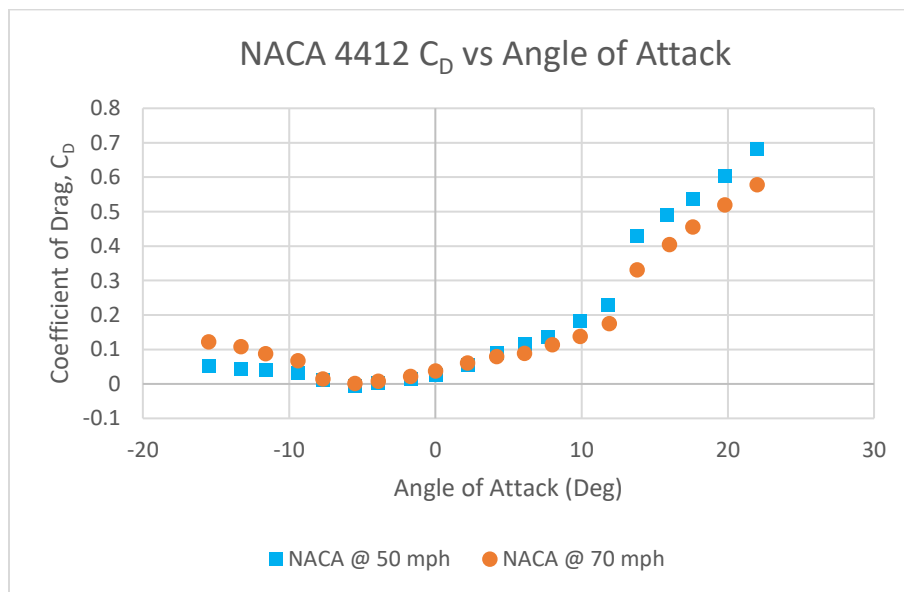


Figure 4.26 - NACA 4412 Drag Coefficient Comparison

4.2.2.3 4412 Results

When the airspeed was increased to 70 mph, the difference between the drag force created between the NACA 4412 and the KFm 4412 was greater. This suggests that with the added camber of the airfoil, there is a different reaction of the air that occurs because of the step.

The testing related to the 4412 pair of wings also confirmed what the results of the 0012 testing did, that the stall angle of the NACA airfoil was not delayed due to the step characteristic. The graphs of coefficients for the 4412 pair of wings confirm what is discussed in section 4.2.1.3, that the coefficients of lift and drag do not depend on the velocity of the air or the environmental factors.

4.2.3 Effective Camber Height

Figure 4.27 shows where the coefficients of lift for the NACA 4412 and KFm 4412 wings cross the x-axis of lift. This location is the zero lift angle of attack (α_{zl}). To find this angle, the slope between the points on each side of the axis is calculated and used to find the x intercept. That point will be the zero lift angle of attack for that wing according to the experimental results.

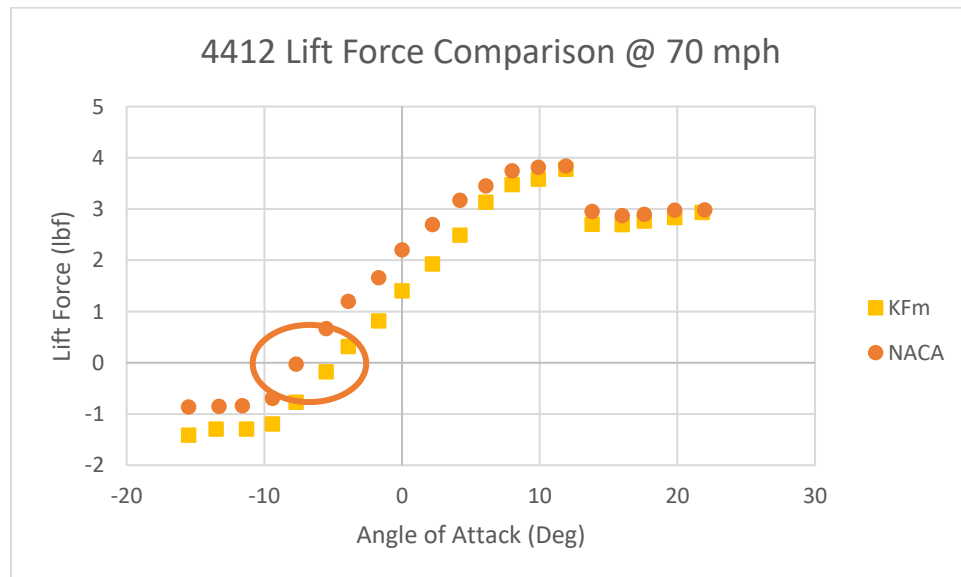


Figure 4.27 – Zero Lift Angle of Attack Focus

Once that angle has been determined, equation 1.3 from section 1.3 *Aerodynamic Equations* can be used. The table below shows the calculated zero lift angle of attack, for

airspeeds of 70 mph, and camber height. The table also shows what the camber height is according to the NACA standards focusing on the first number, X_1 .

$$\alpha_{zl} = -2 * \frac{h}{c} * \frac{180}{\pi} \quad \text{Equation 1.3}$$

Wing	Zero Lift Angle of Attack, α_{zl} (degrees)	Camber Height, h (in)	Actual Camber Height (in)
NACA 0012	-0.439	0.011	0.0
KFm 0012	0.982	-0.026	-
NACA 4412	-7.62	0.199	0.12
KFm 4412	-4.93	0.128	-

The table above confirms that the step characteristics of the KFm airfoils cause the zero lift angle of attack to be greater for the KFm wings and lowers the effective camber height of the wings when compared to the NACA variants.

Chapter 5 - Summary and Conclusion

5.1 Summary

Background research was done in order to find existing data, experiments, and references. These were adapted and combined to create the scope of this project, an experimentation comparison of two sets of airfoils. Rapid prototyping was done in order to find the best 3-D printing orientation for the airfoils as well as to confirm the fit and dimensions of the sting insert. Professionally made airfoil wings were 3-D printed, and hand finished to a standard appropriate for testing. The previously dormant wind tunnel of the K-State MNE department was revived and repaired to working order, and a startup process was created. A

calibration procedure was formed and followed in order to obtain current measurement data to compare to previously captured data as well as known data. Experimental data was collected through an electric strain gauge and displayed through a LabVIEW interface. The data was then processed to calculate lift, drag, coefficient of lift, coefficient of drag and effective camber height. Comparisons were made between the Kfm wings and the NACA counterparts.

5.2 Conclusion

In accordance with Cox [17], there is no substantial evidence to support the claim that Kfm airfoils have an increased stall angle. The simplified airfoil theory calculations were used to calculate an effective camber height of more complex airfoil profiles such as airfoils with Kfm stepped characteristics and is more accurate the lower the airspeed. Through these calculations, the effective camber height of the Kfm airfoils were lower than the corresponding NACA airfoil. This calculation matches what is shown in the experimental data resulting in a higher zero lift angle of attack. The Kfm airfoils did not provide any lift or drag improvements when compared to NACA airfoils which Gross [9] also concludes. Overall if choosing between using a NACA airfoil and a Kfm airfoil, it would come down to the application. At the typical ranges for remote control aircraft, the airfoils have no noticeable performance difference but in terms of commercial and passenger aircraft, the standards that the National Advisory Committee for Aeronautics out preform the Kline-Fogleman modified airfoils.

5.3 Contributions

The contributions of this work fall under two categories, aerodynamic characteristics and engineering skills. For the aerodynamic characteristics contributions, the work's goal was to provide experimental results to prove or disprove the claims made by Kline and Fogleman. For the contributions relating to the skills of an engineer, the importance of these skills was displayed

by the process of rapid prototyping, undergoing calibration procedures, and taking consistent accurate measurements.

5.4 Recommendations for Future Work

For the next steps at studying and comparing the relationship between NACA and Kfm airfoils, there are two routes to take. The first recommendation is to create a pair of airfoils (one Kfm and one NACA) that can be attached to identical remote-control airplanes and do test flights focusing on stalling and stall recovery. The second recommendation is to continue with wind tunnel experimentation. Creating an airfoil that is modular and can easily change the location of the step by adding or removing segments would allow an opportunity to compare the impact of the specific location of the step characteristic. Adding in smoke generation would give insight as to how the air is reacting to the boundary layer and information about when and how it separates from the airfoil.

Bibliography

- [1] J. J. Bertin and M. L. Smith, *Aerodynamics for Engineers*. Upper Saddle River, N.J: Prentice Hall, 1998.
- [2] “Angle of Attack (AOA),” Angle of Attack (AOA) | SKYbrary Aviation Safety, <https://skybrary.aero/articles/angle-attack-aoa#:~:text=The%20Angle%20of%20Attack%20is,help%20prevent%20stall/spin%20accidents> (accessed Nov. 2, 2024).
- [3] “The National Advisory Committee for Aeronautics,” NASA, <https://www.nasa.gov/reference/the-national-advisory-committee-for-aeronautics/> (accessed Nov. 2, 2024).
- [4] S. Saxena and R. Kumar, “Design of NACA 2412 and its Analysis at Different Angle of Attacks, Reynolds Numbers, and a wind tunnel test,” *International Journal of Engineering Research and General Science*, vol. 3, no. 2, 2015.
- [5] R. Kline and F. Fogleman, *The Ultimate Paper Airplane*. New York: Simon & Schuster, 1986.
- [6] R. Voona, thesis, Missouri University of Science and Technology, Rolla, Mo, 2012
- [7] F. Mishriky and P. Walsh, “Effect of Step Depth and Angle in Kline-Fogleman (Kfm-2) Airfoil,” *Global Journal of Researches in Engineering*, vol. 16, no. 4, 2016.
- [8] A. Kabir, Y. M. Akib, A. Hafiz, and M. Islam, “Comparison between two Kline–Fogleman Modified (KFM) based stepped airfoils for better aerodynamic performance,” *2019 2nd*

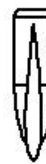
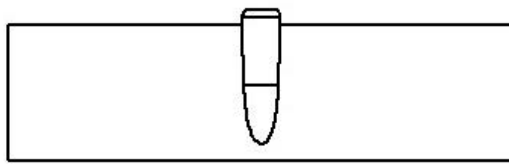
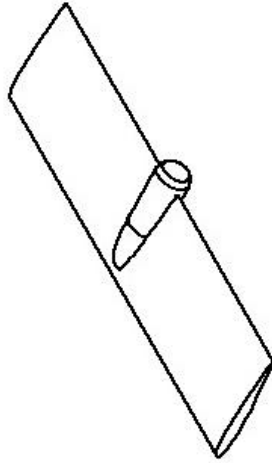
- International Conference on Innovation in Engineering and Technology (ICIET)*, Dec. 2019. doi:10.1109/iciet48527.2019.9290506
- [9] C. Gross, B. Buerge, and S. Miller, “Characterization of Single-Step Kline-Fogleman Airfoils,” thesis, Wichita State University, Wichita, Kan, 2019
- [10] “KFM wings a basic explanation,” Flite Test, <https://www.flitetest.com/articles/kfm-wings-a-basic-explanation> (accessed Nov. 2, 2024).
- [11] K. C.S, “Study of Flow Field Over Fabricated Airfoil Models of NACA 23015 with its Kline-Fogleman Variant,” *Advances in Aerospace Science and Application*, vol. 3, pp. 95–100, 2013.
- [12] J. D. Anderson and M. L. Bowden, *Introduction to Flight*. New York, NY: McGraw Hill LLC, 2022.
- [13] J. D. Anderson and C. Cadou, *Fundamentals of Aerodynamics*. New York, NY: McGraw Hill LLC, 2024.
- [14] M. M. Sarcar, *Computer Aided Design and Manufacturing*. 2008.
- [15] M. Bacon, “The Nature of Making: Rapid Prototyping in Architecture,” thesis, Kansas State University, Manhattan, Kan, 2006
- [16] D. K. Jayashankar, S. S. Gupta, L Y N Stella, K. Tracy, "3D printing of compliant passively actuated 4D structures.", 2019.

[17] M. J. Cox, V. Avakian, and B. P. Huynh. "Performance of a stepped airfoil at low Reynolds numbers." *Proceedings of the 19th Australasian Fluid Mechanics Conference, AFMC 2014*. 2014.

[18] "Ask us - lift & drag vs. Normal & Axial Force," Aerospaceweb.org | Ask Us - Lift & Drag vs. Normal & Axial Force, <https://aerospaceweb.org/question/aerodynamics/q0194.shtml> (accessed Nov. 2, 2024).

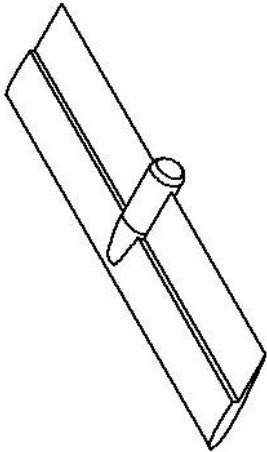
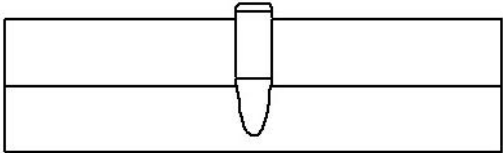
Appendix A - Drawings

NACA 0012 drawing:



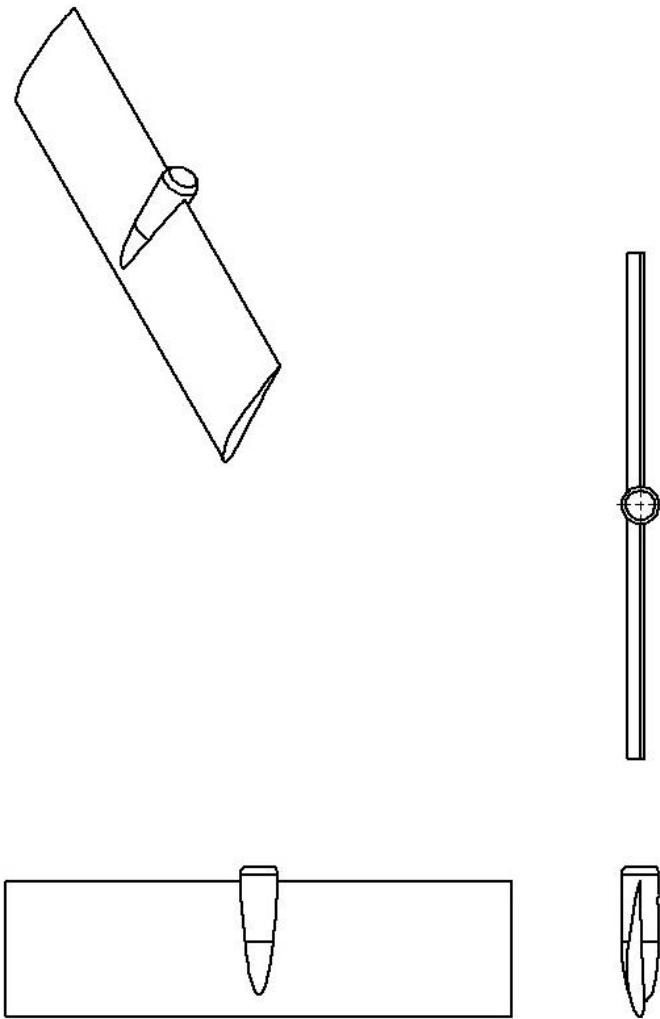
DESIGNER:	EID: riley	DATE: 10/25/2024
MATERIAL:	SECTION:	PART NAME:
MASS: lbs	NACA0012	
VOLUME: in ³		
DEFAULT TOLERANCES:		
.X: ±		
.XX: ±		
.XXX: +		
	SHEET 1 OF 1	PAGE 1 OF 1

KFm 0012 drawing:

		EiD: riley SECTION: DATE: 10/25/2024	
		PART NAME: KFm0012	
		DESIGNER:	
		MATERIAL:	
		MASS: lbs	
		VOLUME: in ³	
		DEFAULT TOLERANCES:	
		.X: ±	
		.XX: ±	
		.XXX: ±	
		SHEET 1 OF 1 PAGE 1 OF 1	



NACA 4412 drawing:

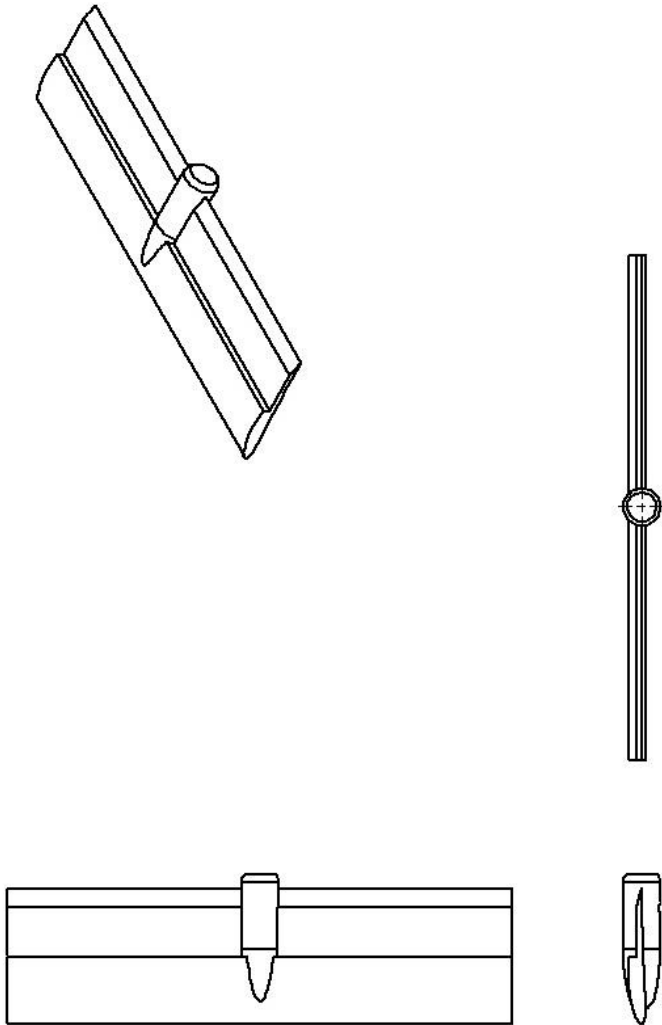


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NACA4412		
DESIGNER:	DEFAULT TOLERANCES:	
MATERIAL:	.X:	±
MASS: lbs	.XX:	±
VOLUME: in³	.XXX:	±

SHEET 1 OF 1 PAGE 1 OF 1



KFm 4412 drawing:



 KANSAS STATE UNIVERSITY College of Engineering	DESIGNER:	DEFAULT TOLERANCES:		
	MATERIAL:	.X:	+	
	MASS: lbs	.XX:	+	
	VOLUME: in³	.XXX:	±	
EID: riley		SECTION:	DATE: 10/25/2024	
		PART NAME:	KFm4412	
		SHEET 1 OF 1	PAGE 1	OF 1

Appendix B - Calibration Data

Table B.1 – Angle Calibration Data

LabVIEW User Interface	Mounted SmartTool	SmartTool - UI
-14.9	-15.0	-0.1
-13.8	-14.0	-0.2
-12.7	-13.0	-0.3
-11.9	-12.0	-0.1
-11.0	-11.0	0.0
-9.9	-10.0	-0.1
-8.8	-9.0	-0.2
-7.7	-8.0	-0.3
-6.9	-7.0	-0.1
-6.1	-6.0	0.1
-5.0	-5.0	0.0
-3.9	-4.0	-0.1
-2.8	-3.0	-0.2
-1.9	-2.0	-0.1
-1.1	-1.0	0.1
0.0	0.0	0.0
1.1	1.0	-0.1
2.2	2.0	-0.2
3.1	3.0	-0.1
3.9	4.0	0.1
5.0	5.0	0.0
6.1	6.0	-0.1
7.2	7.0	-0.2
8.2	8.0	-0.2
8.8	9.0	0.2
9.9	10.0	0.1
11.0	11.0	0.0
12.1	12.0	-0.1
12.8	13.0	0.2
13.8	14.0	0.2
14.9	15.0	0.1

Table B.2 – Sting Balance Calibration Data

The data timestamp, and orientation columns are not included. The airspeed is also not included as the wind tunnel was off for this data collection, $V = 0$.

q	Alpha	NF/SF	AF/AF2	PM/YM	P	Notes
[psf]	[deg]	[lbf]	[lbf]	[in-lbf]	[inH2O]	
1.431	0.0	-0.498	-0.005	1.491	-0.006	Weight: 0.501 Position: 1
1.431	0.0	-0.497	-0.012	0.996	-0.008	Weight: 0.501 Position: 2
1.425	0.0	-0.498	0.002	0.493	-0.006	Weight: 0.501 Position: 3
1.431	0.0	-0.499	-0.002	-0.004	-0.009	Weight: 0.501 Position: 4
1.431	0.0	-0.500	-0.010	-0.496	-0.010	Weight: 0.501 Position: 5
1.425	0.0	-0.496	-0.001	-0.992	-0.008	Weight: 0.501 Position: 6
1.431	-14.9	-0.475	-0.231	1.467	-0.009	Weight: 0.501 Position: 1
1.420	-14.9	-0.473	-0.228	0.991	-0.008	Weight: 0.501 Position: 2
1.420	-14.9	-0.477	-0.218	0.515	-0.009	Weight: 0.501 Position: 3
1.425	-14.9	-0.479	-0.219	0.026	-0.009	Weight: 0.501 Position: 4
1.420	-14.9	-0.476	-0.225	-0.456	-0.012	Weight: 0.501 Position: 5
1.420	-14.9	-0.481	-0.233	-0.944	-0.010	Weight: 0.501 Position: 6
1.420	15.1	-0.450	0.247	1.306	-0.010	Weight: 0.501 Position: 1
1.425	15.1	-0.472	0.259	0.922	-0.010	Weight: 0.501 Position: 2
1.420	15.1	-0.478	0.250	0.451	-0.011	Weight: 0.501 Position: 3
1.425	15.1	-0.477	0.251	-0.031	-0.012	Weight: 0.501 Position: 4
1.420	15.1	-0.477	0.243	-0.509	-0.013	Weight: 0.501 Position: 5
1.415	15.1	-0.481	0.255	-0.989	-0.013	Weight: 0.501 Position: 6
1.415	13.2	-0.959	0.329	2.872	-0.015	Weight: 1.0056 Position: 1
1.410	15.0	-0.947	0.382	1.867	-0.017	Weight: 1.0056 Position: 2
1.415	15.1	-0.948	0.381	0.888	-0.016	Weight: 1.0056 Position: 3
1.410	15.1	-0.953	0.395	-0.085	-0.017	Weight: 1.0056 Position: 4
1.415	15.1	-0.957	0.370	-1.038	-0.015	Weight: 1.0056 Position: 5
1.410	15.1	-0.961	0.367	-1.993	-0.015	Weight: 1.0056 Position: 6
1.405	0.1	-0.996	0.009	2.976	-0.018	Weight: 1.0056 Position: 1
1.410	0.0	-1.003	-0.013	1.983	-0.017	Weight: 1.0056 Position: 2
1.410	0.0	-1.001	-0.023	0.992	-0.019	Weight: 1.0056 Position: 3
1.405	0.0	-1.002	-0.011	-0.001	-0.016	Weight: 1.0056 Position: 4
1.405	0.0	-1.004	-0.014	-1.001	-0.020	Weight: 1.0056 Position: 5
1.399	0.0	-0.997	-0.013	-1.993	-0.020	Weight: 1.0056 Position: 6

1.394	-14.9	-0.962	-0.369	2.960	-0.020	Weight: 1.0056 Position: 1
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1.399	-14.9	-0.963	-0.381	-0.888	-0.020	Weight: 1.0056 Position: 5
1.405	-14.9	-0.967	-0.384	-1.849	-0.022	Weight: 1.0056 Position: 6
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1.394	-14.9	-1.440	-0.502	2.949	-0.023	Weight: 1.4879 Position: 2
1.394	-14.9	-1.438	-0.510	1.513	-0.021	Weight: 1.4879 Position: 3
1.394	-14.9	-1.441	-0.509	0.085	-0.022	Weight: 1.4879 Position: 4
1.394	-14.9	-1.436	-0.512	-1.339	-0.024	Weight: 1.4879 Position: 5
1.389	-14.9	-1.442	-0.530	-2.772	-0.024	Weight: 1.4879 Position: 6
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1.399	0.0	-1.500	0.015	2.983	-0.023	Weight: 1.4879 Position: 2
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1.405	0.0	-1.500	0.011	-1.462	-0.022	Weight: 1.4879 Position: 5
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1.399	14.9	-1.446	0.507	-2.916	-0.029	Weight: 1.4879 Position: 6
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1.384	14.9	-1.932	0.650	1.799	-0.028	Weight: 1.9921 Position: 3
1.389	14.9	-1.932	0.630	-0.110	-0.029	Weight: 1.9921 Position: 4
1.389	14.9	-1.944	0.611	-2.017	-0.029	Weight: 1.9921 Position: 5
1.384	14.9	-1.943	0.608	-3.924	-0.029	Weight: 1.9921 Position: 6
1.379	0.0	-2.009	-0.005	5.941	-0.028	Weight: 1.9921 Position: 1
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1.389	0.0	-2.013	-0.003	1.984	-0.029	Weight: 1.9921 Position: 3
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1.379	-14.9	-1.936	-0.623	3.947	-0.031	Weight: 1.9921 Position: 2
1.379	-14.9	-1.931	-0.649	2.025	-0.032	Weight: 1.9921 Position: 3
1.373	-14.9	-1.936	-0.672	0.118	-0.032	Weight: 1.9921 Position: 4
1.373	-14.9	-1.936	-0.661	-1.786	-0.031	Weight: 1.9921 Position: 5
1.373	-14.9	-1.935	-0.666	-3.714	-0.030	Weight: 1.9921 Position: 6

Appendix C - Air Density Calculations

The calculations below, using equations 1.6 to 1.8, show how air density was determined for the test conditions of a temperature of 52.9 degrees Fahrenheit and a barometer reading of 29.15 inHg.

$$P_{atm} = \left(844.6 \frac{lbm}{ft^3}\right) * \left(32.17 \frac{ft}{sec^2}\right) * (28.92 \text{ in}) * \left[\frac{1 \text{ lbf}}{32.17 \frac{lbm - ft}{sec^2}}\right] * \left[\frac{1 \text{ ft}}{12 \text{ in}}\right]$$

$$P_{atm} = 2051.67 \frac{lbf}{ft^2} * \left[\frac{1 \text{ ft}^2}{144 \text{ in}^2}\right] = 14.24 \text{ psia}$$

$$R = \frac{1545 \frac{ft - lbf}{lbmole - ^\circ R}}{28.97 \frac{lbm}{lbmole}} = 53.33 \frac{ft - lbf}{lbm - ^\circ R}$$

$$\rho_{air} = \frac{\left(14.24 \frac{lbf}{in^2}\right) * \left[\frac{144 \text{ in}^2}{1 \text{ ft}^2}\right]}{\left(53.33 \frac{ft - lbf}{lbm - ^\circ R}\right) * (52.9 + 459.7^\circ R)}$$

$$\rho_{air} = 0.075 \frac{lbm}{ft^3}$$

Appendix D - Wind Tunnel Test Data

Table D.1 – NACA 0012 Data

The data timestamp, and orientation columns are not included

q	V_ref	Alpha	NF/SF	AF/AF2	PM/YM	P	Notes
[psf]	[mph]	[deg]	[lbf]	[lbf]	[in-lbf]	[inH2O]	
0	0	0	-0.301	0.004	-0.492	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.302	0.003	-0.492	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.301	0.004	-0.492	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.301	0.005	-0.492	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.302	0.004	-0.493	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.301	0.004	-0.493	-0.005	Airflow: 0 Angle: 0
0	0	0	-0.303	0.004	-0.494	-0.005	Airflow: 0 Angle: 0
0	0	0	-0.304	0.002	-0.495	-0.005	Airflow: 0 Angle: 0
0	0	0	-0.305	0	-0.496	-0.005	Airflow: 0 Angle: 0
0	0	0	-0.306	0	-0.496	-0.005	Airflow: 0 Angle: 0
6.373	49.93	-15.7	-1.38	-0.097	-2.613	1.146	Airflow: 50 Angle: -16
6.373	49.93	-15.7	-1.372	-0.101	-2.592	1.146	Airflow: 50 Angle: -16
6.368	49.91	-15.7	-1.372	-0.097	-2.592	1.146	Airflow: 50 Angle: -16
6.373	49.93	-15.7	-1.342	-0.095	-2.539	1.146	Airflow: 50 Angle: -16
6.378	49.95	-15.7	-1.353	-0.086	-2.581	1.146	Airflow: 50 Angle: -16
6.383	49.97	-15.7	-1.342	-0.085	-2.54	1.146	Airflow: 50 Angle: -16
6.394	50.01	-15.7	-1.332	-0.094	-2.548	1.146	Airflow: 50 Angle: -16
6.399	50.03	-15.7	-1.365	-0.098	-2.607	1.147	Airflow: 50 Angle: -16
6.404	50.05	-15.7	-1.365	-0.099	-2.607	1.147	Airflow: 50 Angle: -16
6.409	50.07	-15.7	-1.341	-0.099	-2.566	1.147	Airflow: 50 Angle: -16
6.508	50.45	-13.5	-1.5	-0.121	-2.941	1.166	Airflow: 50 Angle: -14
6.518	50.49	-13.5	-1.531	-0.122	-2.949	1.167	Airflow: 50 Angle: -14
6.524	50.51	-13.5	-1.519	-0.124	-2.965	1.168	Airflow: 50 Angle: -14
6.529	50.53	-13.5	-1.519	-0.112	-2.966	1.169	Airflow: 50 Angle: -14
6.534	50.55	-13.5	-1.501	-0.115	-2.933	1.169	Airflow: 50 Angle: -14
6.534	50.55	-13.5	-1.487	-0.119	-2.893	1.17	Airflow: 50 Angle: -14
6.529	50.53	-13.5	-1.456	-0.106	-2.856	1.171	Airflow: 50 Angle: -14
6.524	50.51	-13.5	-1.456	-0.111	-2.855	1.171	Airflow: 50 Angle: -14

6.513	50.47	-13.5	-1.418	-0.11	-2.745	1.172	Airflow: 50 Angle: -14
6.513	50.47	-13.5	-1.438	-0.111	-2.752	1.172	Airflow: 50 Angle: -14
6.435	50.17	-11.9	-1.499	-0.186	-3.258	1.178	Airflow: 50 Angle: -12
6.43	50.15	-11.9	-1.49	-0.186	-3.226	1.177	Airflow: 50 Angle: -12
6.43	50.15	-11.9	-1.474	-0.186	-3.215	1.176	Airflow: 50 Angle: -12
6.425	50.13	-11.9	-1.493	-0.187	-3.242	1.176	Airflow: 50 Angle: -12
6.42	50.11	-11.9	-1.476	-0.185	-3.215	1.175	Airflow: 50 Angle: -12
6.414	50.09	-11.9	-1.482	-0.186	-3.22	1.174	Airflow: 50 Angle: -12
6.414	50.09	-11.9	-1.485	-0.186	-3.241	1.173	Airflow: 50 Angle: -12
6.42	50.11	-11.9	-1.482	-0.186	-3.214	1.173	Airflow: 50 Angle: -12
6.42	50.11	-11.9	-1.5	-0.192	-3.264	1.172	Airflow: 50 Angle: -12
6.43	50.15	-11.9	-1.492	-0.191	-3.264	1.171	Airflow: 50 Angle: -12
6.378	49.95	-9.7	-1.327	-0.173	-2.946	1.167	Airflow: 50 Angle: -10
6.378	49.95	-9.7	-1.328	-0.174	-2.954	1.166	Airflow: 50 Angle: -10
6.378	49.95	-9.7	-1.335	-0.175	-2.963	1.166	Airflow: 50 Angle: -10
6.383	49.97	-9.7	-1.338	-0.175	-2.972	1.166	Airflow: 50 Angle: -10
6.388	49.99	-9.7	-1.342	-0.177	-2.977	1.166	Airflow: 50 Angle: -10
6.388	49.99	-9.7	-1.347	-0.176	-2.983	1.165	Airflow: 50 Angle: -10
6.399	50.03	-9.7	-1.351	-0.176	-3.005	1.165	Airflow: 50 Angle: -10
6.409	50.07	-9.7	-1.357	-0.176	-3.009	1.165	Airflow: 50 Angle: -10
6.414	50.09	-9.7	-1.353	-0.174	-3.006	1.166	Airflow: 50 Angle: -10
6.42	50.11	-9.7	-1.351	-0.174	-3.003	1.166	Airflow: 50 Angle: -10
6.466	50.29	-8	-1.136	-0.113	-2.471	1.18	Airflow: 50 Angle: -8
6.461	50.27	-8	-1.137	-0.113	-2.468	1.18	Airflow: 50 Angle: -8
6.456	50.25	-8	-1.132	-0.112	-2.465	1.179	Airflow: 50 Angle: -8
6.456	50.25	-8	-1.132	-0.112	-2.465	1.179	Airflow: 50 Angle: -8
6.451	50.23	-8	-1.132	-0.111	-2.464	1.179	Airflow: 50 Angle: -8
6.446	50.21	-8	-1.128	-0.111	-2.455	1.179	Airflow: 50 Angle: -8
6.44	50.19	-8	-1.131	-0.113	-2.458	1.178	Airflow: 50 Angle: -8
6.435	50.17	-8	-1.127	-0.113	-2.458	1.178	Airflow: 50 Angle: -8
6.43	50.15	-8	-1.123	-0.115	-2.442	1.177	Airflow: 50 Angle: -8
6.425	50.13	-8	-1.124	-0.117	-2.446	1.177	Airflow: 50 Angle: -8
6.44	50.19	-5.8	-0.916	-0.065	-1.919	1.176	Airflow: 50 Angle: -6
6.446	50.21	-5.8	-0.913	-0.065	-1.914	1.176	Airflow: 50 Angle: -6

6.451	50.23	-5.8	-0.913	-0.065	-1.912	1.177	Airflow: 50 Angle: -6
6.456	50.25	-5.8	-0.913	-0.065	-1.915	1.177	Airflow: 50 Angle: -6
6.456	50.25	-5.8	-0.913	-0.064	-1.915	1.177	Airflow: 50 Angle: -6
6.456	50.25	-5.8	-0.914	-0.064	-1.915	1.178	Airflow: 50 Angle: -6
6.461	50.27	-5.8	-0.915	-0.064	-1.915	1.178	Airflow: 50 Angle: -6
6.466	50.29	-5.8	-0.915	-0.064	-1.915	1.178	Airflow: 50 Angle: -6
6.472	50.31	-5.8	-0.915	-0.064	-1.915	1.178	Airflow: 50 Angle: -6
6.472	50.31	-5.8	-0.92	-0.063	-1.921	1.179	Airflow: 50 Angle: -6
6.446	50.21	-4.1	-0.664	-0.016	-1.298	1.181	Airflow: 50 Angle: -4
6.446	50.21	-4.1	-0.664	-0.018	-1.299	1.181	Airflow: 50 Angle: -4
6.44	50.19	-4.1	-0.667	-0.018	-1.309	1.182	Airflow: 50 Angle: -4
6.44	50.19	-4.1	-0.669	-0.019	-1.31	1.182	Airflow: 50 Angle: -4
6.44	50.19	-4.1	-0.669	-0.018	-1.309	1.182	Airflow: 50 Angle: -4
6.435	50.17	-4.1	-0.669	-0.019	-1.309	1.182	Airflow: 50 Angle: -4
6.435	50.17	-4.1	-0.669	-0.017	-1.305	1.182	Airflow: 50 Angle: -4
6.43	50.15	-4.1	-0.667	-0.016	-1.302	1.182	Airflow: 50 Angle: -4
6.425	50.13	-4.1	-0.665	-0.016	-1.294	1.182	Airflow: 50 Angle: -4
6.414	50.09	-4.1	-0.663	-0.016	-1.291	1.182	Airflow: 50 Angle: -4
6.44	50.19	-1.9	-0.363	0.024	-0.617	1.176	Airflow: 50 Angle: -2
6.44	50.19	-1.9	-0.365	0.029	-0.618	1.176	Airflow: 50 Angle: -2
6.44	50.19	-1.9	-0.368	0.026	-0.626	1.176	Airflow: 50 Angle: -2
6.446	50.21	-1.9	-0.369	0.026	-0.626	1.177	Airflow: 50 Angle: -2
6.44	50.19	-1.9	-0.369	0.023	-0.627	1.177	Airflow: 50 Angle: -2
6.44	50.19	-1.9	-0.369	0.023	-0.627	1.177	Airflow: 50 Angle: -2
6.435	50.17	-1.9	-0.368	0.023	-0.626	1.177	Airflow: 50 Angle: -2
6.435	50.17	-1.9	-0.366	0.023	-0.62	1.177	Airflow: 50 Angle: -2
6.435	50.17	-1.9	-0.367	0.024	-0.62	1.177	Airflow: 50 Angle: -2
6.435	50.17	-1.9	-0.361	0.027	-0.614	1.177	Airflow: 50 Angle: -2
6.466	50.29	-0.3	-0.022	0.041	0.131	1.186	Airflow: 50 Angle: 0
6.466	50.29	-0.3	-0.022	0.047	0.134	1.186	Airflow: 50 Angle: 0
6.472	50.31	-0.3	-0.019	0.046	0.139	1.186	Airflow: 50 Angle: 0
6.466	50.29	-0.3	-0.016	0.048	0.144	1.186	Airflow: 50 Angle: 0
6.461	50.27	-0.3	-0.02	0.046	0.139	1.186	Airflow: 50 Angle: 0
6.461	50.27	-0.3	-0.023	0.043	0.135	1.186	Airflow: 50 Angle: 0

6.451	50.23	-0.3	-0.024	0.044	0.135	1.186	Airflow: 50 Angle: 0
6.446	50.21	-0.3	-0.024	0.044	0.135	1.186	Airflow: 50 Angle: 0
6.446	50.21	-0.3	-0.019	0.044	0.138	1.185	Airflow: 50 Angle: 0
6.44	50.19	-0.3	-0.019	0.044	0.138	1.185	Airflow: 50 Angle: 0
6.42	50.11	1.9	0.26	0.057	0.778	1.189	Airflow: 50 Angle: 2
6.414	50.09	1.9	0.261	0.057	0.785	1.188	Airflow: 50 Angle: 2
6.409	50.07	1.9	0.265	0.057	0.792	1.187	Airflow: 50 Angle: 2
6.404	50.05	1.9	0.266	0.057	0.797	1.187	Airflow: 50 Angle: 2
6.399	50.03	1.9	0.269	0.057	0.802	1.186	Airflow: 50 Angle: 2
6.399	50.03	1.9	0.27	0.056	0.807	1.185	Airflow: 50 Angle: 2
6.399	50.03	1.9	0.271	0.057	0.808	1.184	Airflow: 50 Angle: 2
6.399	50.03	1.9	0.271	0.057	0.808	1.184	Airflow: 50 Angle: 2
6.404	50.05	1.9	0.27	0.055	0.808	1.183	Airflow: 50 Angle: 2
6.404	50.05	1.9	0.268	0.055	0.806	1.183	Airflow: 50 Angle: 2
6.425	50.13	3.6	0.508	0.045	1.373	1.18	Airflow: 50 Angle: 4
6.425	50.13	3.6	0.51	0.045	1.381	1.18	Airflow: 50 Angle: 4
6.425	50.13	3.6	0.511	0.046	1.384	1.18	Airflow: 50 Angle: 4
6.425	50.13	3.6	0.512	0.047	1.387	1.179	Airflow: 50 Angle: 4
6.42	50.11	3.6	0.511	0.046	1.386	1.179	Airflow: 50 Angle: 4
6.414	50.09	3.6	0.511	0.047	1.375	1.179	Airflow: 50 Angle: 4
6.409	50.07	3.6	0.511	0.047	1.373	1.179	Airflow: 50 Angle: 4
6.404	50.05	3.6	0.511	0.047	1.372	1.178	Airflow: 50 Angle: 4
6.399	50.03	3.6	0.512	0.047	1.373	1.178	Airflow: 50 Angle: 4
6.399	50.03	3.6	0.514	0.045	1.377	1.177	Airflow: 50 Angle: 4
6.414	50.09	5.8	0.743	0.028	1.93	1.177	Airflow: 50 Angle: 6
6.414	50.09	5.8	0.741	0.027	1.923	1.177	Airflow: 50 Angle: 6
6.414	50.09	5.8	0.748	0.026	1.941	1.177	Airflow: 50 Angle: 6
6.414	50.09	5.8	0.75	0.025	1.944	1.178	Airflow: 50 Angle: 6
6.42	50.11	5.8	0.755	0.025	1.956	1.178	Airflow: 50 Angle: 6
6.425	50.13	5.8	0.76	0.024	1.972	1.178	Airflow: 50 Angle: 6
6.43	50.15	5.8	0.761	0.024	1.975	1.178	Airflow: 50 Angle: 6
6.435	50.17	5.8	0.762	0.025	1.975	1.179	Airflow: 50 Angle: 6
6.44	50.19	5.8	0.765	0.025	1.979	1.18	Airflow: 50 Angle: 6
6.446	50.21	5.8	0.76	0.028	1.973	1.18	Airflow: 50 Angle: 6

6.529	50.53	7.4	0.96	0.029	2.426	1.191	Airflow: 50 Angle: 8
6.529	50.53	7.4	0.96	0.029	2.422	1.191	Airflow: 50 Angle: 8
6.529	50.53	7.4	0.965	0.027	2.423	1.192	Airflow: 50 Angle: 8
6.524	50.51	7.4	0.953	0.026	2.41	1.192	Airflow: 50 Angle: 8
6.513	50.47	7.4	0.952	0.022	2.403	1.193	Airflow: 50 Angle: 8
6.503	50.43	7.4	0.95	0.023	2.396	1.193	Airflow: 50 Angle: 8
6.492	50.39	7.4	0.935	0.024	2.37	1.193	Airflow: 50 Angle: 8
6.487	50.37	7.4	0.929	0.026	2.341	1.193	Airflow: 50 Angle: 8
6.477	50.33	7.4	0.927	0.026	2.338	1.192	Airflow: 50 Angle: 8
6.472	50.31	7.4	0.929	0.026	2.341	1.192	Airflow: 50 Angle: 8
6.414	50.09	9.6	0.945	0.155	2.043	1.181	Airflow: 50 Angle: 10
6.42	50.11	9.6	1.01	0.158	2.178	1.181	Airflow: 50 Angle: 10
6.425	50.13	9.6	0.978	0.158	2.111	1.181	Airflow: 50 Angle: 10
6.425	50.13	9.6	1.011	0.163	2.235	1.181	Airflow: 50 Angle: 10
6.43	50.15	9.6	0.994	0.165	2.138	1.181	Airflow: 50 Angle: 10
6.43	50.15	9.6	0.951	0.168	2.041	1.182	Airflow: 50 Angle: 10
6.435	50.17	9.6	0.943	0.177	1.987	1.182	Airflow: 50 Angle: 10
6.44	50.19	9.6	0.955	0.177	2.04	1.182	Airflow: 50 Angle: 10
6.44	50.19	9.6	0.991	0.179	2.058	1.182	Airflow: 50 Angle: 10
6.446	50.21	9.6	1.002	0.181	2.059	1.183	Airflow: 50 Angle: 10
6.378	49.95	11.6	0.917	0.215	1.937	1.179	Airflow: 50 Angle: 12
6.373	49.93	11.6	0.917	0.215	1.943	1.179	Airflow: 50 Angle: 12
6.373	49.93	11.6	0.913	0.22	1.898	1.179	Airflow: 50 Angle: 12
6.373	49.93	11.6	0.893	0.218	1.849	1.179	Airflow: 50 Angle: 12
6.383	49.97	11.6	0.909	0.218	1.898	1.179	Airflow: 50 Angle: 12
6.388	49.99	11.6	0.93	0.219	1.923	1.179	Airflow: 50 Angle: 12
6.399	50.03	11.6	0.943	0.22	1.935	1.179	Airflow: 50 Angle: 12
6.404	50.05	11.6	0.948	0.224	1.96	1.179	Airflow: 50 Angle: 12
6.409	50.07	11.6	0.945	0.224	1.944	1.18	Airflow: 50 Angle: 12
6.414	50.09	11.6	0.907	0.219	1.883	1.18	Airflow: 50 Angle: 12
6.362	49.89	13.5	0.892	0.279	1.804	1.174	Airflow: 50 Angle: 14
6.357	49.87	13.5	0.892	0.274	1.807	1.174	Airflow: 50 Angle: 14
6.352	49.85	13.5	0.884	0.268	1.803	1.174	Airflow: 50 Angle: 14
6.362	49.89	13.5	0.878	0.271	1.787	1.174	Airflow: 50 Angle: 14

6.368	49.91	13.5	0.884	0.269	1.792	1.174	Airflow: 50 Angle: 14
6.373	49.93	13.5	0.888	0.272	1.792	1.174	Airflow: 50 Angle: 14
6.378	49.95	13.5	0.905	0.277	1.84	1.174	Airflow: 50 Angle: 14
6.383	49.97	13.5	0.903	0.275	1.819	1.174	Airflow: 50 Angle: 14
6.388	49.99	13.5	0.889	0.271	1.821	1.174	Airflow: 50 Angle: 14
6.388	49.99	13.5	0.888	0.273	1.818	1.175	Airflow: 50 Angle: 14
6.253	49.46	15.7	0.858	0.311	1.69	1.157	Airflow: 50 Angle: 16
6.258	49.48	15.7	0.861	0.311	1.698	1.157	Airflow: 50 Angle: 16
6.264	49.5	15.7	0.866	0.311	1.711	1.157	Airflow: 50 Angle: 16
6.274	49.54	15.7	0.875	0.31	1.752	1.157	Airflow: 50 Angle: 16
6.29	49.6	15.7	0.875	0.306	1.754	1.158	Airflow: 50 Angle: 16
6.31	49.68	15.7	0.884	0.307	1.773	1.158	Airflow: 50 Angle: 16
6.326	49.74	15.7	0.899	0.309	1.809	1.159	Airflow: 50 Angle: 16
6.342	49.8	15.7	0.889	0.309	1.795	1.16	Airflow: 50 Angle: 16
6.357	49.87	15.7	0.887	0.31	1.773	1.16	Airflow: 50 Angle: 16
6.373	49.93	15.7	0.903	0.311	1.793	1.162	Airflow: 50 Angle: 16
6.388	49.99	17.3	0.914	0.333	1.811	1.175	Airflow: 50 Angle: 18
6.394	50.01	17.3	0.921	0.332	1.815	1.175	Airflow: 50 Angle: 18
6.394	50.01	17.3	0.914	0.332	1.792	1.175	Airflow: 50 Angle: 18
6.394	50.01	17.3	0.901	0.332	1.774	1.175	Airflow: 50 Angle: 18
6.394	50.01	17.3	0.885	0.33	1.769	1.175	Airflow: 50 Angle: 18
6.404	50.05	17.3	0.885	0.331	1.769	1.176	Airflow: 50 Angle: 18
6.404	50.05	17.3	0.934	0.332	1.836	1.176	Airflow: 50 Angle: 18
6.409	50.07	17.3	0.937	0.332	1.849	1.176	Airflow: 50 Angle: 18
6.42	50.11	17.3	0.938	0.331	1.861	1.176	Airflow: 50 Angle: 18
6.43	50.15	17.3	0.929	0.33	1.832	1.177	Airflow: 50 Angle: 18
6.388	49.99	19.6	0.984	0.356	1.959	1.175	Airflow: 50 Angle: 20
6.388	49.99	19.6	0.995	0.355	1.972	1.176	Airflow: 50 Angle: 20
6.394	50.01	19.6	0.989	0.355	1.972	1.177	Airflow: 50 Angle: 20
6.399	50.03	19.6	0.99	0.353	1.977	1.177	Airflow: 50 Angle: 20
6.404	50.05	19.6	0.99	0.354	1.977	1.178	Airflow: 50 Angle: 20
6.409	50.07	19.6	0.99	0.357	1.981	1.179	Airflow: 50 Angle: 20
6.409	50.07	19.6	1.007	0.365	2.012	1.18	Airflow: 50 Angle: 20
6.409	50.07	19.6	0.992	0.361	1.979	1.181	Airflow: 50 Angle: 20

6.409	50.07	19.6	0.988	0.361	1.967	1.181	Airflow: 50 Angle: 20
6.394	50.01	19.6	0.986	0.356	1.964	1.181	Airflow: 50 Angle: 20
6.269	49.52	21.5	1.063	0.378	2.11	1.162	Airflow: 50 Angle: 22
6.269	49.52	21.5	1.063	0.377	2.114	1.162	Airflow: 50 Angle: 22
6.274	49.54	21.5	1.073	0.378	2.116	1.163	Airflow: 50 Angle: 22
6.274	49.54	21.5	1.063	0.377	2.11	1.163	Airflow: 50 Angle: 22
6.279	49.56	21.5	1.028	0.373	2.04	1.163	Airflow: 50 Angle: 22
6.284	49.58	21.5	1.057	0.373	2.082	1.164	Airflow: 50 Angle: 22
6.305	49.66	21.5	1.023	0.369	2.04	1.164	Airflow: 50 Angle: 22
6.321	49.72	21.5	1.071	0.372	2.135	1.165	Airflow: 50 Angle: 22
6.347	49.83	21.5	1.099	0.373	2.188	1.166	Airflow: 50 Angle: 22
6.352	49.85	21.5	1.105	0.38	2.193	1.168	Airflow: 50 Angle: 22
12.584	70.16	21.8	2.437	0.529	4.759	2.305	Airflow: 70 Angle: 22
12.579	70.14	21.8	2.433	0.542	4.754	2.305	Airflow: 70 Angle: 22
12.584	70.16	21.8	2.402	0.527	4.699	2.305	Airflow: 70 Angle: 22
12.574	70.13	21.8	2.385	0.528	4.668	2.305	Airflow: 70 Angle: 22
12.574	70.13	21.8	2.402	0.511	4.7	2.305	Airflow: 70 Angle: 22
12.574	70.13	21.8	2.421	0.535	4.711	2.305	Airflow: 70 Angle: 22
12.569	70.12	21.8	2.421	0.512	4.708	2.304	Airflow: 70 Angle: 22
12.574	70.13	21.8	2.443	0.536	4.76	2.304	Airflow: 70 Angle: 22
12.564	70.1	21.8	2.436	0.533	4.76	2.304	Airflow: 70 Angle: 22
12.569	70.12	21.8	2.462	0.532	4.786	2.304	Airflow: 70 Angle: 22
12.735	70.58	19.6	2.287	0.521	4.463	2.344	Airflow: 70 Angle: 20
12.751	70.62	19.6	2.287	0.5	4.465	2.344	Airflow: 70 Angle: 20
12.756	70.64	19.6	2.258	0.507	4.444	2.345	Airflow: 70 Angle: 20
12.751	70.62	19.6	2.258	0.497	4.445	2.346	Airflow: 70 Angle: 20
12.746	70.61	19.6	2.281	0.498	4.445	2.346	Airflow: 70 Angle: 20
12.74	70.59	19.6	2.302	0.514	4.486	2.346	Airflow: 70 Angle: 20
12.74	70.59	19.6	2.281	0.503	4.44	2.346	Airflow: 70 Angle: 20
12.725	70.55	19.6	2.301	0.512	4.452	2.346	Airflow: 70 Angle: 20
12.714	70.52	19.6	2.301	0.505	4.453	2.346	Airflow: 70 Angle: 20
12.709	70.51	19.6	2.271	0.502	4.43	2.346	Airflow: 70 Angle: 20
12.746	70.61	17.3	2.099	0.48	4.092	2.359	Airflow: 70 Angle: 18
12.735	70.58	17.3	2.106	0.478	4.099	2.357	Airflow: 70 Angle: 18

12.72	70.54	17.3	2.099	0.478	4.092	2.355	Airflow: 70 Angle: 18
12.709	70.51	17.3	2.078	0.476	4.069	2.353	Airflow: 70 Angle: 18
12.683	70.43	17.3	2.036	0.474	3.97	2.351	Airflow: 70 Angle: 18
12.652	70.35	17.3	2.04	0.474	3.97	2.348	Airflow: 70 Angle: 18
12.631	70.29	17.3	2.037	0.473	3.953	2.346	Airflow: 70 Angle: 18
12.616	70.25	17.3	2.037	0.464	3.957	2.343	Airflow: 70 Angle: 18
12.605	70.22	17.3	2.053	0.477	4.016	2.341	Airflow: 70 Angle: 18
12.595	70.19	17.3	2.083	0.482	4.075	2.339	Airflow: 70 Angle: 18
12.803	70.77	15.7	2.121	0.459	4.204	2.365	Airflow: 70 Angle: 16
12.792	70.74	15.7	2.174	0.464	4.239	2.364	Airflow: 70 Angle: 16
12.787	70.72	15.7	2.174	0.463	4.24	2.363	Airflow: 70 Angle: 16
12.772	70.68	15.7	2.106	0.463	4.139	2.362	Airflow: 70 Angle: 16
12.772	70.68	15.7	2.09	0.458	4.084	2.361	Airflow: 70 Angle: 16
12.761	70.65	15.7	2.064	0.46	4.05	2.36	Airflow: 70 Angle: 16
12.761	70.65	15.7	2.073	0.461	4.069	2.359	Airflow: 70 Angle: 16
12.766	70.67	15.7	2.107	0.462	4.124	2.358	Airflow: 70 Angle: 16
12.746	70.61	15.7	2.107	0.462	4.124	2.357	Airflow: 70 Angle: 16
12.72	70.54	15.7	2.14	0.464	4.165	2.356	Airflow: 70 Angle: 16
12.642	70.32	13.5	2.135	0.387	4.199	2.321	Airflow: 70 Angle: 14
12.652	70.35	13.5	2.151	0.391	4.246	2.322	Airflow: 70 Angle: 14
12.662	70.38	13.5	2.12	0.39	4.165	2.323	Airflow: 70 Angle: 14
12.678	70.42	13.5	2.094	0.384	4.135	2.324	Airflow: 70 Angle: 14
12.673	70.41	13.5	2.092	0.382	4.073	2.325	Airflow: 70 Angle: 14
12.668	70.39	13.5	2.093	0.383	4.135	2.326	Airflow: 70 Angle: 14
12.662	70.38	13.5	2.131	0.385	4.211	2.327	Airflow: 70 Angle: 14
12.657	70.36	13.5	2.131	0.392	4.211	2.328	Airflow: 70 Angle: 14
12.647	70.33	13.5	2.132	0.392	4.211	2.328	Airflow: 70 Angle: 14
12.636	70.3	13.5	2.132	0.39	4.193	2.329	Airflow: 70 Angle: 14
12.61	70.23	11.6	2.031	0.307	4.012	2.326	Airflow: 70 Angle: 12
12.61	70.23	11.6	2.02	0.312	4.062	2.326	Airflow: 70 Angle: 12
12.61	70.23	11.6	2.02	0.318	4.05	2.327	Airflow: 70 Angle: 12
12.616	70.25	11.6	2.075	0.333	4.101	2.327	Airflow: 70 Angle: 12
12.616	70.25	11.6	2.154	0.337	4.267	2.328	Airflow: 70 Angle: 12
12.605	70.22	11.6	2.084	0.337	4.186	2.328	Airflow: 70 Angle: 12

12.605	70.22	11.6	2.068	0.332	4.15	2.328	Airflow: 70 Angle: 12
12.6	70.2	11.6	2.063	0.33	4.122	2.328	Airflow: 70 Angle: 12
12.6	70.2	11.6	2.068	0.333	4.145	2.328	Airflow: 70 Angle: 12
12.605	70.22	11.6	2.068	0.333	4.146	2.328	Airflow: 70 Angle: 12
12.605	70.22	9.6	2.21	0.197	4.634	2.332	Airflow: 70 Angle: 10
12.616	70.25	9.6	2.21	0.195	4.634	2.332	Airflow: 70 Angle: 10
12.605	70.22	9.6	2.244	0.199	4.766	2.332	Airflow: 70 Angle: 10
12.6	70.2	9.6	2.248	0.199	4.766	2.331	Airflow: 70 Angle: 10
12.6	70.2	9.6	2.245	0.213	4.596	2.331	Airflow: 70 Angle: 10
12.6	70.2	9.6	2.308	0.218	4.79	2.33	Airflow: 70 Angle: 10
12.605	70.22	9.6	2.245	0.215	4.596	2.33	Airflow: 70 Angle: 10
12.61	70.23	9.6	2.306	0.222	4.657	2.33	Airflow: 70 Angle: 10
12.616	70.25	9.6	2.191	0.233	4.494	2.33	Airflow: 70 Angle: 10
12.621	70.26	9.6	2.059	0.231	4.292	2.33	Airflow: 70 Angle: 10
12.527	70	7.7	2.312	-0.066	5.516	2.323	Airflow: 70 Angle: 8
12.538	70.03	7.7	2.318	-0.066	5.555	2.323	Airflow: 70 Angle: 8
12.553	70.07	7.7	2.339	-0.075	5.582	2.324	Airflow: 70 Angle: 8
12.569	70.12	7.7	2.339	-0.074	5.582	2.324	Airflow: 70 Angle: 8
12.574	70.13	7.7	2.328	-0.075	5.554	2.325	Airflow: 70 Angle: 8
12.595	70.19	7.7	2.316	-0.072	5.538	2.326	Airflow: 70 Angle: 8
12.616	70.25	7.7	2.315	-0.067	5.528	2.327	Airflow: 70 Angle: 8
12.636	70.3	7.7	2.315	-0.067	5.528	2.329	Airflow: 70 Angle: 8
12.662	70.38	7.7	2.341	-0.068	5.608	2.33	Airflow: 70 Angle: 8
12.683	70.43	7.7	2.35	-0.069	5.613	2.332	Airflow: 70 Angle: 8
12.522	69.99	5.8	1.918	-0.024	4.575	2.335	Airflow: 70 Angle: 6
12.506	69.94	5.8	1.897	-0.022	4.497	2.334	Airflow: 70 Angle: 6
12.501	69.93	5.8	1.889	-0.02	4.495	2.333	Airflow: 70 Angle: 6
12.496	69.91	5.8	1.884	-0.02	4.494	2.332	Airflow: 70 Angle: 6
12.496	69.91	5.8	1.894	-0.02	4.508	2.331	Airflow: 70 Angle: 6
12.496	69.91	5.8	1.905	-0.018	4.54	2.33	Airflow: 70 Angle: 6
12.501	69.93	5.8	1.928	-0.018	4.594	2.329	Airflow: 70 Angle: 6
12.496	69.91	5.8	1.937	-0.018	4.608	2.329	Airflow: 70 Angle: 6
12.506	69.94	5.8	1.942	-0.023	4.624	2.328	Airflow: 70 Angle: 6
12.506	69.94	5.8	1.945	-0.023	4.635	2.328	Airflow: 70 Angle: 6

12.595	70.19	3.9	1.47	0.038	3.453	2.346	Airflow: 70 Angle: 4
12.59	70.17	3.9	1.471	0.039	3.445	2.345	Airflow: 70 Angle: 4
12.584	70.16	3.9	1.472	0.039	3.435	2.344	Airflow: 70 Angle: 4
12.569	70.12	3.9	1.473	0.039	3.433	2.344	Airflow: 70 Angle: 4
12.558	70.09	3.9	1.473	0.039	3.427	2.343	Airflow: 70 Angle: 4
12.548	70.06	3.9	1.472	0.036	3.423	2.341	Airflow: 70 Angle: 4
12.543	70.04	3.9	1.471	0.036	3.422	2.34	Airflow: 70 Angle: 4
12.543	70.04	3.9	1.457	0.035	3.425	2.339	Airflow: 70 Angle: 4
12.548	70.06	3.9	1.458	0.036	3.473	2.338	Airflow: 70 Angle: 4
12.574	70.13	3.9	1.459	0.035	3.513	2.337	Airflow: 70 Angle: 4
12.558	70.09	1.9	1.154	0.094	2.227	2.336	Airflow: 70 Angle: 2
12.548	70.06	1.9	1.151	0.094	2.214	2.335	Airflow: 70 Angle: 2
12.543	70.04	1.9	1.15	0.084	2.214	2.334	Airflow: 70 Angle: 2
12.538	70.03	1.9	1.148	0.084	2.215	2.334	Airflow: 70 Angle: 2
12.532	70.01	1.9	1.144	0.076	2.231	2.333	Airflow: 70 Angle: 2
12.543	70.04	1.9	1.144	0.076	2.257	2.332	Airflow: 70 Angle: 2
12.538	70.03	1.9	1.144	0.085	2.26	2.332	Airflow: 70 Angle: 2
12.548	70.06	1.9	1.143	0.085	2.261	2.331	Airflow: 70 Angle: 2
12.548	70.06	1.9	1.143	0.086	2.266	2.331	Airflow: 70 Angle: 2
12.548	70.06	1.9	1.143	0.085	2.275	2.331	Airflow: 70 Angle: 2
12.59	70.17	-0.3	0.549	0.094	0.929	2.332	Airflow: 70 Angle: 0
12.59	70.17	-0.3	0.548	0.094	0.93	2.332	Airflow: 70 Angle: 0
12.59	70.17	-0.3	0.548	0.097	0.933	2.332	Airflow: 70 Angle: 0
12.59	70.17	-0.3	0.547	0.094	0.93	2.332	Airflow: 70 Angle: 0
12.595	70.19	-0.3	0.547	0.1	0.927	2.332	Airflow: 70 Angle: 0
12.584	70.16	-0.3	0.546	0.097	0.927	2.333	Airflow: 70 Angle: 0
12.569	70.12	-0.3	0.545	0.1	0.917	2.333	Airflow: 70 Angle: 0
12.548	70.06	-0.3	0.545	0.101	0.914	2.332	Airflow: 70 Angle: 0
12.532	70.01	-0.3	0.545	0.098	0.908	2.332	Airflow: 70 Angle: 0
12.517	69.97	-0.3	0.547	0.098	0.905	2.331	Airflow: 70 Angle: 0
12.61	70.23	-1.9	-0.069	0.085	-0.39	2.345	Airflow: 70 Angle: -2
12.605	70.22	-1.9	-0.07	0.079	-0.388	2.344	Airflow: 70 Angle: -2
12.61	70.23	-1.9	-0.071	0.079	-0.389	2.344	Airflow: 70 Angle: -2
12.605	70.22	-1.9	-0.073	0.078	-0.389	2.344	Airflow: 70 Angle: -2

12.6	70.2	-1.9	-0.074	0.078	-0.388	2.344	Airflow: 70 Angle: -2
12.59	70.17	-1.9	-0.074	0.077	-0.386	2.343	Airflow: 70 Angle: -2
12.595	70.19	-1.9	-0.076	0.079	-0.386	2.343	Airflow: 70 Angle: -2
12.59	70.17	-1.9	-0.077	0.082	-0.386	2.343	Airflow: 70 Angle: -2
12.584	70.16	-1.9	-0.077	0.084	-0.386	2.342	Airflow: 70 Angle: -2
12.584	70.16	-1.9	-0.077	0.081	-0.385	2.342	Airflow: 70 Angle: -2
12.543	70.04	-4.1	-0.665	0.032	-1.814	2.331	Airflow: 70 Angle: -4
12.548	70.06	-4.1	-0.664	0.032	-1.814	2.331	Airflow: 70 Angle: -4
12.553	70.07	-4.1	-0.664	0.032	-1.815	2.331	Airflow: 70 Angle: -4
12.564	70.1	-4.1	-0.665	0.032	-1.81	2.331	Airflow: 70 Angle: -4
12.569	70.12	-4.1	-0.666	0.037	-1.812	2.331	Airflow: 70 Angle: -4
12.569	70.12	-4.1	-0.666	0.031	-1.81	2.331	Airflow: 70 Angle: -4
12.574	70.13	-4.1	-0.667	0.031	-1.81	2.331	Airflow: 70 Angle: -4
12.579	70.14	-4.1	-0.667	0.029	-1.812	2.331	Airflow: 70 Angle: -4
12.59	70.17	-4.1	-0.668	0.029	-1.812	2.332	Airflow: 70 Angle: -4
12.6	70.2	-4.1	-0.669	0.028	-1.815	2.332	Airflow: 70 Angle: -4
12.642	70.32	-5.8	-1.182	-0.021	-2.997	2.343	Airflow: 70 Angle: -6
12.636	70.3	-5.8	-1.183	-0.021	-2.996	2.343	Airflow: 70 Angle: -6
12.631	70.29	-5.8	-1.183	-0.02	-2.992	2.344	Airflow: 70 Angle: -6
12.616	70.25	-5.8	-1.183	-0.02	-2.991	2.344	Airflow: 70 Angle: -6
12.6	70.2	-5.8	-1.183	-0.021	-2.984	2.344	Airflow: 70 Angle: -6
12.59	70.17	-5.8	-1.184	-0.022	-2.98	2.344	Airflow: 70 Angle: -6
12.579	70.14	-5.8	-1.184	-0.027	-2.974	2.343	Airflow: 70 Angle: -6
12.569	70.12	-5.8	-1.184	-0.029	-2.974	2.343	Airflow: 70 Angle: -6
12.564	70.1	-5.8	-1.183	-0.03	-2.988	2.342	Airflow: 70 Angle: -6
12.569	70.12	-5.8	-1.184	-0.03	-3	2.342	Airflow: 70 Angle: -6
12.595	70.19	-8	-1.67	-0.14	-4.282	2.338	Airflow: 70 Angle: -8
12.59	70.17	-8	-1.672	-0.14	-4.268	2.338	Airflow: 70 Angle: -8
12.584	70.16	-8	-1.672	-0.141	-4.241	2.338	Airflow: 70 Angle: -8
12.574	70.13	-8	-1.673	-0.141	-4.214	2.338	Airflow: 70 Angle: -8
12.574	70.13	-8	-1.673	-0.141	-4.187	2.338	Airflow: 70 Angle: -8
12.564	70.1	-8	-1.674	-0.14	-4.165	2.337	Airflow: 70 Angle: -8
12.564	70.1	-8	-1.674	-0.14	-4.163	2.337	Airflow: 70 Angle: -8
12.564	70.1	-8	-1.675	-0.14	-4.165	2.337	Airflow: 70 Angle: -8

12.558	70.09	-8	-1.676	-0.141	-4.172	2.336	Airflow: 70 Angle: -8
12.558	70.09	-8	-1.674	-0.142	-4.184	2.336	Airflow: 70 Angle: -8
12.558	70.09	-9.7	-2.109	-0.272	-5.397	2.334	Airflow: 70 Angle: -10
12.564	70.1	-9.7	-2.111	-0.273	-5.394	2.334	Airflow: 70 Angle: -10
12.579	70.14	-9.7	-2.113	-0.273	-5.396	2.334	Airflow: 70 Angle: -10
12.595	70.19	-9.7	-2.113	-0.274	-5.397	2.335	Airflow: 70 Angle: -10
12.605	70.22	-9.7	-2.113	-0.272	-5.417	2.335	Airflow: 70 Angle: -10
12.626	70.28	-9.7	-2.116	-0.271	-5.429	2.336	Airflow: 70 Angle: -10
12.642	70.32	-9.7	-2.118	-0.267	-5.434	2.338	Airflow: 70 Angle: -10
12.652	70.35	-9.7	-2.119	-0.267	-5.44	2.339	Airflow: 70 Angle: -10
12.668	70.39	-9.7	-2.121	-0.274	-5.434	2.34	Airflow: 70 Angle: -10
12.668	70.39	-9.7	-2.121	-0.274	-5.434	2.341	Airflow: 70 Angle: -10
12.626	70.28	-11.6	-2.398	-0.368	-6.271	2.338	Airflow: 70 Angle: -12
12.626	70.28	-11.6	-2.402	-0.367	-6.256	2.339	Airflow: 70 Angle: -12
12.626	70.28	-11.6	-2.406	-0.367	-6.241	2.339	Airflow: 70 Angle: -12
12.631	70.29	-11.6	-2.407	-0.367	-6.234	2.34	Airflow: 70 Angle: -12
12.636	70.3	-11.6	-2.408	-0.368	-6.233	2.341	Airflow: 70 Angle: -12
12.642	70.32	-11.6	-2.408	-0.368	-6.234	2.341	Airflow: 70 Angle: -12
12.647	70.33	-11.6	-2.408	-0.371	-6.23	2.342	Airflow: 70 Angle: -12
12.647	70.33	-11.6	-2.41	-0.371	-6.229	2.342	Airflow: 70 Angle: -12
12.636	70.3	-11.6	-2.412	-0.371	-6.209	2.343	Airflow: 70 Angle: -12
12.626	70.28	-11.6	-2.414	-0.372	-6.197	2.343	Airflow: 70 Angle: -12
12.381	69.59	-13.5	-2.705	-0.144	-5.7	2.298	Airflow: 70 Angle: -14
12.392	69.62	-13.5	-2.706	-0.118	-5.749	2.299	Airflow: 70 Angle: -14
12.413	69.68	-13.5	-2.711	-0.145	-5.803	2.301	Airflow: 70 Angle: -14
12.428	69.72	-13.5	-2.697	-0.145	-5.803	2.302	Airflow: 70 Angle: -14
12.449	69.78	-13.5	-2.681	-0.145	-5.743	2.303	Airflow: 70 Angle: -14
12.465	69.83	-13.5	-2.666	-0.145	-5.729	2.304	Airflow: 70 Angle: -14
12.47	69.84	-13.5	-2.613	-0.138	-5.693	2.306	Airflow: 70 Angle: -14
12.475	69.85	-13.5	-2.613	-0.125	-5.657	2.307	Airflow: 70 Angle: -14
12.496	69.91	-13.5	-2.573	-0.137	-5.693	2.308	Airflow: 70 Angle: -14
12.522	69.99	-13.5	-2.573	-0.136	-5.665	2.31	Airflow: 70 Angle: -14
12.574	70.13	-15.7	-2.342	-0.029	-4.688	2.334	Airflow: 70 Angle: -16
12.574	70.13	-15.7	-2.333	-0.027	-4.665	2.334	Airflow: 70 Angle: -16

12.584	70.16	-15.7	-2.308	-0.02	-4.607	2.334	Airflow: 70 Angle: -16
12.59	70.17	-15.7	-2.286	-0.018	-4.552	2.334	Airflow: 70 Angle: -16
12.584	70.16	-15.7	-2.267	-0.028	-4.5	2.334	Airflow: 70 Angle: -16
12.574	70.13	-15.7	-2.257	-0.025	-4.499	2.334	Airflow: 70 Angle: -16
12.558	70.09	-15.7	-2.286	-0.029	-4.54	2.334	Airflow: 70 Angle: -16
12.548	70.06	-15.7	-2.329	-0.03	-4.54	2.334	Airflow: 70 Angle: -16
12.558	70.09	-15.7	-2.318	-0.029	-4.54	2.333	Airflow: 70 Angle: -16
12.558	70.09	-15.7	-2.334	-0.028	-4.616	2.333	Airflow: 70 Angle: -16

Table D.2 – KFm 0012 Data

The data timestamp, and orientation columns are not included

q	V_ref	Alpha	NF/SF	AF/AF2	PM/YM	P	Notes
[psf]	[mph]	[deg]	[lbf]	[lbf]	[in-lbf]	[inH2O]	
0	0	0	-0.255	0.013	-0.4	0.002	Airflow: 0 Angle: 0
0	0	0	-0.255	0.012	-0.4	0.002	Airflow: 0 Angle: 0
0	0	0	-0.255	0.013	-0.402	0.002	Airflow: 0 Angle: 0
0	0	0	-0.255	0.011	-0.403	0.002	Airflow: 0 Angle: 0
0	0	0	-0.256	0.008	-0.403	0.001	Airflow: 0 Angle: 0
0	0	0	-0.256	0.008	-0.403	0.001	Airflow: 0 Angle: 0
0	0	0	-0.254	0.009	-0.404	0.001	Airflow: 0 Angle: 0
0	0	0	-0.254	0.008	-0.403	0.001	Airflow: 0 Angle: 0
0	0	0	-0.254	0.009	-0.403	0.001	Airflow: 0 Angle: 0
0	0	0	-0.254	0.01	-0.402	0.001	Airflow: 0 Angle: 0
6.399	50.03	-15.5	-1.358	-0.08	-2.532	1.162	Airflow: 50 Angle: -16
6.404	50.05	-15.5	-1.379	-0.081	-2.547	1.162	Airflow: 50 Angle: -16
6.399	50.03	-15.5	-1.374	-0.081	-2.532	1.162	Airflow: 50 Angle: -16
6.404	50.05	-15.5	-1.374	-0.081	-2.532	1.161	Airflow: 50 Angle: -16
6.409	50.07	-15.5	-1.356	-0.08	-2.512	1.161	Airflow: 50 Angle: -16
6.409	50.07	-15.5	-1.356	-0.078	-2.512	1.161	Airflow: 50 Angle: -16
6.414	50.09	-15.5	-1.36	-0.078	-2.515	1.161	Airflow: 50 Angle: -16
6.404	50.05	-15.5	-1.36	-0.078	-2.518	1.161	Airflow: 50 Angle: -16
6.409	50.07	-15.5	-1.391	-0.087	-2.596	1.161	Airflow: 50 Angle: -16
6.409	50.07	-15.5	-1.391	-0.088	-2.596	1.161	Airflow: 50 Angle: -16

6.352	49.85	-13.3	-1.42	-0.08	-2.739	1.163	Airflow: 50 Angle: -14
6.357	49.87	-13.3	-1.418	-0.075	-2.727	1.162	Airflow: 50 Angle: -14
6.357	49.87	-13.3	-1.418	-0.075	-2.68	1.162	Airflow: 50 Angle: -14
6.362	49.89	-13.3	-1.411	-0.07	-2.68	1.161	Airflow: 50 Angle: -14
6.362	49.89	-13.3	-1.411	-0.07	-2.68	1.161	Airflow: 50 Angle: -14
6.362	49.89	-13.3	-1.419	-0.075	-2.725	1.16	Airflow: 50 Angle: -14
6.362	49.89	-13.3	-1.468	-0.076	-2.771	1.16	Airflow: 50 Angle: -14
6.362	49.89	-13.3	-1.457	-0.074	-2.764	1.16	Airflow: 50 Angle: -14
6.362	49.89	-13.3	-1.456	-0.078	-2.763	1.16	Airflow: 50 Angle: -14
6.362	49.89	-13.3	-1.41	-0.071	-2.642	1.159	Airflow: 50 Angle: -14
6.43	50.15	-11.6	-1.467	-0.135	-3.033	1.18	Airflow: 50 Angle: -12
6.43	50.15	-11.6	-1.458	-0.132	-3.012	1.179	Airflow: 50 Angle: -12
6.43	50.15	-11.6	-1.464	-0.125	-2.948	1.178	Airflow: 50 Angle: -12
6.435	50.17	-11.6	-1.464	-0.123	-2.949	1.178	Airflow: 50 Angle: -12
6.43	50.15	-11.6	-1.448	-0.12	-2.949	1.177	Airflow: 50 Angle: -12
6.425	50.13	-11.6	-1.468	-0.124	-2.96	1.176	Airflow: 50 Angle: -12
6.42	50.11	-11.6	-1.461	-0.121	-2.96	1.176	Airflow: 50 Angle: -12
6.409	50.07	-11.6	-1.456	-0.121	-2.984	1.175	Airflow: 50 Angle: -12
6.404	50.05	-11.6	-1.456	-0.12	-2.993	1.175	Airflow: 50 Angle: -12
6.399	50.03	-11.6	-1.456	-0.12	-2.993	1.174	Airflow: 50 Angle: -12
6.383	49.97	-9.4	-1.355	-0.157	-2.933	1.168	Airflow: 50 Angle: -10
6.383	49.97	-9.4	-1.355	-0.158	-2.94	1.168	Airflow: 50 Angle: -10
6.378	49.95	-9.4	-1.355	-0.159	-2.95	1.168	Airflow: 50 Angle: -10
6.378	49.95	-9.4	-1.359	-0.159	-2.952	1.168	Airflow: 50 Angle: -10
6.378	49.95	-9.4	-1.359	-0.158	-2.952	1.168	Airflow: 50 Angle: -10
6.378	49.95	-9.4	-1.355	-0.155	-2.936	1.168	Airflow: 50 Angle: -10
6.378	49.95	-9.4	-1.353	-0.155	-2.932	1.167	Airflow: 50 Angle: -10
6.373	49.93	-9.4	-1.353	-0.155	-2.931	1.167	Airflow: 50 Angle: -10
6.373	49.93	-9.4	-1.354	-0.157	-2.934	1.167	Airflow: 50 Angle: -10
6.378	49.95	-9.4	-1.356	-0.157	-2.938	1.166	Airflow: 50 Angle: -10
6.404	50.05	-7.7	-1.144	-0.105	-2.439	1.163	Airflow: 50 Angle: -8
6.414	50.09	-7.7	-1.144	-0.105	-2.439	1.164	Airflow: 50 Angle: -8
6.425	50.13	-7.7	-1.144	-0.104	-2.436	1.164	Airflow: 50 Angle: -8
6.435	50.17	-7.7	-1.144	-0.104	-2.433	1.165	Airflow: 50 Angle: -8

6.44	50.19	-7.7	-1.143	-0.104	-2.429	1.166	Airflow: 50 Angle: -8
6.451	50.23	-7.7	-1.138	-0.103	-2.426	1.167	Airflow: 50 Angle: -8
6.461	50.27	-7.7	-1.138	-0.104	-2.422	1.168	Airflow: 50 Angle: -8
6.466	50.29	-7.7	-1.138	-0.105	-2.423	1.169	Airflow: 50 Angle: -8
6.466	50.29	-7.7	-1.136	-0.105	-2.422	1.17	Airflow: 50 Angle: -8
6.466	50.29	-7.7	-1.133	-0.105	-2.405	1.171	Airflow: 50 Angle: -8
6.409	50.07	-5.5	-0.883	-0.048	-1.819	1.171	Airflow: 50 Angle: -6
6.414	50.09	-5.5	-0.882	-0.048	-1.819	1.171	Airflow: 50 Angle: -6
6.414	50.09	-5.5	-0.882	-0.046	-1.819	1.171	Airflow: 50 Angle: -6
6.414	50.09	-5.5	-0.882	-0.044	-1.819	1.171	Airflow: 50 Angle: -6
6.414	50.09	-5.5	-0.882	-0.043	-1.818	1.171	Airflow: 50 Angle: -6
6.414	50.09	-5.5	-0.881	-0.042	-1.816	1.171	Airflow: 50 Angle: -6
6.414	50.09	-5.5	-0.878	-0.042	-1.812	1.171	Airflow: 50 Angle: -6
6.414	50.09	-5.5	-0.877	-0.042	-1.812	1.171	Airflow: 50 Angle: -6
6.409	50.07	-5.5	-0.877	-0.043	-1.812	1.171	Airflow: 50 Angle: -6
6.404	50.05	-5.5	-0.876	-0.043	-1.805	1.171	Airflow: 50 Angle: -6
6.336	49.78	-3.9	-0.587	0.012	-1.149	1.168	Airflow: 50 Angle: -4
6.331	49.76	-3.9	-0.586	0.01	-1.152	1.168	Airflow: 50 Angle: -4
6.326	49.74	-3.9	-0.586	0.009	-1.153	1.167	Airflow: 50 Angle: -4
6.326	49.74	-3.9	-0.587	0.009	-1.156	1.167	Airflow: 50 Angle: -4
6.326	49.74	-3.9	-0.587	0.01	-1.155	1.166	Airflow: 50 Angle: -4
6.321	49.72	-3.9	-0.589	0.01	-1.155	1.166	Airflow: 50 Angle: -4
6.321	49.72	-3.9	-0.589	0.01	-1.155	1.166	Airflow: 50 Angle: -4
6.321	49.72	-3.9	-0.589	0.01	-1.155	1.165	Airflow: 50 Angle: -4
6.326	49.74	-3.9	-0.589	0.012	-1.157	1.165	Airflow: 50 Angle: -4
6.336	49.78	-3.9	-0.59	0.011	-1.159	1.165	Airflow: 50 Angle: -4
6.368	49.91	-1.7	-0.326	0.05	-0.535	1.169	Airflow: 50 Angle: -2
6.368	49.91	-1.7	-0.326	0.051	-0.533	1.169	Airflow: 50 Angle: -2
6.373	49.93	-1.7	-0.326	0.05	-0.532	1.169	Airflow: 50 Angle: -2
6.378	49.95	-1.7	-0.327	0.052	-0.535	1.17	Airflow: 50 Angle: -2
6.383	49.97	-1.7	-0.326	0.053	-0.531	1.17	Airflow: 50 Angle: -2
6.388	49.99	-1.7	-0.328	0.052	-0.534	1.17	Airflow: 50 Angle: -2
6.388	49.99	-1.7	-0.327	0.052	-0.537	1.171	Airflow: 50 Angle: -2
6.388	49.99	-1.7	-0.325	0.052	-0.532	1.171	Airflow: 50 Angle: -2

6.394	50.01	-1.7	-0.327	0.052	-0.539	1.172	Airflow: 50 Angle: -2
6.399	50.03	-1.7	-0.327	0.054	-0.533	1.172	Airflow: 50 Angle: -2
6.435	50.17	0	-0.046	0.077	0.093	1.173	Airflow: 50 Angle: 0
6.435	50.17	0	-0.046	0.074	0.094	1.174	Airflow: 50 Angle: 0
6.43	50.15	0	-0.049	0.073	0.093	1.174	Airflow: 50 Angle: 0
6.425	50.13	0	-0.049	0.073	0.092	1.174	Airflow: 50 Angle: 0
6.414	50.09	0	-0.051	0.074	0.09	1.174	Airflow: 50 Angle: 0
6.404	50.05	0	-0.052	0.072	0.086	1.174	Airflow: 50 Angle: 0
6.404	50.05	0	-0.052	0.074	0.086	1.174	Airflow: 50 Angle: 0
6.394	50.01	0	-0.052	0.074	0.085	1.174	Airflow: 50 Angle: 0
6.388	49.99	0	-0.052	0.072	0.085	1.174	Airflow: 50 Angle: 0
6.383	49.97	0	-0.049	0.071	0.086	1.174	Airflow: 50 Angle: 0
6.368	49.91	2.2	0.213	0.087	0.7	1.175	Airflow: 50 Angle: 2
6.373	49.93	2.2	0.214	0.087	0.704	1.175	Airflow: 50 Angle: 2
6.373	49.93	2.2	0.214	0.087	0.704	1.175	Airflow: 50 Angle: 2
6.373	49.93	2.2	0.212	0.087	0.704	1.175	Airflow: 50 Angle: 2
6.373	49.93	2.2	0.212	0.088	0.704	1.175	Airflow: 50 Angle: 2
6.378	49.95	2.2	0.212	0.088	0.701	1.175	Airflow: 50 Angle: 2
6.383	49.97	2.2	0.211	0.087	0.697	1.175	Airflow: 50 Angle: 2
6.388	49.99	2.2	0.211	0.089	0.699	1.175	Airflow: 50 Angle: 2
6.399	50.03	2.2	0.21	0.089	0.698	1.175	Airflow: 50 Angle: 2
6.409	50.07	2.2	0.21	0.09	0.702	1.176	Airflow: 50 Angle: 2
6.331	49.76	4.2	0.483	0.076	1.341	1.174	Airflow: 50 Angle: 4
6.331	49.76	4.2	0.486	0.077	1.346	1.173	Airflow: 50 Angle: 4
6.331	49.76	4.2	0.489	0.076	1.353	1.173	Airflow: 50 Angle: 4
6.331	49.76	4.2	0.493	0.074	1.374	1.172	Airflow: 50 Angle: 4
6.336	49.78	4.2	0.497	0.074	1.379	1.172	Airflow: 50 Angle: 4
6.336	49.78	4.2	0.499	0.072	1.384	1.172	Airflow: 50 Angle: 4
6.342	49.8	4.2	0.498	0.073	1.379	1.171	Airflow: 50 Angle: 4
6.336	49.78	4.2	0.498	0.072	1.374	1.171	Airflow: 50 Angle: 4
6.336	49.78	4.2	0.495	0.075	1.37	1.171	Airflow: 50 Angle: 4
6.342	49.8	4.2	0.493	0.077	1.364	1.171	Airflow: 50 Angle: 4
6.368	49.91	6.1	0.724	0.051	1.859	1.179	Airflow: 50 Angle: 6
6.368	49.91	6.1	0.724	0.051	1.859	1.178	Airflow: 50 Angle: 6

6.362	49.89	6.1	0.723	0.052	1.859	1.178	Airflow: 50 Angle: 6
6.368	49.91	6.1	0.722	0.052	1.859	1.177	Airflow: 50 Angle: 6
6.362	49.89	6.1	0.723	0.054	1.859	1.176	Airflow: 50 Angle: 6
6.362	49.89	6.1	0.723	0.053	1.864	1.176	Airflow: 50 Angle: 6
6.362	49.89	6.1	0.724	0.051	1.863	1.175	Airflow: 50 Angle: 6
6.357	49.87	6.1	0.724	0.051	1.863	1.175	Airflow: 50 Angle: 6
6.357	49.87	6.1	0.723	0.051	1.858	1.174	Airflow: 50 Angle: 6
6.357	49.87	6.1	0.722	0.054	1.853	1.174	Airflow: 50 Angle: 6
6.394	50.01	8	0.925	0.038	2.308	1.18	Airflow: 50 Angle: 8
6.388	49.99	8	0.918	0.039	2.294	1.18	Airflow: 50 Angle: 8
6.383	49.97	8	0.917	0.038	2.289	1.179	Airflow: 50 Angle: 8
6.373	49.93	8	0.909	0.037	2.276	1.179	Airflow: 50 Angle: 8
6.368	49.91	8	0.908	0.037	2.272	1.179	Airflow: 50 Angle: 8
6.362	49.89	8	0.91	0.034	2.274	1.178	Airflow: 50 Angle: 8
6.357	49.87	8	0.912	0.037	2.275	1.177	Airflow: 50 Angle: 8
6.357	49.87	8	0.912	0.037	2.278	1.177	Airflow: 50 Angle: 8
6.352	49.85	8	0.912	0.037	2.28	1.176	Airflow: 50 Angle: 8
6.347	49.83	8	0.912	0.038	2.278	1.176	Airflow: 50 Angle: 8
6.279	49.56	9.9	0.767	0.21	1.574	1.158	Airflow: 50 Angle: 10
6.279	49.56	9.9	0.767	0.21	1.568	1.159	Airflow: 50 Angle: 10
6.284	49.58	9.9	0.785	0.211	1.59	1.159	Airflow: 50 Angle: 10
6.279	49.56	9.9	0.781	0.212	1.59	1.159	Airflow: 50 Angle: 10
6.274	49.54	9.9	0.772	0.212	1.571	1.16	Airflow: 50 Angle: 10
6.279	49.56	9.9	0.773	0.214	1.594	1.16	Airflow: 50 Angle: 10
6.279	49.56	9.9	0.773	0.212	1.594	1.16	Airflow: 50 Angle: 10
6.279	49.56	9.9	0.778	0.212	1.601	1.16	Airflow: 50 Angle: 10
6.274	49.54	9.9	0.798	0.216	1.637	1.16	Airflow: 50 Angle: 10
6.274	49.54	9.9	0.778	0.215	1.596	1.161	Airflow: 50 Angle: 10
6.414	50.09	11.6	0.825	0.247	1.662	1.175	Airflow: 50 Angle: 12
6.42	50.11	11.6	0.808	0.251	1.648	1.176	Airflow: 50 Angle: 12
6.425	50.13	11.6	0.813	0.253	1.669	1.177	Airflow: 50 Angle: 12
6.425	50.13	11.6	0.794	0.25	1.621	1.178	Airflow: 50 Angle: 12
6.425	50.13	11.6	0.798	0.25	1.622	1.179	Airflow: 50 Angle: 12
6.425	50.13	11.6	0.775	0.253	1.59	1.18	Airflow: 50 Angle: 12

6.414	50.09	11.6	0.79	0.25	1.602	1.18	Airflow: 50 Angle: 12
6.404	50.05	11.6	0.798	0.257	1.622	1.181	Airflow: 50 Angle: 12
6.394	50.01	11.6	0.793	0.251	1.619	1.181	Airflow: 50 Angle: 12
6.388	49.99	11.6	0.79	0.25	1.617	1.181	Airflow: 50 Angle: 12
6.336	49.78	13.8	0.825	0.282	1.676	1.169	Airflow: 50 Angle: 14
6.342	49.8	13.8	0.826	0.277	1.677	1.169	Airflow: 50 Angle: 14
6.347	49.83	13.8	0.846	0.277	1.715	1.17	Airflow: 50 Angle: 14
6.352	49.85	13.8	0.845	0.276	1.699	1.17	Airflow: 50 Angle: 14
6.352	49.85	13.8	0.846	0.278	1.723	1.171	Airflow: 50 Angle: 14
6.352	49.85	13.8	0.837	0.279	1.697	1.172	Airflow: 50 Angle: 14
6.352	49.85	13.8	0.834	0.279	1.682	1.172	Airflow: 50 Angle: 14
6.347	49.83	13.8	0.811	0.278	1.653	1.172	Airflow: 50 Angle: 14
6.342	49.8	13.8	0.811	0.279	1.653	1.173	Airflow: 50 Angle: 14
6.342	49.8	13.8	0.822	0.279	1.66	1.173	Airflow: 50 Angle: 14
6.284	49.58	16	0.909	0.3	1.811	1.157	Airflow: 50 Angle: 16
6.29	49.6	16	0.904	0.3	1.811	1.157	Airflow: 50 Angle: 16
6.3	49.64	16	0.892	0.304	1.8	1.158	Airflow: 50 Angle: 16
6.305	49.66	16	0.892	0.302	1.8	1.159	Airflow: 50 Angle: 16
6.316	49.7	16	0.882	0.299	1.774	1.159	Airflow: 50 Angle: 16
6.326	49.74	16	0.871	0.301	1.759	1.16	Airflow: 50 Angle: 16
6.331	49.76	16	0.895	0.299	1.811	1.161	Airflow: 50 Angle: 16
6.336	49.78	16	0.895	0.303	1.811	1.162	Airflow: 50 Angle: 16
6.336	49.78	16	0.903	0.305	1.81	1.162	Airflow: 50 Angle: 16
6.336	49.78	16	0.904	0.304	1.813	1.163	Airflow: 50 Angle: 16
6.3	49.64	17.6	0.929	0.322	1.874	1.158	Airflow: 50 Angle: 18
6.305	49.66	17.6	0.929	0.32	1.881	1.159	Airflow: 50 Angle: 18
6.31	49.68	17.6	0.927	0.32	1.873	1.16	Airflow: 50 Angle: 18
6.321	49.72	17.6	0.931	0.321	1.881	1.16	Airflow: 50 Angle: 18
6.336	49.78	17.6	0.938	0.325	1.887	1.161	Airflow: 50 Angle: 18
6.342	49.8	17.6	0.938	0.325	1.897	1.163	Airflow: 50 Angle: 18
6.357	49.87	17.6	0.931	0.32	1.865	1.164	Airflow: 50 Angle: 18
6.368	49.91	17.6	0.931	0.323	1.876	1.165	Airflow: 50 Angle: 18
6.378	49.95	17.6	0.931	0.32	1.882	1.166	Airflow: 50 Angle: 18
6.388	49.99	17.6	0.931	0.315	1.883	1.168	Airflow: 50 Angle: 18

6.409	50.07	19.8	1.022	0.345	2.044	1.181	Airflow: 50 Angle: 20
6.409	50.07	19.8	1.023	0.345	2.044	1.18	Airflow: 50 Angle: 20
6.409	50.07	19.8	1.021	0.345	2.036	1.181	Airflow: 50 Angle: 20
6.404	50.05	19.8	1.023	0.345	2.036	1.18	Airflow: 50 Angle: 20
6.404	50.05	19.8	1.009	0.344	2.021	1.18	Airflow: 50 Angle: 20
6.394	50.01	19.8	1.001	0.342	2.014	1.18	Airflow: 50 Angle: 20
6.394	50.01	19.8	1.001	0.341	2.014	1.18	Airflow: 50 Angle: 20
6.388	49.99	19.8	1.007	0.343	2.008	1.179	Airflow: 50 Angle: 20
6.388	49.99	19.8	1.014	0.343	2.028	1.179	Airflow: 50 Angle: 20
6.388	49.99	19.8	1.014	0.343	2.029	1.179	Airflow: 50 Angle: 20
6.227	49.35	21.8	1.091	0.35	2.176	1.146	Airflow: 50 Angle: 22
6.227	49.35	21.8	1.096	0.364	2.184	1.146	Airflow: 50 Angle: 22
6.238	49.39	21.8	1.091	0.348	2.176	1.146	Airflow: 50 Angle: 22
6.232	49.37	21.8	1.1	0.349	2.187	1.147	Airflow: 50 Angle: 22
6.227	49.35	21.8	1.085	0.348	2.154	1.147	Airflow: 50 Angle: 22
6.217	49.31	21.8	1.063	0.355	2.111	1.148	Airflow: 50 Angle: 22
6.212	49.29	21.8	1.048	0.354	2.092	1.148	Airflow: 50 Angle: 22
6.206	49.27	21.8	1.046	0.354	2.092	1.148	Airflow: 50 Angle: 22
6.206	49.27	21.8	1.056	0.354	2.121	1.148	Airflow: 50 Angle: 22
6.212	49.29	21.8	1.087	0.356	2.171	1.148	Airflow: 50 Angle: 22
12.6	70.2	21.8	2.478	0.514	4.873	2.288	Airflow: 70 Angle: 22
12.636	70.3	21.8	2.467	0.495	4.858	2.29	Airflow: 70 Angle: 22
12.673	70.41	21.8	2.478	0.519	4.873	2.292	Airflow: 70 Angle: 22
12.678	70.42	21.8	2.508	0.512	4.938	2.294	Airflow: 70 Angle: 22
12.714	70.52	21.8	2.515	0.516	4.96	2.297	Airflow: 70 Angle: 22
12.73	70.56	21.8	2.524	0.512	4.969	2.299	Airflow: 70 Angle: 22
12.756	70.64	21.8	2.542	0.514	4.99	2.302	Airflow: 70 Angle: 22
12.766	70.67	21.8	2.521	0.508	4.96	2.304	Airflow: 70 Angle: 22
12.777	70.69	21.8	2.521	0.518	4.959	2.307	Airflow: 70 Angle: 22
12.772	70.68	21.8	2.496	0.492	4.902	2.309	Airflow: 70 Angle: 22
12.766	70.67	19.8	2.263	0.494	4.459	2.359	Airflow: 70 Angle: 20
12.735	70.58	19.8	2.25	0.494	4.437	2.356	Airflow: 70 Angle: 20
12.699	70.48	19.8	2.239	0.492	4.411	2.354	Airflow: 70 Angle: 20
12.678	70.42	19.8	2.239	0.492	4.408	2.351	Airflow: 70 Angle: 20

12.657	70.36	19.8	2.228	0.485	4.392	2.348	Airflow: 70 Angle: 20
12.647	70.33	19.8	2.228	0.486	4.392	2.345	Airflow: 70 Angle: 20
12.642	70.32	19.8	2.261	0.483	4.454	2.342	Airflow: 70 Angle: 20
12.642	70.32	19.8	2.261	0.483	4.461	2.339	Airflow: 70 Angle: 20
12.652	70.35	19.8	2.282	0.497	4.496	2.337	Airflow: 70 Angle: 20
12.657	70.36	19.8	2.282	0.497	4.496	2.336	Airflow: 70 Angle: 20
12.704	70.49	17.6	2.084	0.461	4.12	2.34	Airflow: 70 Angle: 18
12.678	70.42	17.6	2.076	0.46	4.107	2.339	Airflow: 70 Angle: 18
12.668	70.39	17.6	2.103	0.462	4.183	2.339	Airflow: 70 Angle: 18
12.673	70.41	17.6	2.087	0.465	4.137	2.338	Airflow: 70 Angle: 18
12.673	70.41	17.6	2.123	0.467	4.183	2.337	Airflow: 70 Angle: 18
12.678	70.42	17.6	2.1	0.472	4.149	2.337	Airflow: 70 Angle: 18
12.683	70.43	17.6	2.1	0.478	4.149	2.336	Airflow: 70 Angle: 18
12.673	70.41	17.6	2.1	0.472	4.149	2.336	Airflow: 70 Angle: 18
12.673	70.41	17.6	2.1	0.471	4.149	2.336	Airflow: 70 Angle: 18
12.673	70.41	17.6	2.098	0.468	4.138	2.336	Airflow: 70 Angle: 18
12.699	70.48	16	1.988	0.441	3.917	2.347	Airflow: 70 Angle: 16
12.699	70.48	16	2.011	0.446	3.951	2.346	Airflow: 70 Angle: 16
12.694	70.46	16	2.029	0.449	3.996	2.345	Airflow: 70 Angle: 16
12.694	70.46	16	2.031	0.449	4.012	2.345	Airflow: 70 Angle: 16
12.694	70.46	16	2.042	0.449	4.016	2.344	Airflow: 70 Angle: 16
12.688	70.45	16	2.033	0.447	4.012	2.344	Airflow: 70 Angle: 16
12.683	70.43	16	2.038	0.441	4.013	2.343	Airflow: 70 Angle: 16
12.668	70.39	16	2.033	0.444	4.007	2.342	Airflow: 70 Angle: 16
12.662	70.38	16	1.964	0.44	3.869	2.341	Airflow: 70 Angle: 16
12.647	70.33	16	1.929	0.433	3.826	2.34	Airflow: 70 Angle: 16
12.787	70.72	13.8	1.955	0.406	3.812	2.353	Airflow: 70 Angle: 14
12.772	70.68	13.8	1.955	0.403	3.812	2.353	Airflow: 70 Angle: 14
12.766	70.67	13.8	1.955	0.4	3.813	2.352	Airflow: 70 Angle: 14
12.751	70.62	13.8	1.961	0.401	3.828	2.352	Airflow: 70 Angle: 14
12.73	70.56	13.8	1.961	0.401	3.828	2.351	Airflow: 70 Angle: 14
12.72	70.54	13.8	1.939	0.4	3.792	2.35	Airflow: 70 Angle: 14
12.714	70.52	13.8	1.939	0.402	3.792	2.35	Airflow: 70 Angle: 14
12.699	70.48	13.8	1.913	0.401	3.769	2.349	Airflow: 70 Angle: 14

12.694	70.46	13.8	1.939	0.408	3.792	2.348	Airflow: 70 Angle: 14
12.678	70.42	13.8	1.957	0.408	3.853	2.347	Airflow: 70 Angle: 14
12.647	70.33	11.9	1.834	0.362	3.568	2.342	Airflow: 70 Angle: 12
12.636	70.3	11.9	1.861	0.364	3.651	2.342	Airflow: 70 Angle: 12
12.631	70.29	11.9	1.861	0.37	3.65	2.341	Airflow: 70 Angle: 12
12.626	70.28	11.9	1.862	0.369	3.65	2.34	Airflow: 70 Angle: 12
12.621	70.26	11.9	1.866	0.371	3.651	2.339	Airflow: 70 Angle: 12
12.621	70.26	11.9	1.866	0.356	3.652	2.339	Airflow: 70 Angle: 12
12.621	70.26	11.9	1.85	0.353	3.65	2.338	Airflow: 70 Angle: 12
12.616	70.25	11.9	1.848	0.36	3.632	2.338	Airflow: 70 Angle: 12
12.616	70.25	11.9	1.816	0.363	3.602	2.337	Airflow: 70 Angle: 12
12.61	70.23	11.9	1.816	0.364	3.602	2.336	Airflow: 70 Angle: 12
12.616	70.25	9.9	1.913	0.315	3.793	2.346	Airflow: 70 Angle: 10
12.584	70.16	9.9	1.874	0.313	3.733	2.344	Airflow: 70 Angle: 10
12.569	70.12	9.9	1.873	0.31	3.695	2.343	Airflow: 70 Angle: 10
12.564	70.1	9.9	1.841	0.309	3.677	2.341	Airflow: 70 Angle: 10
12.553	70.07	9.9	1.863	0.313	3.695	2.34	Airflow: 70 Angle: 10
12.548	70.06	9.9	1.894	0.326	3.715	2.338	Airflow: 70 Angle: 10
12.548	70.06	9.9	1.9	0.333	3.8	2.337	Airflow: 70 Angle: 10
12.548	70.06	9.9	1.987	0.343	3.887	2.336	Airflow: 70 Angle: 10
12.548	70.06	9.9	1.902	0.334	3.822	2.334	Airflow: 70 Angle: 10
12.558	70.09	9.9	1.926	0.334	3.821	2.333	Airflow: 70 Angle: 10
12.647	70.33	7.7	2.202	-0.042	5.223	2.335	Airflow: 70 Angle: 8
12.652	70.35	7.7	2.202	-0.036	5.222	2.336	Airflow: 70 Angle: 8
12.647	70.33	7.7	2.202	-0.034	5.219	2.337	Airflow: 70 Angle: 8
12.631	70.29	7.7	2.189	-0.033	5.193	2.337	Airflow: 70 Angle: 8
12.621	70.26	7.7	2.174	-0.034	5.139	2.337	Airflow: 70 Angle: 8
12.61	70.23	7.7	2.159	-0.035	5.123	2.337	Airflow: 70 Angle: 8
12.595	70.19	7.7	2.155	-0.035	5.111	2.336	Airflow: 70 Angle: 8
12.584	70.16	7.7	2.155	-0.031	5.109	2.336	Airflow: 70 Angle: 8
12.574	70.13	7.7	2.155	-0.031	5.109	2.335	Airflow: 70 Angle: 8
12.564	70.1	7.7	2.147	-0.032	5.077	2.334	Airflow: 70 Angle: 8
12.662	70.38	6.1	1.854	0.019	4.427	2.349	Airflow: 70 Angle: 6
12.657	70.36	6.1	1.861	0.015	4.44	2.348	Airflow: 70 Angle: 6

12.652	70.35	6.1	1.861	0.016	4.44	2.347	Airflow: 70 Angle: 6
12.647	70.33	6.1	1.853	0.016	4.423	2.346	Airflow: 70 Angle: 6
12.647	70.33	6.1	1.848	0.015	4.406	2.345	Airflow: 70 Angle: 6
12.647	70.33	6.1	1.83	0.017	4.357	2.345	Airflow: 70 Angle: 6
12.626	70.28	6.1	1.814	0.018	4.323	2.344	Airflow: 70 Angle: 6
12.616	70.25	6.1	1.785	0.019	4.271	2.342	Airflow: 70 Angle: 6
12.605	70.22	6.1	1.776	0.016	4.256	2.341	Airflow: 70 Angle: 6
12.605	70.22	6.1	1.776	0.015	4.256	2.34	Airflow: 70 Angle: 6
12.584	70.16	4.1	1.32	0.089	3.238	2.334	Airflow: 70 Angle: 4
12.59	70.17	4.1	1.321	0.089	3.239	2.333	Airflow: 70 Angle: 4
12.59	70.17	4.1	1.329	0.085	3.258	2.333	Airflow: 70 Angle: 4
12.579	70.14	4.1	1.329	0.085	3.261	2.333	Airflow: 70 Angle: 4
12.584	70.16	4.1	1.336	0.083	3.272	2.333	Airflow: 70 Angle: 4
12.579	70.14	4.1	1.336	0.083	3.272	2.332	Airflow: 70 Angle: 4
12.569	70.12	4.1	1.337	0.083	3.276	2.332	Airflow: 70 Angle: 4
12.564	70.1	4.1	1.337	0.083	3.276	2.331	Airflow: 70 Angle: 4
12.553	70.07	4.1	1.335	0.086	3.272	2.33	Airflow: 70 Angle: 4
12.548	70.06	4.2	1.33	0.086	3.247	2.33	Airflow: 70 Angle: 4
12.595	70.19	2.2	0.697	0.129	1.874	2.346	Airflow: 70 Angle: 2
12.59	70.17	2.2	0.701	0.13	1.877	2.344	Airflow: 70 Angle: 2
12.579	70.14	2.2	0.703	0.13	1.89	2.343	Airflow: 70 Angle: 2
12.574	70.13	2.2	0.71	0.129	1.909	2.342	Airflow: 70 Angle: 2
12.569	70.12	2.2	0.712	0.124	1.918	2.341	Airflow: 70 Angle: 2
12.564	70.1	2.2	0.713	0.125	1.919	2.341	Airflow: 70 Angle: 2
12.569	70.12	2.2	0.713	0.125	1.92	2.34	Airflow: 70 Angle: 2
12.569	70.12	2.2	0.717	0.125	1.92	2.34	Airflow: 70 Angle: 2
12.584	70.16	2.2	0.718	0.125	1.935	2.34	Airflow: 70 Angle: 2
12.579	70.14	2.2	0.723	0.126	1.938	2.34	Airflow: 70 Angle: 2
12.694	70.46	0	0.234	0.124	0.756	2.343	Airflow: 70 Angle: 0
12.694	70.46	0	0.237	0.124	0.76	2.344	Airflow: 70 Angle: 0
12.688	70.45	0	0.231	0.127	0.757	2.344	Airflow: 70 Angle: 0
12.683	70.43	0	0.231	0.127	0.749	2.344	Airflow: 70 Angle: 0
12.678	70.42	0	0.232	0.127	0.751	2.344	Airflow: 70 Angle: 0
12.673	70.41	0	0.232	0.126	0.751	2.344	Airflow: 70 Angle: 0

12.673	70.41	0	0.232	0.127	0.754	2.343	Airflow: 70 Angle: 0
12.673	70.41	0	0.233	0.127	0.754	2.344	Airflow: 70 Angle: 0
12.657	70.36	0	0.233	0.129	0.753	2.343	Airflow: 70 Angle: 0
12.642	70.32	0	0.233	0.127	0.75	2.343	Airflow: 70 Angle: 0
12.642	70.32	-1.7	-0.352	0.105	-0.584	2.34	Airflow: 70 Angle: -2
12.642	70.32	-1.7	-0.348	0.104	-0.574	2.339	Airflow: 70 Angle: -2
12.642	70.32	-1.7	-0.346	0.105	-0.57	2.339	Airflow: 70 Angle: -2
12.642	70.32	-1.7	-0.343	0.104	-0.57	2.339	Airflow: 70 Angle: -2
12.642	70.32	-1.7	-0.343	0.105	-0.568	2.339	Airflow: 70 Angle: -2
12.647	70.33	-1.7	-0.346	0.105	-0.569	2.339	Airflow: 70 Angle: -2
12.662	70.38	-1.7	-0.347	0.111	-0.572	2.339	Airflow: 70 Angle: -2
12.668	70.39	-1.7	-0.348	0.108	-0.573	2.339	Airflow: 70 Angle: -2
12.668	70.39	-1.7	-0.349	0.107	-0.576	2.339	Airflow: 70 Angle: -2
12.662	70.38	-1.7	-0.349	0.107	-0.574	2.34	Airflow: 70 Angle: -2
12.564	70.1	-3.9	-0.874	0.058	-1.8	2.332	Airflow: 70 Angle: -4
12.558	70.09	-3.9	-0.874	0.055	-1.8	2.332	Airflow: 70 Angle: -4
12.553	70.07	-3.9	-0.873	0.056	-1.801	2.331	Airflow: 70 Angle: -4
12.564	70.1	-3.9	-0.877	0.058	-1.808	2.331	Airflow: 70 Angle: -4
12.569	70.12	-3.9	-0.879	0.061	-1.816	2.331	Airflow: 70 Angle: -4
12.569	70.12	-3.9	-0.881	0.061	-1.822	2.331	Airflow: 70 Angle: -4
12.564	70.1	-3.9	-0.882	0.058	-1.823	2.331	Airflow: 70 Angle: -4
12.558	70.09	-3.9	-0.88	0.053	-1.82	2.331	Airflow: 70 Angle: -4
12.543	70.04	-3.9	-0.876	0.053	-1.813	2.331	Airflow: 70 Angle: -4
12.543	70.04	-3.9	-0.874	0.057	-1.808	2.331	Airflow: 70 Angle: -4
12.678	70.42	-5.5	-1.428	-0.012	-3.069	2.343	Airflow: 70 Angle: -6
12.678	70.42	-5.5	-1.427	-0.012	-3.066	2.343	Airflow: 70 Angle: -6
12.673	70.41	-5.5	-1.427	-0.012	-3.069	2.344	Airflow: 70 Angle: -6
12.668	70.39	-5.5	-1.425	-0.012	-3.06	2.344	Airflow: 70 Angle: -6
12.662	70.38	-5.5	-1.428	-0.011	-3.064	2.344	Airflow: 70 Angle: -6
12.662	70.38	-5.5	-1.428	-0.01	-3.067	2.344	Airflow: 70 Angle: -6
12.657	70.36	-5.5	-1.425	-0.01	-3.063	2.344	Airflow: 70 Angle: -6
12.657	70.36	-5.5	-1.427	-0.009	-3.065	2.344	Airflow: 70 Angle: -6
12.657	70.36	-5.5	-1.425	-0.011	-3.065	2.344	Airflow: 70 Angle: -6
12.657	70.36	-5.5	-1.427	-0.011	-3.065	2.344	Airflow: 70 Angle: -6

12.616	70.25	-7.7	-2.01	-0.132	-4.402	2.337	Airflow: 70 Angle: -8
12.616	70.25	-7.7	-2.01	-0.132	-4.406	2.338	Airflow: 70 Angle: -8
12.621	70.26	-7.7	-2.009	-0.13	-4.406	2.338	Airflow: 70 Angle: -8
12.621	70.26	-7.7	-2.007	-0.131	-4.408	2.338	Airflow: 70 Angle: -8
12.621	70.26	-7.7	-2.006	-0.131	-4.406	2.338	Airflow: 70 Angle: -8
12.621	70.26	-7.7	-2.004	-0.131	-4.399	2.339	Airflow: 70 Angle: -8
12.616	70.25	-7.7	-2.004	-0.131	-4.396	2.339	Airflow: 70 Angle: -8
12.616	70.25	-7.7	-1.999	-0.132	-4.383	2.339	Airflow: 70 Angle: -8
12.61	70.23	-7.7	-1.999	-0.132	-4.383	2.339	Airflow: 70 Angle: -8
12.61	70.23	-7.7	-1.998	-0.136	-4.379	2.339	Airflow: 70 Angle: -8
12.579	70.14	-9.4	-2.457	-0.247	-5.432	2.332	Airflow: 70 Angle: -10
12.584	70.16	-9.4	-2.461	-0.246	-5.45	2.332	Airflow: 70 Angle: -10
12.584	70.16	-9.4	-2.471	-0.249	-5.472	2.332	Airflow: 70 Angle: -10
12.59	70.17	-9.4	-2.477	-0.252	-5.483	2.332	Airflow: 70 Angle: -10
12.6	70.2	-9.4	-2.483	-0.253	-5.499	2.333	Airflow: 70 Angle: -10
12.605	70.22	-9.4	-2.483	-0.256	-5.499	2.333	Airflow: 70 Angle: -10
12.616	70.25	-9.4	-2.482	-0.252	-5.499	2.334	Airflow: 70 Angle: -10
12.626	70.28	-9.4	-2.485	-0.251	-5.502	2.334	Airflow: 70 Angle: -10
12.631	70.29	-9.4	-2.485	-0.251	-5.519	2.335	Airflow: 70 Angle: -10
12.636	70.3	-9.4	-2.485	-0.249	-5.519	2.336	Airflow: 70 Angle: -10
12.636	70.3	-11.3	-2.832	-0.283	-6.192	2.344	Airflow: 70 Angle: -12
12.631	70.29	-11.3	-2.87	-0.285	-6.215	2.344	Airflow: 70 Angle: -12
12.636	70.3	-11.3	-2.864	-0.292	-6.272	2.344	Airflow: 70 Angle: -12
12.636	70.3	-11.3	-2.864	-0.292	-6.272	2.343	Airflow: 70 Angle: -12
12.636	70.3	-11.3	-2.867	-0.287	-6.306	2.343	Airflow: 70 Angle: -12
12.636	70.3	-11.3	-2.864	-0.287	-6.256	2.343	Airflow: 70 Angle: -12
12.636	70.3	-11.3	-2.864	-0.284	-6.235	2.343	Airflow: 70 Angle: -12
12.636	70.3	-11.3	-2.866	-0.285	-6.265	2.342	Airflow: 70 Angle: -12
12.631	70.29	-11.3	-2.84	-0.278	-6.221	2.342	Airflow: 70 Angle: -12
12.626	70.28	-11.3	-2.797	-0.265	-6.029	2.342	Airflow: 70 Angle: -12
12.605	70.22	-13.3	-2.68	-0.078	-5.192	2.332	Airflow: 70 Angle: -14
12.605	70.22	-13.3	-2.649	-0.053	-5.069	2.332	Airflow: 70 Angle: -14
12.6	70.2	-13.3	-2.658	-0.053	-5.069	2.331	Airflow: 70 Angle: -14
12.595	70.19	-13.3	-2.723	-0.068	-5.265	2.331	Airflow: 70 Angle: -14

12.6	70.2	-13.3	-2.723	-0.068	-5.265	2.331	Airflow: 70 Angle: -14
12.605	70.22	-13.3	-2.764	-0.075	-5.314	2.331	Airflow: 70 Angle: -14
12.616	70.25	-13.3	-2.764	-0.075	-5.314	2.331	Airflow: 70 Angle: -14
12.621	70.26	-13.3	-2.75	-0.074	-5.284	2.332	Airflow: 70 Angle: -14
12.631	70.29	-13.3	-2.752	-0.077	-5.403	2.332	Airflow: 70 Angle: -14
12.626	70.28	-13.3	-2.673	-0.072	-5.131	2.333	Airflow: 70 Angle: -14
12.47	69.84	-15.5	-2.539	-0.038	-4.756	2.309	Airflow: 70 Angle: -16
12.475	69.85	-15.5	-2.542	-0.039	-4.756	2.31	Airflow: 70 Angle: -16
12.47	69.84	-15.5	-2.526	-0.034	-4.743	2.311	Airflow: 70 Angle: -16
12.47	69.84	-15.5	-2.565	-0.04	-4.805	2.311	Airflow: 70 Angle: -16
12.48	69.87	-15.5	-2.578	-0.049	-4.838	2.312	Airflow: 70 Angle: -16
12.491	69.9	-15.5	-2.646	-0.043	-4.938	2.312	Airflow: 70 Angle: -16
12.506	69.94	-15.5	-2.687	-0.059	-5.055	2.313	Airflow: 70 Angle: -16
12.506	69.94	-15.5	-2.683	-0.054	-5.056	2.314	Airflow: 70 Angle: -16
12.501	69.93	-15.5	-2.65	-0.046	-4.942	2.315	Airflow: 70 Angle: -16
12.506	69.94	-15.5	-2.604	-0.043	-4.848	2.316	Airflow: 70 Angle: -16

Table D.3 – NACA 4412 Data

The data timestamp, and orientation columns are not included

q	V_ref	Alpha	NF/SF	AF/AF2	PM/YM	P	Notes
[psf]	[mph]	[deg]	[lbf]	[lbf]	[in-lbf]	[inH2O]	
0	0	0	-0.296	0.004	-0.501	-0.007	Airflow: 0 Angle: 0
0	0	0	-0.295	0.004	-0.5	-0.007	Airflow: 0 Angle: 0
0	0	0	-0.295	0.005	-0.5	-0.007	Airflow: 0 Angle: 0
0	0	0	-0.296	0.005	-0.5	-0.007	Airflow: 0 Angle: 0
0	0	0	-0.297	0.006	-0.5	-0.007	Airflow: 0 Angle: 0
0	0	0	-0.297	0.006	-0.502	-0.007	Airflow: 0 Angle: 0
0	0	0	-0.296	0.006	-0.502	-0.007	Airflow: 0 Angle: 0
0	0	0	-0.295	0.005	-0.502	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.295	0.004	-0.503	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.295	0.004	-0.503	-0.006	Airflow: 0 Angle: 0
6.466	50.29	-15.5	-0.562	-0.008	-2.039	1.15	Airflow: 50 Angle: -16
6.466	50.29	-15.5	-0.562	-0.008	-2.049	1.15	Airflow: 50 Angle: -16

6.466	50.29	-15.5	-0.561	-0.007	-2.049	1.151	Airflow: 50 Angle: -16
6.466	50.29	-15.5	-0.561	-0.008	-2.049	1.152	Airflow: 50 Angle: -16
6.461	50.27	-15.5	-0.559	-0.01	-2.054	1.152	Airflow: 50 Angle: -16
6.456	50.25	-15.5	-0.56	-0.011	-2.062	1.152	Airflow: 50 Angle: -16
6.456	50.25	-15.5	-0.562	-0.011	-2.077	1.153	Airflow: 50 Angle: -16
6.456	50.25	-15.5	-0.564	-0.011	-2.085	1.153	Airflow: 50 Angle: -16
6.456	50.25	-15.5	-0.564	-0.01	-2.073	1.153	Airflow: 50 Angle: -16
6.451	50.23	-15.5	-0.564	-0.011	-2.073	1.154	Airflow: 50 Angle: -16
6.466	50.29	-13.3	-0.57	-0.005	-2.006	1.164	Airflow: 50 Angle: -14
6.472	50.31	-13.3	-0.57	-0.004	-2.006	1.164	Airflow: 50 Angle: -14
6.472	50.31	-13.3	-0.571	-0.009	-2.016	1.164	Airflow: 50 Angle: -14
6.477	50.33	-13.3	-0.571	-0.009	-2.026	1.164	Airflow: 50 Angle: -14
6.482	50.35	-13.3	-0.572	-0.01	-2.029	1.164	Airflow: 50 Angle: -14
6.482	50.35	-13.3	-0.573	-0.009	-2.05	1.165	Airflow: 50 Angle: -14
6.482	50.35	-13.3	-0.573	-0.009	-2.052	1.165	Airflow: 50 Angle: -14
6.477	50.33	-13.3	-0.573	-0.007	-2.039	1.165	Airflow: 50 Angle: -14
6.477	50.33	-13.3	-0.576	-0.006	-2.052	1.165	Airflow: 50 Angle: -14
6.477	50.33	-13.3	-0.576	-0.006	-2.07	1.165	Airflow: 50 Angle: -14
6.461	50.27	-11.6	-0.569	-0.002	-2.018	1.172	Airflow: 50 Angle: -12
6.466	50.29	-11.6	-0.568	-0.002	-2.018	1.172	Airflow: 50 Angle: -12
6.466	50.29	-11.6	-0.568	0.002	-1.983	1.172	Airflow: 50 Angle: -12
6.466	50.29	-11.6	-0.568	0.003	-1.976	1.172	Airflow: 50 Angle: -12
6.461	50.27	-11.6	-0.568	0.002	-1.988	1.172	Airflow: 50 Angle: -12
6.456	50.25	-11.6	-0.568	0.004	-1.988	1.171	Airflow: 50 Angle: -12
6.456	50.25	-11.6	-0.567	0	-1.99	1.171	Airflow: 50 Angle: -12
6.451	50.23	-11.6	-0.567	-0.001	-1.994	1.171	Airflow: 50 Angle: -12
6.446	50.21	-11.6	-0.567	-0.001	-1.99	1.171	Airflow: 50 Angle: -12
6.44	50.19	-11.6	-0.57	-0.001	-2.005	1.17	Airflow: 50 Angle: -12
6.508	50.45	-9.4	-0.556	0.008	-1.994	1.184	Airflow: 50 Angle: -10
6.508	50.45	-9.4	-0.556	0.006	-2.007	1.184	Airflow: 50 Angle: -10
6.508	50.45	-9.4	-0.556	0.007	-1.959	1.184	Airflow: 50 Angle: -10
6.503	50.43	-9.4	-0.556	0.006	-1.991	1.184	Airflow: 50 Angle: -10
6.498	50.41	-9.4	-0.556	0.005	-1.991	1.184	Airflow: 50 Angle: -10
6.492	50.39	-9.4	-0.556	0.007	-1.99	1.183	Airflow: 50 Angle: -10

6.492	50.39	-9.4	-0.554	0.005	-1.99	1.183	Airflow: 50 Angle: -10
6.487	50.37	-9.4	-0.553	0.005	-1.961	1.183	Airflow: 50 Angle: -10
6.482	50.35	-9.4	-0.553	0.005	-1.953	1.182	Airflow: 50 Angle: -10
6.482	50.35	-9.4	-0.553	0.004	-1.953	1.182	Airflow: 50 Angle: -10
6.503	50.43	-7.7	-0.492	-0.016	-2.043	1.192	Airflow: 50 Angle: -8
6.498	50.41	-7.7	-0.492	-0.015	-2.047	1.191	Airflow: 50 Angle: -8
6.492	50.39	-7.7	-0.492	-0.016	-2.054	1.19	Airflow: 50 Angle: -8
6.482	50.35	-7.7	-0.492	-0.014	-2.056	1.189	Airflow: 50 Angle: -8
6.477	50.33	-7.7	-0.492	-0.008	-2.06	1.188	Airflow: 50 Angle: -8
6.466	50.29	-7.7	-0.492	-0.009	-2.07	1.187	Airflow: 50 Angle: -8
6.456	50.25	-7.7	-0.492	-0.01	-2.07	1.186	Airflow: 50 Angle: -8
6.456	50.25	-7.7	-0.492	-0.008	-2.067	1.186	Airflow: 50 Angle: -8
6.44	50.19	-7.7	-0.493	-0.009	-2.07	1.184	Airflow: 50 Angle: -8
6.435	50.17	-7.7	-0.496	-0.009	-2.063	1.183	Airflow: 50 Angle: -8
6.383	49.97	-5.5	-0.42	-0.021	-1.323	1.17	Airflow: 50 Angle: -6
6.383	49.97	-5.5	-0.418	-0.021	-1.323	1.17	Airflow: 50 Angle: -6
6.383	49.97	-5.5	-0.418	-0.019	-1.324	1.169	Airflow: 50 Angle: -6
6.378	49.95	-5.5	-0.418	-0.019	-1.324	1.169	Airflow: 50 Angle: -6
6.378	49.95	-5.5	-0.418	-0.019	-1.325	1.169	Airflow: 50 Angle: -6
6.378	49.95	-5.5	-0.418	-0.019	-1.324	1.168	Airflow: 50 Angle: -6
6.378	49.95	-5.5	-0.418	-0.02	-1.325	1.168	Airflow: 50 Angle: -6
6.373	49.93	-5.5	-0.418	-0.019	-1.32	1.167	Airflow: 50 Angle: -6
6.378	49.95	-5.5	-0.418	-0.019	-1.32	1.167	Airflow: 50 Angle: -6
6.383	49.97	-5.5	-0.419	-0.019	-1.32	1.166	Airflow: 50 Angle: -6
6.43	50.15	-3.9	-0.135	0.022	-0.559	1.18	Airflow: 50 Angle: -4
6.435	50.17	-3.9	-0.135	0.022	-0.554	1.179	Airflow: 50 Angle: -4
6.44	50.19	-3.9	-0.135	0.023	-0.554	1.179	Airflow: 50 Angle: -4
6.446	50.21	-3.9	-0.135	0.023	-0.552	1.179	Airflow: 50 Angle: -4
6.451	50.23	-3.9	-0.135	0.024	-0.552	1.179	Airflow: 50 Angle: -4
6.456	50.25	-3.9	-0.135	0.023	-0.552	1.178	Airflow: 50 Angle: -4
6.466	50.29	-3.9	-0.135	0.021	-0.551	1.179	Airflow: 50 Angle: -4
6.477	50.33	-3.9	-0.135	0.021	-0.552	1.179	Airflow: 50 Angle: -4
6.482	50.35	-3.9	-0.135	0.022	-0.552	1.179	Airflow: 50 Angle: -4
6.477	50.33	-3.9	-0.135	0.021	-0.552	1.179	Airflow: 50 Angle: -4

6.399	50.03	-1.7	0.138	0.04	0.111	1.175	Airflow: 50 Angle: -2
6.399	50.03	-1.7	0.138	0.039	0.113	1.174	Airflow: 50 Angle: -2
6.399	50.03	-1.7	0.138	0.039	0.114	1.174	Airflow: 50 Angle: -2
6.404	50.05	-1.7	0.138	0.039	0.111	1.173	Airflow: 50 Angle: -2
6.409	50.07	-1.7	0.137	0.038	0.107	1.173	Airflow: 50 Angle: -2
6.414	50.09	-1.7	0.137	0.039	0.112	1.173	Airflow: 50 Angle: -2
6.425	50.13	-1.7	0.137	0.038	0.112	1.173	Airflow: 50 Angle: -2
6.43	50.15	-1.7	0.137	0.036	0.112	1.173	Airflow: 50 Angle: -2
6.435	50.17	-1.7	0.137	0.039	0.112	1.173	Airflow: 50 Angle: -2
6.435	50.17	-1.7	0.137	0.037	0.111	1.174	Airflow: 50 Angle: -2
6.482	50.35	0	0.402	0.047	0.763	1.185	Airflow: 50 Angle: 0
6.477	50.33	0	0.403	0.047	0.764	1.185	Airflow: 50 Angle: 0
6.466	50.29	0	0.404	0.044	0.766	1.184	Airflow: 50 Angle: 0
6.461	50.27	0	0.403	0.044	0.763	1.184	Airflow: 50 Angle: 0
6.446	50.21	0	0.404	0.044	0.764	1.184	Airflow: 50 Angle: 0
6.44	50.19	0	0.403	0.043	0.766	1.183	Airflow: 50 Angle: 0
6.435	50.17	0	0.401	0.043	0.772	1.183	Airflow: 50 Angle: 0
6.43	50.15	0	0.4	0.043	0.774	1.182	Airflow: 50 Angle: 0
6.43	50.15	0	0.399	0.042	0.776	1.181	Airflow: 50 Angle: 0
6.43	50.15	0	0.401	0.043	0.782	1.181	Airflow: 50 Angle: 0
6.451	50.23	2.2	0.693	0.036	1.528	1.185	Airflow: 50 Angle: 2
6.451	50.23	2.2	0.694	0.038	1.531	1.185	Airflow: 50 Angle: 2
6.451	50.23	2.2	0.696	0.041	1.533	1.184	Airflow: 50 Angle: 2
6.451	50.23	2.2	0.697	0.042	1.534	1.184	Airflow: 50 Angle: 2
6.446	50.21	2.2	0.697	0.044	1.533	1.184	Airflow: 50 Angle: 2
6.451	50.23	2.2	0.698	0.042	1.531	1.183	Airflow: 50 Angle: 2
6.451	50.23	2.2	0.698	0.042	1.521	1.183	Airflow: 50 Angle: 2
6.446	50.21	2.2	0.697	0.039	1.513	1.183	Airflow: 50 Angle: 2
6.446	50.21	2.2	0.698	0.039	1.516	1.182	Airflow: 50 Angle: 2
6.44	50.19	2.2	0.698	0.039	1.518	1.182	Airflow: 50 Angle: 2
6.404	50.05	4.2	1.016	0.022	2.171	1.181	Airflow: 50 Angle: 4
6.404	50.05	4.2	1.016	0.023	2.172	1.18	Airflow: 50 Angle: 4
6.394	50.01	4.2	1.016	0.023	2.175	1.179	Airflow: 50 Angle: 4
6.388	49.99	4.2	1.016	0.022	2.176	1.179	Airflow: 50 Angle: 4

6.383	49.97	4.2	1.018	0.023	2.178	1.178	Airflow: 50 Angle: 4
6.383	49.97	4.2	1.018	0.021	2.179	1.178	Airflow: 50 Angle: 4
6.378	49.95	4.2	1.018	0.024	2.179	1.177	Airflow: 50 Angle: 4
6.373	49.93	4.2	1.017	0.024	2.18	1.176	Airflow: 50 Angle: 4
6.373	49.93	4.2	1.016	0.024	2.182	1.176	Airflow: 50 Angle: 4
6.378	49.95	4.2	1.016	0.021	2.209	1.175	Airflow: 50 Angle: 4
6.492	50.39	6.1	1.334	-0.025	2.93	1.181	Airflow: 50 Angle: 6
6.498	50.41	6.1	1.326	-0.025	2.922	1.182	Airflow: 50 Angle: 6
6.498	50.41	6.1	1.324	-0.026	2.904	1.183	Airflow: 50 Angle: 6
6.503	50.43	6.1	1.318	-0.025	2.889	1.183	Airflow: 50 Angle: 6
6.508	50.45	6.1	1.308	-0.025	2.871	1.184	Airflow: 50 Angle: 6
6.513	50.47	6.1	1.307	-0.025	2.856	1.185	Airflow: 50 Angle: 6
6.518	50.49	6.1	1.306	-0.022	2.854	1.185	Airflow: 50 Angle: 6
6.524	50.51	6.1	1.304	-0.023	2.85	1.186	Airflow: 50 Angle: 6
6.524	50.51	6.1	1.303	-0.022	2.831	1.187	Airflow: 50 Angle: 6
6.524	50.51	6.1	1.303	-0.023	2.833	1.187	Airflow: 50 Angle: 6
6.461	50.27	7.7	1.521	-0.078	3.355	1.184	Airflow: 50 Angle: 8
6.466	50.29	7.7	1.519	-0.078	3.361	1.183	Airflow: 50 Angle: 8
6.466	50.29	7.7	1.521	-0.076	3.363	1.183	Airflow: 50 Angle: 8
6.472	50.31	7.7	1.522	-0.077	3.378	1.183	Airflow: 50 Angle: 8
6.466	50.29	7.7	1.524	-0.079	3.388	1.184	Airflow: 50 Angle: 8
6.472	50.31	7.7	1.53	-0.078	3.418	1.184	Airflow: 50 Angle: 8
6.472	50.31	7.7	1.534	-0.081	3.448	1.184	Airflow: 50 Angle: 8
6.477	50.33	7.7	1.54	-0.083	3.472	1.184	Airflow: 50 Angle: 8
6.482	50.35	7.7	1.547	-0.083	3.485	1.184	Airflow: 50 Angle: 8
6.482	50.35	7.7	1.551	-0.083	3.488	1.184	Airflow: 50 Angle: 8
6.399	50.03	9.9	1.623	-0.111	3.73	1.174	Airflow: 50 Angle: 10
6.409	50.07	9.9	1.621	-0.11	3.729	1.174	Airflow: 50 Angle: 10
6.414	50.09	9.9	1.619	-0.109	3.707	1.175	Airflow: 50 Angle: 10
6.42	50.11	9.9	1.616	-0.108	3.703	1.175	Airflow: 50 Angle: 10
6.42	50.11	9.9	1.614	-0.107	3.692	1.175	Airflow: 50 Angle: 10
6.42	50.11	9.9	1.612	-0.112	3.692	1.176	Airflow: 50 Angle: 10
6.425	50.13	9.9	1.612	-0.112	3.692	1.176	Airflow: 50 Angle: 10
6.43	50.15	9.9	1.61	-0.112	3.679	1.177	Airflow: 50 Angle: 10

6.435	50.17	9.9	1.608	-0.11	3.67	1.177	Airflow: 50 Angle: 10
6.43	50.15	9.9	1.605	-0.106	3.668	1.177	Airflow: 50 Angle: 10
6.394	50.01	11.8	1.642	-0.124	3.772	1.177	Airflow: 50 Angle: 12
6.394	50.01	11.8	1.641	-0.122	3.766	1.177	Airflow: 50 Angle: 12
6.399	50.03	11.8	1.641	-0.122	3.76	1.177	Airflow: 50 Angle: 12
6.404	50.05	11.8	1.644	-0.121	3.775	1.177	Airflow: 50 Angle: 12
6.409	50.07	11.8	1.645	-0.121	3.798	1.177	Airflow: 50 Angle: 12
6.414	50.09	11.8	1.651	-0.123	3.81	1.177	Airflow: 50 Angle: 12
6.42	50.11	11.8	1.654	-0.128	3.825	1.177	Airflow: 50 Angle: 12
6.425	50.13	11.8	1.655	-0.126	3.829	1.177	Airflow: 50 Angle: 12
6.43	50.15	11.8	1.655	-0.128	3.831	1.178	Airflow: 50 Angle: 12
6.44	50.19	11.8	1.662	-0.128	3.838	1.178	Airflow: 50 Angle: 12
6.316	49.7	13.8	1.312	0.221	2.126	1.148	Airflow: 50 Angle: 14
6.331	49.76	13.8	1.312	0.226	2.113	1.149	Airflow: 50 Angle: 14
6.342	49.8	13.8	1.314	0.221	2.138	1.151	Airflow: 50 Angle: 14
6.352	49.85	13.8	1.313	0.226	2.141	1.152	Airflow: 50 Angle: 14
6.368	49.91	13.8	1.312	0.224	2.138	1.154	Airflow: 50 Angle: 14
6.378	49.95	13.8	1.312	0.221	2.138	1.156	Airflow: 50 Angle: 14
6.383	49.97	13.8	1.312	0.221	2.13	1.158	Airflow: 50 Angle: 14
6.388	49.99	13.8	1.309	0.22	2.121	1.16	Airflow: 50 Angle: 14
6.394	50.01	13.8	1.311	0.221	2.131	1.162	Airflow: 50 Angle: 14
6.394	50.01	13.8	1.311	0.217	2.153	1.163	Airflow: 50 Angle: 14
6.368	49.91	15.8	1.307	0.264	2.209	1.164	Airflow: 50 Angle: 16
6.378	49.95	15.8	1.31	0.264	2.209	1.165	Airflow: 50 Angle: 16
6.394	50.01	15.8	1.312	0.264	2.208	1.166	Airflow: 50 Angle: 16
6.404	50.05	15.8	1.31	0.266	2.192	1.168	Airflow: 50 Angle: 16
6.414	50.09	15.8	1.31	0.27	2.189	1.169	Airflow: 50 Angle: 16
6.425	50.13	15.8	1.308	0.268	2.186	1.17	Airflow: 50 Angle: 16
6.43	50.15	15.8	1.308	0.268	2.185	1.171	Airflow: 50 Angle: 16
6.435	50.17	15.8	1.308	0.263	2.179	1.173	Airflow: 50 Angle: 16
6.44	50.19	15.8	1.305	0.261	2.185	1.173	Airflow: 50 Angle: 16
6.44	50.19	15.8	1.311	0.265	2.188	1.174	Airflow: 50 Angle: 16
6.409	50.07	17.6	1.316	0.273	2.287	1.174	Airflow: 50 Angle: 18
6.409	50.07	17.6	1.317	0.275	2.282	1.175	Airflow: 50 Angle: 18

6.414	50.09	17.6	1.318	0.279	2.293	1.175	Airflow: 50 Angle: 18
6.42	50.11	17.6	1.318	0.282	2.292	1.176	Airflow: 50 Angle: 18
6.425	50.13	17.6	1.317	0.279	2.305	1.176	Airflow: 50 Angle: 18
6.425	50.13	17.6	1.317	0.278	2.304	1.176	Airflow: 50 Angle: 18
6.425	50.13	17.6	1.316	0.279	2.268	1.177	Airflow: 50 Angle: 18
6.43	50.15	17.6	1.317	0.277	2.299	1.177	Airflow: 50 Angle: 18
6.435	50.17	17.6	1.319	0.283	2.299	1.177	Airflow: 50 Angle: 18
6.44	50.19	17.6	1.318	0.283	2.299	1.178	Airflow: 50 Angle: 18
6.409	50.07	19.8	1.327	0.299	2.392	1.178	Airflow: 50 Angle: 20
6.404	50.05	19.8	1.327	0.299	2.427	1.178	Airflow: 50 Angle: 20
6.394	50.01	19.8	1.327	0.299	2.427	1.178	Airflow: 50 Angle: 20
6.383	49.97	19.8	1.328	0.298	2.418	1.177	Airflow: 50 Angle: 20
6.383	49.97	19.8	1.336	0.3	2.418	1.177	Airflow: 50 Angle: 20
6.378	49.95	19.8	1.342	0.301	2.414	1.177	Airflow: 50 Angle: 20
6.378	49.95	19.8	1.341	0.302	2.404	1.176	Airflow: 50 Angle: 20
6.383	49.97	19.8	1.341	0.302	2.392	1.176	Airflow: 50 Angle: 20
6.388	49.99	19.8	1.339	0.302	2.404	1.176	Airflow: 50 Angle: 20
6.388	49.99	19.8	1.34	0.299	2.42	1.176	Airflow: 50 Angle: 20
6.342	49.8	22	1.388	0.319	2.577	1.164	Airflow: 50 Angle: 22
6.347	49.83	22	1.39	0.319	2.571	1.164	Airflow: 50 Angle: 22
6.347	49.83	22	1.408	0.319	2.588	1.165	Airflow: 50 Angle: 22
6.352	49.85	22	1.415	0.32	2.598	1.165	Airflow: 50 Angle: 22
6.362	49.89	22	1.418	0.32	2.635	1.166	Airflow: 50 Angle: 22
6.368	49.91	22	1.418	0.319	2.639	1.166	Airflow: 50 Angle: 22
6.383	49.97	22	1.418	0.321	2.639	1.167	Airflow: 50 Angle: 22
6.378	49.95	22	1.418	0.321	2.639	1.167	Airflow: 50 Angle: 22
6.388	49.99	22	1.418	0.323	2.61	1.168	Airflow: 50 Angle: 22
6.383	49.97	22	1.417	0.323	2.596	1.169	Airflow: 50 Angle: 22
12.532	70.01	22	2.972	0.406	5.617	2.253	Airflow: 70 Angle: 22
12.512	69.96	22	2.993	0.397	5.624	2.253	Airflow: 70 Angle: 22
12.501	69.93	22	2.965	0.403	5.556	2.253	Airflow: 70 Angle: 22
12.486	69.88	22	2.944	0.394	5.488	2.253	Airflow: 70 Angle: 22
12.475	69.85	22	2.928	0.425	5.425	2.254	Airflow: 70 Angle: 22
12.454	69.8	22	2.909	0.424	5.395	2.253	Airflow: 70 Angle: 22

12.444	69.77	22	2.905	0.398	5.41	2.253	Airflow: 70 Angle: 22
12.439	69.75	22	2.905	0.419	5.411	2.253	Airflow: 70 Angle: 22
12.418	69.69	22	2.904	0.398	5.394	2.253	Airflow: 70 Angle: 22
12.413	69.68	22	2.904	0.419	5.409	2.252	Airflow: 70 Angle: 22
12.626	70.28	19.8	2.861	0.397	5.195	2.312	Airflow: 70 Angle: 20
12.61	70.23	19.8	2.861	0.436	5.194	2.31	Airflow: 70 Angle: 20
12.595	70.19	19.8	2.854	0.403	5.195	2.307	Airflow: 70 Angle: 20
12.584	70.16	19.8	2.861	0.379	5.302	2.305	Airflow: 70 Angle: 20
12.579	70.14	19.8	2.867	0.405	5.372	2.302	Airflow: 70 Angle: 20
12.584	70.16	19.8	2.867	0.404	5.372	2.3	Airflow: 70 Angle: 20
12.59	70.17	19.8	2.876	0.381	5.394	2.299	Airflow: 70 Angle: 20
12.59	70.17	19.8	2.87	0.408	5.325	2.297	Airflow: 70 Angle: 20
12.579	70.14	19.8	2.875	0.409	5.323	2.296	Airflow: 70 Angle: 20
12.579	70.14	19.8	2.871	0.381	5.335	2.296	Airflow: 70 Angle: 20
12.553	70.07	17.6	2.708	0.37	5.073	2.294	Airflow: 70 Angle: 18
12.543	70.04	17.6	2.717	0.371	4.991	2.293	Airflow: 70 Angle: 18
12.538	70.03	17.6	2.717	0.37	4.989	2.292	Airflow: 70 Angle: 18
12.522	69.99	17.6	2.719	0.371	4.989	2.291	Airflow: 70 Angle: 18
12.496	69.91	17.6	2.719	0.379	4.998	2.29	Airflow: 70 Angle: 18
12.506	69.94	17.6	2.72	0.379	5.015	2.29	Airflow: 70 Angle: 18
12.496	69.91	17.6	2.725	0.371	4.998	2.289	Airflow: 70 Angle: 18
12.491	69.9	17.6	2.743	0.363	4.995	2.287	Airflow: 70 Angle: 18
12.491	69.9	17.6	2.743	0.363	4.98	2.286	Airflow: 70 Angle: 18
12.486	69.88	17.6	2.727	0.374	4.98	2.285	Airflow: 70 Angle: 18
12.897	71.02	16	2.675	0.345	4.889	2.349	Airflow: 70 Angle: 16
12.85	70.9	16	2.675	0.345	4.889	2.349	Airflow: 70 Angle: 16
12.808	70.78	16	2.664	0.342	4.784	2.348	Airflow: 70 Angle: 16
12.766	70.67	16	2.664	0.342	4.784	2.346	Airflow: 70 Angle: 16
12.74	70.59	16	2.666	0.343	4.855	2.345	Airflow: 70 Angle: 16
12.709	70.51	16	2.663	0.352	4.854	2.342	Airflow: 70 Angle: 16
12.673	70.41	16	2.664	0.34	4.855	2.339	Airflow: 70 Angle: 16
12.647	70.33	16	2.667	0.351	4.931	2.336	Airflow: 70 Angle: 16
12.636	70.3	16	2.666	0.349	4.867	2.333	Airflow: 70 Angle: 16
12.626	70.28	16	2.672	0.35	4.937	2.331	Airflow: 70 Angle: 16

12.428	69.72	13.8	2.674	0.21	5.118	2.286	Airflow: 70 Angle: 14
12.433	69.74	13.8	2.68	0.21	5.118	2.286	Airflow: 70 Angle: 14
12.439	69.75	13.8	2.686	0.21	5.111	2.286	Airflow: 70 Angle: 14
12.444	69.77	13.8	2.69	0.21	5.162	2.286	Airflow: 70 Angle: 14
12.444	69.77	13.8	2.688	0.197	5.194	2.286	Airflow: 70 Angle: 14
12.449	69.78	13.8	2.687	0.197	5.143	2.287	Airflow: 70 Angle: 14
12.454	69.8	13.8	2.689	0.197	5.194	2.287	Airflow: 70 Angle: 14
12.47	69.84	13.8	2.687	0.2	5.101	2.288	Airflow: 70 Angle: 14
12.475	69.85	13.8	2.692	0.2	5.101	2.288	Airflow: 70 Angle: 14
12.496	69.91	13.8	2.694	0.201	5.172	2.289	Airflow: 70 Angle: 14
12.496	69.91	11.9	3.462	-0.382	8.012	2.296	Airflow: 70 Angle: 12
12.506	69.94	11.9	3.464	-0.381	8.015	2.297	Airflow: 70 Angle: 12
12.512	69.96	11.9	3.466	-0.381	8.009	2.297	Airflow: 70 Angle: 12
12.506	69.94	11.9	3.466	-0.382	7.965	2.298	Airflow: 70 Angle: 12
12.506	69.94	11.9	3.466	-0.381	7.963	2.298	Airflow: 70 Angle: 12
12.501	69.93	11.9	3.466	-0.379	7.963	2.298	Airflow: 70 Angle: 12
12.496	69.91	11.9	3.466	-0.376	7.957	2.299	Airflow: 70 Angle: 12
12.496	69.91	11.9	3.466	-0.382	7.967	2.299	Airflow: 70 Angle: 12
12.501	69.93	11.9	3.465	-0.381	7.995	2.299	Airflow: 70 Angle: 12
12.501	69.93	11.9	3.465	-0.385	7.979	2.299	Airflow: 70 Angle: 12
12.543	70.04	9.9	3.438	-0.33	7.771	2.307	Airflow: 70 Angle: 10
12.548	70.06	9.9	3.439	-0.336	7.839	2.307	Airflow: 70 Angle: 10
12.548	70.06	9.9	3.437	-0.339	7.897	2.307	Airflow: 70 Angle: 10
12.548	70.06	9.9	3.44	-0.342	7.907	2.307	Airflow: 70 Angle: 10
12.538	70.03	9.9	3.443	-0.342	7.921	2.307	Airflow: 70 Angle: 10
12.522	69.99	9.9	3.446	-0.336	7.905	2.307	Airflow: 70 Angle: 10
12.512	69.96	9.9	3.446	-0.337	7.851	2.307	Airflow: 70 Angle: 10
12.501	69.93	9.9	3.447	-0.334	7.754	2.306	Airflow: 70 Angle: 10
12.486	69.88	9.9	3.445	-0.331	7.744	2.305	Airflow: 70 Angle: 10
12.48	69.87	9.9	3.435	-0.333	7.738	2.304	Airflow: 70 Angle: 10
12.595	70.19	8	3.383	-0.266	7.598	2.314	Airflow: 70 Angle: 8
12.6	70.2	8	3.384	-0.262	7.575	2.315	Airflow: 70 Angle: 8
12.6	70.2	8	3.388	-0.259	7.542	2.315	Airflow: 70 Angle: 8
12.6	70.2	8	3.39	-0.255	7.524	2.316	Airflow: 70 Angle: 8

12.6	70.2	8	3.392	-0.255	7.478	2.316	Airflow: 70 Angle: 8
12.6	70.2	8	3.393	-0.248	7.46	2.316	Airflow: 70 Angle: 8
12.59	70.17	8	3.392	-0.248	7.43	2.316	Airflow: 70 Angle: 8
12.595	70.19	8	3.389	-0.244	7.417	2.316	Airflow: 70 Angle: 8
12.584	70.16	8	3.381	-0.245	7.352	2.316	Airflow: 70 Angle: 8
12.574	70.13	8	3.361	-0.241	7.329	2.316	Airflow: 70 Angle: 8
12.61	70.23	6.1	3.104	-0.151	6.659	2.323	Airflow: 70 Angle: 6
12.6	70.2	6.1	3.103	-0.152	6.622	2.322	Airflow: 70 Angle: 6
12.584	70.16	6.1	3.102	-0.143	6.564	2.322	Airflow: 70 Angle: 6
12.569	70.12	6.1	3.1	-0.143	6.564	2.321	Airflow: 70 Angle: 6
12.564	70.1	6.1	3.093	-0.147	6.568	2.321	Airflow: 70 Angle: 6
12.569	70.12	6.1	3.089	-0.149	6.616	2.32	Airflow: 70 Angle: 6
12.574	70.13	6.1	3.089	-0.149	6.633	2.319	Airflow: 70 Angle: 6
12.579	70.14	6.1	3.089	-0.152	6.633	2.319	Airflow: 70 Angle: 6
12.579	70.14	6.1	3.089	-0.152	6.613	2.319	Airflow: 70 Angle: 6
12.569	70.12	6.1	3.088	-0.147	6.612	2.318	Airflow: 70 Angle: 6
12.465	69.83	4.2	2.826	-0.028	5.355	2.309	Airflow: 70 Angle: 4
12.46	69.81	4.2	2.826	-0.029	5.357	2.308	Airflow: 70 Angle: 4
12.449	69.78	4.2	2.828	-0.019	5.348	2.307	Airflow: 70 Angle: 4
12.449	69.78	4.2	2.827	-0.02	5.275	2.307	Airflow: 70 Angle: 4
12.444	69.77	4.2	2.827	-0.02	5.256	2.306	Airflow: 70 Angle: 4
12.449	69.78	4.2	2.827	-0.02	5.256	2.305	Airflow: 70 Angle: 4
12.454	69.8	4.2	2.827	-0.02	5.262	2.304	Airflow: 70 Angle: 4
12.465	69.83	4.2	2.826	-0.022	5.303	2.304	Airflow: 70 Angle: 4
12.47	69.84	4.2	2.826	-0.022	5.306	2.304	Airflow: 70 Angle: 4
12.465	69.83	4.2	2.828	-0.018	5.277	2.304	Airflow: 70 Angle: 4
12.553	70.07	2.2	2.358	0.078	3.927	2.32	Airflow: 70 Angle: 2
12.543	70.04	2.2	2.358	0.068	3.918	2.319	Airflow: 70 Angle: 2
12.538	70.03	2.2	2.36	0.078	3.906	2.318	Airflow: 70 Angle: 2
12.532	70.01	2.2	2.361	0.077	3.906	2.317	Airflow: 70 Angle: 2
12.532	70.01	2.2	2.36	0.075	3.913	2.316	Airflow: 70 Angle: 2
12.527	70	2.2	2.359	0.075	3.919	2.316	Airflow: 70 Angle: 2
12.543	70.04	2.2	2.358	0.071	3.941	2.315	Airflow: 70 Angle: 2
12.543	70.04	2.2	2.359	0.072	3.959	2.315	Airflow: 70 Angle: 2

12.548	70.06	2.2	2.358	0.076	3.966	2.314	Airflow: 70 Angle: 2
12.548	70.06	2.2	2.358	0.076	3.966	2.314	Airflow: 70 Angle: 2
12.59	70.17	0	1.873	0.121	2.585	2.326	Airflow: 70 Angle: 0
12.579	70.14	0	1.872	0.118	2.58	2.325	Airflow: 70 Angle: 0
12.569	70.12	0	1.871	0.121	2.585	2.324	Airflow: 70 Angle: 0
12.548	70.06	0	1.869	0.123	2.591	2.323	Airflow: 70 Angle: 0
12.538	70.03	0	1.867	0.123	2.599	2.322	Airflow: 70 Angle: 0
12.532	70.01	0	1.867	0.123	2.606	2.32	Airflow: 70 Angle: 0
12.532	70.01	0	1.867	0.116	2.608	2.319	Airflow: 70 Angle: 0
12.527	70	0	1.868	0.125	2.607	2.318	Airflow: 70 Angle: 0
12.522	69.99	0	1.868	0.125	2.602	2.317	Airflow: 70 Angle: 0
12.522	69.99	0	1.869	0.125	2.583	2.316	Airflow: 70 Angle: 0
12.486	69.88	-1.7	1.333	0.134	1.158	2.311	Airflow: 70 Angle: -2
12.48	69.87	-1.7	1.333	0.134	1.158	2.31	Airflow: 70 Angle: -2
12.48	69.87	-1.7	1.332	0.133	1.158	2.309	Airflow: 70 Angle: -2
12.48	69.87	-1.7	1.332	0.131	1.158	2.309	Airflow: 70 Angle: -2
12.48	69.87	-1.7	1.332	0.131	1.157	2.308	Airflow: 70 Angle: -2
12.475	69.85	-1.7	1.332	0.126	1.16	2.308	Airflow: 70 Angle: -2
12.46	69.81	-1.7	1.332	0.126	1.162	2.307	Airflow: 70 Angle: -2
12.454	69.8	-1.7	1.332	0.126	1.153	2.307	Airflow: 70 Angle: -2
12.444	69.77	-1.7	1.332	0.126	1.146	2.306	Airflow: 70 Angle: -2
12.439	69.75	-1.7	1.331	0.13	1.146	2.305	Airflow: 70 Angle: -2
12.532	70.01	-3.9	0.881	0.126	-0.025	2.314	Airflow: 70 Angle: -4
12.532	70.01	-3.9	0.88	0.129	-0.025	2.313	Airflow: 70 Angle: -4
12.532	70.01	-3.9	0.879	0.12	-0.027	2.313	Airflow: 70 Angle: -4
12.543	70.04	-3.9	0.879	0.126	-0.03	2.313	Airflow: 70 Angle: -4
12.543	70.04	-3.9	0.878	0.12	-0.03	2.313	Airflow: 70 Angle: -4
12.553	70.07	-3.9	0.878	0.131	-0.03	2.313	Airflow: 70 Angle: -4
12.553	70.07	-3.9	0.878	0.131	-0.023	2.314	Airflow: 70 Angle: -4
12.548	70.06	-3.9	0.878	0.128	-0.028	2.314	Airflow: 70 Angle: -4
12.538	70.03	-3.9	0.879	0.127	-0.028	2.314	Airflow: 70 Angle: -4
12.532	70.01	-3.9	0.879	0.127	-0.028	2.314	Airflow: 70 Angle: -4
12.522	69.99	-5.5	0.355	0.09	-1.329	2.311	Airflow: 70 Angle: -6
12.522	69.99	-5.5	0.355	0.09	-1.329	2.311	Airflow: 70 Angle: -6

12.517	69.97	-5.5	0.357	0.089	-1.328	2.311	Airflow: 70 Angle: -6
12.512	69.96	-5.5	0.357	0.086	-1.328	2.311	Airflow: 70 Angle: -6
12.506	69.94	-5.5	0.357	0.086	-1.333	2.311	Airflow: 70 Angle: -6
12.512	69.96	-5.5	0.356	0.086	-1.329	2.311	Airflow: 70 Angle: -6
12.517	69.97	-5.5	0.357	0.086	-1.333	2.311	Airflow: 70 Angle: -6
12.517	69.97	-5.5	0.357	0.09	-1.334	2.311	Airflow: 70 Angle: -6
12.512	69.96	-5.5	0.357	0.09	-1.331	2.311	Airflow: 70 Angle: -6
12.512	69.96	-5.5	0.358	0.086	-1.334	2.311	Airflow: 70 Angle: -6
12.543	70.04	-7.7	-0.329	0.057	-2.937	2.316	Airflow: 70 Angle: -8
12.543	70.04	-7.7	-0.329	0.057	-2.937	2.317	Airflow: 70 Angle: -8
12.548	70.06	-7.7	-0.329	0.057	-2.938	2.317	Airflow: 70 Angle: -8
12.558	70.09	-7.7	-0.329	0.052	-2.942	2.317	Airflow: 70 Angle: -8
12.569	70.12	-7.7	-0.328	0.052	-2.942	2.318	Airflow: 70 Angle: -8
12.569	70.12	-7.7	-0.328	0.054	-2.948	2.319	Airflow: 70 Angle: -8
12.569	70.12	-7.7	-0.328	0.053	-2.948	2.319	Airflow: 70 Angle: -8
12.569	70.12	-7.7	-0.33	0.053	-2.943	2.32	Airflow: 70 Angle: -8
12.569	70.12	-7.7	-0.33	0.055	-2.943	2.32	Airflow: 70 Angle: -8
12.564	70.1	-7.7	-0.33	0.048	-2.939	2.32	Airflow: 70 Angle: -8
12.475	69.85	-9.4	-1.003	0.101	-3.533	2.303	Airflow: 70 Angle: -10
12.475	69.85	-9.4	-1.003	0.104	-3.471	2.304	Airflow: 70 Angle: -10
12.47	69.84	-9.4	-1.013	0.104	-3.435	2.304	Airflow: 70 Angle: -10
12.47	69.84	-9.4	-1.015	0.103	-3.544	2.304	Airflow: 70 Angle: -10
12.47	69.84	-9.4	-1.015	0.102	-3.465	2.304	Airflow: 70 Angle: -10
12.47	69.84	-9.4	-1.012	0.094	-3.42	2.304	Airflow: 70 Angle: -10
12.47	69.84	-9.4	-1.013	0.093	-3.452	2.304	Airflow: 70 Angle: -10
12.47	69.84	-9.4	-1.013	0.093	-3.433	2.304	Airflow: 70 Angle: -10
12.475	69.85	-9.4	-1.01	0.09	-3.459	2.304	Airflow: 70 Angle: -10
12.486	69.88	-9.4	-1.014	0.086	-3.508	2.304	Airflow: 70 Angle: -10
12.423	69.71	-11.6	-1.135	0.092	-3.714	2.3	Airflow: 70 Angle: -12
12.423	69.71	-11.6	-1.135	0.091	-3.716	2.3	Airflow: 70 Angle: -12
12.423	69.71	-11.6	-1.142	0.092	-3.716	2.3	Airflow: 70 Angle: -12
12.433	69.74	-11.6	-1.151	0.092	-3.716	2.3	Airflow: 70 Angle: -12
12.444	69.77	-11.6	-1.155	0.095	-3.681	2.3	Airflow: 70 Angle: -12
12.454	69.8	-11.6	-1.155	0.096	-3.623	2.3	Airflow: 70 Angle: -12

12.465	69.83	-11.6	-1.162	0.095	-3.623	2.301	Airflow: 70 Angle: -12
12.475	69.85	-11.6	-1.163	0.092	-3.681	2.302	Airflow: 70 Angle: -12
12.475	69.85	-11.6	-1.165	0.09	-3.694	2.302	Airflow: 70 Angle: -12
12.48	69.87	-11.6	-1.17	0.09	-3.738	2.303	Airflow: 70 Angle: -12
12.46	69.81	-13.3	-1.166	0.122	-3.509	2.31	Airflow: 70 Angle: -14
12.454	69.8	-13.3	-1.166	0.126	-3.51	2.31	Airflow: 70 Angle: -14
12.449	69.78	-13.3	-1.166	0.129	-3.509	2.309	Airflow: 70 Angle: -14
12.449	69.78	-13.3	-1.166	0.124	-3.504	2.308	Airflow: 70 Angle: -14
12.449	69.78	-13.3	-1.161	0.127	-3.414	2.308	Airflow: 70 Angle: -14
12.454	69.8	-13.3	-1.16	0.128	-3.42	2.307	Airflow: 70 Angle: -14
12.454	69.8	-13.3	-1.161	0.127	-3.428	2.307	Airflow: 70 Angle: -14
12.454	69.8	-13.3	-1.166	0.129	-3.578	2.307	Airflow: 70 Angle: -14
12.46	69.81	-13.3	-1.164	0.127	-3.578	2.306	Airflow: 70 Angle: -14
12.46	69.81	-13.3	-1.165	0.125	-3.659	2.306	Airflow: 70 Angle: -14
12.428	69.72	-15.5	-1.174	0.124	-3.536	2.3	Airflow: 70 Angle: -16
12.423	69.71	-15.5	-1.171	0.124	-3.541	2.3	Airflow: 70 Angle: -16
12.407	69.66	-15.5	-1.172	0.124	-3.507	2.3	Airflow: 70 Angle: -16
12.381	69.59	-15.5	-1.173	0.124	-3.492	2.3	Airflow: 70 Angle: -16
12.371	69.56	-15.5	-1.173	0.122	-3.492	2.299	Airflow: 70 Angle: -16
12.355	69.52	-15.5	-1.175	0.118	-3.492	2.298	Airflow: 70 Angle: -16
12.345	69.49	-15.5	-1.173	0.121	-3.518	2.297	Airflow: 70 Angle: -16
12.34	69.47	-15.5	-1.169	0.116	-3.475	2.296	Airflow: 70 Angle: -16
12.335	69.46	-15.5	-1.17	0.121	-3.539	2.296	Airflow: 70 Angle: -16
12.335	69.46	-15.5	-1.169	0.123	-3.476	2.295	Airflow: 70 Angle: -16

Table D.4 – KFm 4412 Data

The data timestamp, and orientation columns are not included

q	V_ref	Alpha	NF/SF	AF/AF2	PM/YM	P	Notes
[psf]	[mph]	[deg]	[lbf]	[lbf]	[in-lbf]	[inH2O]	
0	0	0	-0.271	0.003	-0.432	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.27	0.003	-0.432	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.271	0.003	-0.434	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.271	0.003	-0.435	-0.006	Airflow: 0 Angle: 0

0	0	0	-0.273	0.003	-0.435	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.273	0.002	-0.436	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.272	0.002	-0.435	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.272	0.003	-0.434	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.272	0.002	-0.433	-0.006	Airflow: 0 Angle: 0
0	0	0	-0.27	0.005	-0.433	-0.006	Airflow: 0 Angle: 0
6.44	50.19	-15.5	-0.995	-0.016	-1.93	1.139	Airflow: 50 Angle: -16
6.44	50.19	-15.5	-0.995	-0.018	-1.948	1.14	Airflow: 50 Angle: -16
6.435	50.17	-15.5	-0.995	-0.017	-1.939	1.14	Airflow: 50 Angle: -16
6.435	50.17	-15.5	-0.995	-0.018	-1.947	1.141	Airflow: 50 Angle: -16
6.44	50.19	-15.5	-0.995	-0.014	-1.947	1.141	Airflow: 50 Angle: -16
6.44	50.19	-15.5	-0.987	-0.013	-1.92	1.142	Airflow: 50 Angle: -16
6.44	50.19	-15.5	-0.962	-0.012	-1.876	1.143	Airflow: 50 Angle: -16
6.44	50.19	-15.5	-0.978	-0.014	-1.885	1.143	Airflow: 50 Angle: -16
6.44	50.19	-15.5	-0.954	-0.012	-1.871	1.144	Airflow: 50 Angle: -16
6.435	50.17	-15.5	-0.957	-0.012	-1.871	1.145	Airflow: 50 Angle: -16
6.498	50.41	-13.3	-0.955	-0.005	-1.864	1.171	Airflow: 50 Angle: -14
6.498	50.41	-13.3	-0.955	0.001	-1.859	1.171	Airflow: 50 Angle: -14
6.492	50.39	-13.3	-0.952	0.001	-1.856	1.171	Airflow: 50 Angle: -14
6.487	50.37	-13.3	-0.943	0.001	-1.841	1.17	Airflow: 50 Angle: -14
6.487	50.37	-13.3	-0.934	-0.002	-1.838	1.17	Airflow: 50 Angle: -14
6.482	50.35	-13.3	-0.943	-0.003	-1.841	1.17	Airflow: 50 Angle: -14
6.477	50.33	-13.3	-0.949	-0.008	-1.857	1.17	Airflow: 50 Angle: -14
6.472	50.31	-13.3	-0.931	-0.003	-1.815	1.169	Airflow: 50 Angle: -14
6.472	50.31	-13.3	-0.962	-0.004	-1.857	1.169	Airflow: 50 Angle: -14
6.472	50.31	-13.3	-0.943	-0.004	-1.833	1.169	Airflow: 50 Angle: -14
6.565	50.68	-11.3	-0.901	0.013	-1.758	1.182	Airflow: 50 Angle: -12
6.555	50.64	-11.3	-0.914	0.014	-1.779	1.182	Airflow: 50 Angle: -12
6.555	50.64	-11.3	-0.914	0.011	-1.779	1.182	Airflow: 50 Angle: -12
6.55	50.62	-11.3	-0.914	0.012	-1.78	1.182	Airflow: 50 Angle: -12
6.544	50.6	-11.3	-0.9	0.013	-1.751	1.182	Airflow: 50 Angle: -12
6.539	50.57	-11.3	-0.9	0.013	-1.751	1.182	Airflow: 50 Angle: -12
6.534	50.55	-11.3	-0.9	0.013	-1.751	1.182	Airflow: 50 Angle: -12
6.534	50.55	-11.3	-0.913	0.011	-1.795	1.182	Airflow: 50 Angle: -12

6.524	50.51	-11.3	-0.917	0.01	-1.795	1.181	Airflow: 50 Angle: -12
6.513	50.47	-11.3	-0.913	0.008	-1.778	1.181	Airflow: 50 Angle: -12
6.513	50.47	-9.4	-0.845	0.002	-1.697	1.183	Airflow: 50 Angle: -10
6.513	50.47	-9.4	-0.845	0.003	-1.694	1.182	Airflow: 50 Angle: -10
6.503	50.43	-9.4	-0.832	0.004	-1.676	1.182	Airflow: 50 Angle: -10
6.498	50.41	-9.4	-0.831	0.004	-1.676	1.182	Airflow: 50 Angle: -10
6.492	50.39	-9.4	-0.831	0.003	-1.681	1.182	Airflow: 50 Angle: -10
6.487	50.37	-9.4	-0.845	0.002	-1.691	1.181	Airflow: 50 Angle: -10
6.492	50.39	-9.4	-0.844	0.004	-1.687	1.181	Airflow: 50 Angle: -10
6.498	50.41	-9.4	-0.84	0.004	-1.687	1.181	Airflow: 50 Angle: -10
6.498	50.41	-9.4	-0.824	0.005	-1.659	1.181	Airflow: 50 Angle: -10
6.498	50.41	-9.4	-0.802	0.009	-1.616	1.181	Airflow: 50 Angle: -10
6.498	50.41	-7.7	-0.742	-0.001	-1.665	1.18	Airflow: 50 Angle: -8
6.498	50.41	-7.7	-0.741	-0.001	-1.653	1.181	Airflow: 50 Angle: -8
6.498	50.41	-7.7	-0.731	0	-1.648	1.181	Airflow: 50 Angle: -8
6.503	50.43	-7.7	-0.728	-0.001	-1.643	1.181	Airflow: 50 Angle: -8
6.503	50.43	-7.7	-0.731	-0.002	-1.643	1.181	Airflow: 50 Angle: -8
6.498	50.41	-7.7	-0.728	0.002	-1.637	1.182	Airflow: 50 Angle: -8
6.498	50.41	-7.7	-0.724	0.003	-1.635	1.182	Airflow: 50 Angle: -8
6.498	50.41	-7.7	-0.732	0.003	-1.637	1.182	Airflow: 50 Angle: -8
6.498	50.41	-7.7	-0.729	0.003	-1.632	1.182	Airflow: 50 Angle: -8
6.498	50.41	-7.7	-0.732	-0.001	-1.634	1.182	Airflow: 50 Angle: -8
6.534	50.55	-5.5	-0.426	-0.008	-1.125	1.188	Airflow: 50 Angle: -6
6.534	50.55	-5.5	-0.425	-0.008	-1.125	1.188	Airflow: 50 Angle: -6
6.534	50.55	-5.5	-0.427	-0.005	-1.13	1.188	Airflow: 50 Angle: -6
6.539	50.57	-5.5	-0.428	-0.004	-1.128	1.188	Airflow: 50 Angle: -6
6.539	50.57	-5.5	-0.427	-0.004	-1.128	1.188	Airflow: 50 Angle: -6
6.539	50.57	-5.5	-0.428	-0.004	-1.132	1.188	Airflow: 50 Angle: -6
6.539	50.57	-5.5	-0.427	-0.005	-1.131	1.188	Airflow: 50 Angle: -6
6.544	50.6	-5.5	-0.427	-0.006	-1.132	1.188	Airflow: 50 Angle: -6
6.539	50.57	-5.5	-0.427	-0.007	-1.132	1.188	Airflow: 50 Angle: -6
6.539	50.57	-5.5	-0.429	-0.009	-1.132	1.189	Airflow: 50 Angle: -6
6.404	50.05	-3.9	-0.171	0.025	-0.535	1.176	Airflow: 50 Angle: -4
6.404	50.05	-3.9	-0.172	0.026	-0.536	1.175	Airflow: 50 Angle: -4

6.404	50.05	-3.9	-0.172	0.024	-0.535	1.175	Airflow: 50 Angle: -4
6.404	50.05	-3.9	-0.173	0.027	-0.535	1.174	Airflow: 50 Angle: -4
6.409	50.07	-3.9	-0.172	0.027	-0.535	1.174	Airflow: 50 Angle: -4
6.409	50.07	-3.9	-0.172	0.025	-0.533	1.174	Airflow: 50 Angle: -4
6.409	50.07	-3.9	-0.172	0.026	-0.532	1.173	Airflow: 50 Angle: -4
6.409	50.07	-3.9	-0.168	0.026	-0.531	1.173	Airflow: 50 Angle: -4
6.414	50.09	-3.9	-0.171	0.026	-0.532	1.173	Airflow: 50 Angle: -4
6.42	50.11	-3.9	-0.169	0.026	-0.532	1.173	Airflow: 50 Angle: -4
6.404	50.05	-1.7	0.088	0.043	0.066	1.178	Airflow: 50 Angle: -2
6.404	50.05	-1.7	0.088	0.047	0.06	1.177	Airflow: 50 Angle: -2
6.404	50.05	-1.7	0.087	0.047	0.059	1.177	Airflow: 50 Angle: -2
6.399	50.03	-1.7	0.087	0.047	0.057	1.176	Airflow: 50 Angle: -2
6.399	50.03	-1.7	0.087	0.044	0.059	1.176	Airflow: 50 Angle: -2
6.399	50.03	-1.7	0.086	0.043	0.06	1.175	Airflow: 50 Angle: -2
6.399	50.03	-1.7	0.086	0.043	0.06	1.175	Airflow: 50 Angle: -2
6.399	50.03	-1.7	0.087	0.044	0.061	1.175	Airflow: 50 Angle: -2
6.404	50.05	-1.7	0.086	0.044	0.06	1.175	Airflow: 50 Angle: -2
6.409	50.07	-1.7	0.086	0.044	0.06	1.174	Airflow: 50 Angle: -2
6.482	50.35	0	0.375	0.063	0.711	1.179	Airflow: 50 Angle: 0
6.487	50.37	0	0.375	0.063	0.71	1.18	Airflow: 50 Angle: 0
6.487	50.37	0	0.374	0.066	0.709	1.18	Airflow: 50 Angle: 0
6.498	50.41	0	0.372	0.066	0.707	1.181	Airflow: 50 Angle: 0
6.503	50.43	0	0.372	0.066	0.707	1.182	Airflow: 50 Angle: 0
6.508	50.45	0	0.371	0.066	0.703	1.183	Airflow: 50 Angle: 0
6.513	50.47	0	0.371	0.068	0.699	1.184	Airflow: 50 Angle: 0
6.524	50.51	0	0.369	0.067	0.699	1.185	Airflow: 50 Angle: 0
6.524	50.51	0	0.368	0.066	0.695	1.186	Airflow: 50 Angle: 0
6.534	50.55	0	0.368	0.065	0.695	1.187	Airflow: 50 Angle: 0
6.404	50.05	2.2	0.564	0.072	1.145	1.179	Airflow: 50 Angle: 2
6.404	50.05	2.2	0.568	0.073	1.149	1.179	Airflow: 50 Angle: 2
6.399	50.03	2.2	0.568	0.073	1.149	1.179	Airflow: 50 Angle: 2
6.394	50.01	2.2	0.571	0.073	1.151	1.178	Airflow: 50 Angle: 2
6.394	50.01	2.2	0.572	0.072	1.152	1.178	Airflow: 50 Angle: 2
6.388	49.99	2.2	0.569	0.072	1.143	1.177	Airflow: 50 Angle: 2

6.383	49.97	2.2	0.571	0.07	1.152	1.177	Airflow: 50 Angle: 2
6.383	49.97	2.2	0.568	0.07	1.147	1.176	Airflow: 50 Angle: 2
6.388	49.99	2.2	0.567	0.069	1.143	1.176	Airflow: 50 Angle: 2
6.394	50.01	2.2	0.568	0.068	1.149	1.176	Airflow: 50 Angle: 2
6.435	50.17	3.9	0.814	0.056	1.728	1.176	Airflow: 50 Angle: 4
6.425	50.13	3.9	0.813	0.057	1.722	1.176	Airflow: 50 Angle: 4
6.42	50.11	3.9	0.811	0.057	1.714	1.176	Airflow: 50 Angle: 4
6.409	50.07	3.9	0.811	0.06	1.71	1.176	Airflow: 50 Angle: 4
6.404	50.05	3.9	0.808	0.06	1.71	1.176	Airflow: 50 Angle: 4
6.399	50.03	3.9	0.806	0.059	1.705	1.175	Airflow: 50 Angle: 4
6.394	50.01	3.9	0.803	0.057	1.698	1.175	Airflow: 50 Angle: 4
6.388	49.99	3.9	0.806	0.055	1.703	1.174	Airflow: 50 Angle: 4
6.383	49.97	3.9	0.809	0.054	1.71	1.174	Airflow: 50 Angle: 4
6.388	49.99	3.9	0.81	0.053	1.713	1.174	Airflow: 50 Angle: 4
6.414	50.09	6.1	1.154	0.008	2.592	1.185	Airflow: 50 Angle: 6
6.414	50.09	6.1	1.153	0.009	2.59	1.184	Airflow: 50 Angle: 6
6.409	50.07	6.1	1.155	0.009	2.594	1.183	Airflow: 50 Angle: 6
6.404	50.05	6.1	1.157	0.006	2.598	1.182	Airflow: 50 Angle: 6
6.404	50.05	6.1	1.158	0.007	2.604	1.182	Airflow: 50 Angle: 6
6.409	50.07	6.1	1.168	0.008	2.625	1.181	Airflow: 50 Angle: 6
6.409	50.07	6.1	1.17	0.008	2.633	1.181	Airflow: 50 Angle: 6
6.409	50.07	6.1	1.172	0.009	2.634	1.18	Airflow: 50 Angle: 6
6.414	50.09	6.1	1.178	0.006	2.645	1.18	Airflow: 50 Angle: 6
6.42	50.11	6.1	1.177	0.006	2.643	1.18	Airflow: 50 Angle: 6
6.44	50.19	7.7	1.389	-0.048	3.126	1.183	Airflow: 50 Angle: 8
6.446	50.21	7.7	1.386	-0.048	3.121	1.184	Airflow: 50 Angle: 8
6.451	50.23	7.7	1.382	-0.045	3.117	1.184	Airflow: 50 Angle: 8
6.451	50.23	7.7	1.383	-0.043	3.116	1.184	Airflow: 50 Angle: 8
6.446	50.21	7.7	1.385	-0.043	3.116	1.184	Airflow: 50 Angle: 8
6.446	50.21	7.7	1.392	-0.042	3.136	1.184	Airflow: 50 Angle: 8
6.451	50.23	7.7	1.399	-0.041	3.142	1.184	Airflow: 50 Angle: 8
6.446	50.21	7.7	1.401	-0.041	3.159	1.184	Airflow: 50 Angle: 8
6.446	50.21	7.7	1.402	-0.039	3.161	1.184	Airflow: 50 Angle: 8
6.446	50.21	7.7	1.401	-0.041	3.153	1.184	Airflow: 50 Angle: 8

6.466	50.29	9.9	1.507	-0.08	3.399	1.188	Airflow: 50 Angle: 10
6.472	50.31	9.9	1.49	-0.077	3.365	1.189	Airflow: 50 Angle: 10
6.477	50.33	9.9	1.489	-0.075	3.363	1.189	Airflow: 50 Angle: 10
6.477	50.33	9.9	1.487	-0.075	3.35	1.19	Airflow: 50 Angle: 10
6.482	50.35	9.9	1.481	-0.075	3.333	1.19	Airflow: 50 Angle: 10
6.482	50.35	9.9	1.471	-0.075	3.32	1.191	Airflow: 50 Angle: 10
6.487	50.37	9.9	1.467	-0.075	3.303	1.191	Airflow: 50 Angle: 10
6.482	50.35	9.9	1.458	-0.073	3.289	1.192	Airflow: 50 Angle: 10
6.477	50.33	9.9	1.456	-0.076	3.282	1.192	Airflow: 50 Angle: 10
6.466	50.29	9.9	1.445	-0.075	3.262	1.192	Airflow: 50 Angle: 10
6.394	50.01	11.9	1.524	-0.094	3.484	1.179	Airflow: 50 Angle: 12
6.399	50.03	11.9	1.534	-0.092	3.496	1.179	Airflow: 50 Angle: 12
6.404	50.05	11.9	1.54	-0.093	3.516	1.179	Airflow: 50 Angle: 12
6.42	50.11	11.9	1.549	-0.093	3.535	1.179	Airflow: 50 Angle: 12
6.43	50.15	11.9	1.572	-0.093	3.581	1.18	Airflow: 50 Angle: 12
6.44	50.19	11.9	1.573	-0.098	3.584	1.181	Airflow: 50 Angle: 12
6.456	50.25	11.9	1.575	-0.097	3.585	1.182	Airflow: 50 Angle: 12
6.456	50.25	11.9	1.567	-0.097	3.567	1.183	Airflow: 50 Angle: 12
6.461	50.27	11.9	1.55	-0.094	3.529	1.183	Airflow: 50 Angle: 12
6.461	50.27	11.9	1.541	-0.092	3.503	1.184	Airflow: 50 Angle: 12
6.42	50.11	13.8	1.126	0.206	2.184	1.174	Airflow: 50 Angle: 14
6.42	50.11	13.8	1.112	0.206	2.153	1.175	Airflow: 50 Angle: 14
6.414	50.09	13.8	1.105	0.207	2.151	1.175	Airflow: 50 Angle: 14
6.414	50.09	13.8	1.105	0.21	2.151	1.175	Airflow: 50 Angle: 14
6.414	50.09	13.8	1.121	0.211	2.163	1.175	Airflow: 50 Angle: 14
6.409	50.07	13.8	1.118	0.211	2.162	1.175	Airflow: 50 Angle: 14
6.409	50.07	13.8	1.126	0.212	2.177	1.175	Airflow: 50 Angle: 14
6.414	50.09	13.8	1.121	0.21	2.163	1.175	Airflow: 50 Angle: 14
6.414	50.09	13.8	1.118	0.209	2.163	1.176	Airflow: 50 Angle: 14
6.42	50.11	13.8	1.117	0.206	2.183	1.176	Airflow: 50 Angle: 14
6.347	49.83	15.7	1.177	0.257	2.274	1.16	Airflow: 50 Angle: 16
6.357	49.87	15.7	1.192	0.257	2.28	1.16	Airflow: 50 Angle: 16
6.368	49.91	15.7	1.177	0.258	2.266	1.162	Airflow: 50 Angle: 16
6.378	49.95	15.7	1.171	0.256	2.262	1.163	Airflow: 50 Angle: 16

6.388	49.99	15.7	1.147	0.254	2.213	1.164	Airflow: 50 Angle: 16
6.388	49.99	15.7	1.154	0.249	2.215	1.165	Airflow: 50 Angle: 16
6.394	50.01	15.7	1.14	0.25	2.201	1.166	Airflow: 50 Angle: 16
6.394	50.01	15.7	1.144	0.253	2.201	1.167	Airflow: 50 Angle: 16
6.383	49.97	15.7	1.124	0.252	2.161	1.168	Airflow: 50 Angle: 16
6.378	49.95	15.7	1.123	0.252	2.153	1.169	Airflow: 50 Angle: 16
6.399	50.03	17.6	1.204	0.278	2.314	1.171	Airflow: 50 Angle: 18
6.399	50.03	17.6	1.201	0.278	2.297	1.172	Airflow: 50 Angle: 18
6.399	50.03	17.6	1.207	0.278	2.32	1.172	Airflow: 50 Angle: 18
6.404	50.05	17.6	1.187	0.277	2.279	1.173	Airflow: 50 Angle: 18
6.404	50.05	17.6	1.167	0.268	2.245	1.173	Airflow: 50 Angle: 18
6.409	50.07	17.6	1.147	0.266	2.207	1.174	Airflow: 50 Angle: 18
6.409	50.07	17.6	1.148	0.265	2.223	1.174	Airflow: 50 Angle: 18
6.414	50.09	17.6	1.147	0.264	2.203	1.174	Airflow: 50 Angle: 18
6.409	50.07	17.6	1.2	0.27	2.312	1.174	Airflow: 50 Angle: 18
6.409	50.07	17.6	1.215	0.272	2.335	1.175	Airflow: 50 Angle: 18
6.368	49.91	19.8	1.266	0.307	2.431	1.168	Airflow: 50 Angle: 20
6.368	49.91	19.8	1.266	0.307	2.431	1.168	Airflow: 50 Angle: 20
6.373	49.93	19.8	1.269	0.31	2.433	1.168	Airflow: 50 Angle: 20
6.368	49.91	19.8	1.281	0.308	2.446	1.168	Airflow: 50 Angle: 20
6.368	49.91	19.8	1.296	0.308	2.484	1.168	Airflow: 50 Angle: 20
6.368	49.91	19.8	1.297	0.308	2.488	1.168	Airflow: 50 Angle: 20
6.378	49.95	19.8	1.297	0.31	2.488	1.169	Airflow: 50 Angle: 20
6.383	49.97	19.8	1.287	0.307	2.471	1.169	Airflow: 50 Angle: 20
6.388	49.99	19.8	1.284	0.304	2.464	1.169	Airflow: 50 Angle: 20
6.404	50.05	19.8	1.283	0.304	2.462	1.17	Airflow: 50 Angle: 20
6.362	49.89	21.8	1.36	0.34	2.589	1.16	Airflow: 50 Angle: 22
6.368	49.91	21.8	1.374	0.343	2.613	1.161	Airflow: 50 Angle: 22
6.383	49.97	21.8	1.368	0.342	2.602	1.162	Airflow: 50 Angle: 22
6.394	50.01	21.8	1.355	0.337	2.571	1.164	Airflow: 50 Angle: 22
6.404	50.05	21.8	1.356	0.332	2.587	1.165	Airflow: 50 Angle: 22
6.414	50.09	21.8	1.355	0.329	2.572	1.167	Airflow: 50 Angle: 22
6.425	50.13	21.8	1.369	0.33	2.62	1.168	Airflow: 50 Angle: 22
6.435	50.17	21.8	1.389	0.335	2.648	1.17	Airflow: 50 Angle: 22

6.44	50.19	21.8	1.393	0.339	2.659	1.171	Airflow: 50 Angle: 22
6.446	50.21	21.8	1.393	0.343	2.658	1.173	Airflow: 50 Angle: 22
12.725	70.55	21.8	3.013	0.442	5.675	2.242	Airflow: 70 Angle: 22
12.735	70.58	21.8	3.009	0.442	5.662	2.244	Airflow: 70 Angle: 22
12.756	70.64	21.8	3.013	0.428	5.676	2.246	Airflow: 70 Angle: 22
12.766	70.67	21.8	2.974	0.426	5.597	2.249	Airflow: 70 Angle: 22
12.772	70.68	21.8	2.966	0.423	5.591	2.251	Airflow: 70 Angle: 22
12.787	70.72	21.8	2.972	0.426	5.597	2.253	Airflow: 70 Angle: 22
12.803	70.77	21.8	2.974	0.418	5.597	2.255	Airflow: 70 Angle: 22
12.803	70.77	21.8	2.956	0.422	5.563	2.257	Airflow: 70 Angle: 22
12.813	70.79	21.8	2.956	0.413	5.564	2.259	Airflow: 70 Angle: 22
12.808	70.78	21.8	2.979	0.424	5.595	2.261	Airflow: 70 Angle: 22
13.068	71.5	19.8	2.836	0.421	5.335	2.361	Airflow: 70 Angle: 20
13.053	71.45	19.8	2.778	0.409	5.254	2.361	Airflow: 70 Angle: 20
13.027	71.38	19.8	2.807	0.416	5.282	2.36	Airflow: 70 Angle: 20
13.011	71.34	19.8	2.777	0.415	5.244	2.359	Airflow: 70 Angle: 20
12.985	71.27	19.8	2.777	0.408	5.247	2.357	Airflow: 70 Angle: 20
12.964	71.21	19.8	2.817	0.417	5.297	2.356	Airflow: 70 Angle: 20
12.933	71.12	19.8	2.833	0.419	5.351	2.354	Airflow: 70 Angle: 20
12.912	71.07	19.8	2.867	0.421	5.369	2.352	Airflow: 70 Angle: 20
12.876	70.97	19.8	2.873	0.426	5.372	2.35	Airflow: 70 Angle: 20
12.865	70.94	19.8	2.839	0.417	5.317	2.347	Airflow: 70 Angle: 20
12.824	70.82	17.6	2.708	0.396	5.074	2.333	Airflow: 70 Angle: 18
12.818	70.81	17.6	2.699	0.389	5.086	2.333	Airflow: 70 Angle: 18
12.813	70.79	17.6	2.714	0.39	5.09	2.333	Airflow: 70 Angle: 18
12.792	70.74	17.6	2.728	0.392	5.121	2.332	Airflow: 70 Angle: 18
12.782	70.71	17.6	2.714	0.402	5.089	2.332	Airflow: 70 Angle: 18
12.766	70.67	17.6	2.64	0.389	4.995	2.331	Airflow: 70 Angle: 18
12.761	70.65	17.6	2.64	0.386	4.995	2.33	Airflow: 70 Angle: 18
12.735	70.58	17.6	2.671	0.381	5.014	2.329	Airflow: 70 Angle: 18
12.73	70.56	17.6	2.69	0.382	5.044	2.328	Airflow: 70 Angle: 18
12.725	70.55	17.6	2.69	0.382	5.044	2.327	Airflow: 70 Angle: 18
12.673	70.41	16	2.541	0.363	4.8	2.337	Airflow: 70 Angle: 16
12.668	70.39	16	2.541	0.363	4.8	2.335	Airflow: 70 Angle: 16

12.673	70.41	16	2.551	0.363	4.8	2.334	Airflow: 70 Angle: 16
12.673	70.41	16	2.556	0.355	4.819	2.332	Airflow: 70 Angle: 16
12.688	70.45	16	2.598	0.373	4.881	2.331	Airflow: 70 Angle: 16
12.704	70.49	16	2.611	0.374	4.887	2.33	Airflow: 70 Angle: 16
12.704	70.49	16	2.603	0.373	4.887	2.329	Airflow: 70 Angle: 16
12.72	70.54	16	2.611	0.371	4.89	2.329	Airflow: 70 Angle: 16
12.725	70.55	16	2.644	0.38	4.974	2.329	Airflow: 70 Angle: 16
12.746	70.61	16	2.611	0.384	4.899	2.329	Airflow: 70 Angle: 16
12.704	70.49	13.8	2.525	0.301	4.761	2.341	Airflow: 70 Angle: 14
12.688	70.45	13.8	2.525	0.31	4.76	2.339	Airflow: 70 Angle: 14
12.688	70.45	13.8	2.541	0.315	4.798	2.338	Airflow: 70 Angle: 14
12.673	70.41	13.8	2.505	0.313	4.764	2.336	Airflow: 70 Angle: 14
12.668	70.39	13.8	2.518	0.311	4.79	2.335	Airflow: 70 Angle: 14
12.668	70.39	13.8	2.597	0.313	4.889	2.333	Airflow: 70 Angle: 14
12.662	70.38	13.8	2.564	0.31	4.889	2.332	Airflow: 70 Angle: 14
12.657	70.36	13.8	2.536	0.308	4.819	2.331	Airflow: 70 Angle: 14
12.652	70.35	13.8	2.559	0.312	4.86	2.33	Airflow: 70 Angle: 14
12.657	70.36	13.8	2.563	0.317	4.859	2.329	Airflow: 70 Angle: 14
12.756	70.64	11.9	3.532	-0.279	7.714	2.343	Airflow: 70 Angle: 12
12.751	70.62	11.9	3.527	-0.274	7.704	2.343	Airflow: 70 Angle: 12
12.72	70.54	11.9	3.496	-0.275	7.624	2.343	Airflow: 70 Angle: 12
12.725	70.55	11.9	3.486	-0.273	7.61	2.343	Airflow: 70 Angle: 12
12.725	70.55	11.9	3.508	-0.271	7.679	2.342	Airflow: 70 Angle: 12
12.709	70.51	11.9	3.523	-0.275	7.689	2.341	Airflow: 70 Angle: 12
12.699	70.48	11.9	3.531	-0.279	7.711	2.341	Airflow: 70 Angle: 12
12.694	70.46	11.9	3.533	-0.278	7.724	2.34	Airflow: 70 Angle: 12
12.683	70.43	11.9	3.528	-0.285	7.693	2.34	Airflow: 70 Angle: 12
12.678	70.42	11.9	3.515	-0.279	7.679	2.339	Airflow: 70 Angle: 12
12.746	70.61	9.9	3.367	-0.189	7.292	2.327	Airflow: 70 Angle: 10
12.746	70.61	9.9	3.356	-0.186	7.255	2.328	Airflow: 70 Angle: 10
12.735	70.58	9.9	3.356	-0.181	7.25	2.329	Airflow: 70 Angle: 10
12.714	70.52	9.9	3.341	-0.182	7.218	2.329	Airflow: 70 Angle: 10
12.699	70.48	9.9	3.315	-0.18	7.174	2.329	Airflow: 70 Angle: 10
12.688	70.45	9.9	3.301	-0.185	7.137	2.329	Airflow: 70 Angle: 10

12.683	70.43	9.9	3.299	-0.182	7.13	2.329	Airflow: 70 Angle: 10
12.678	70.42	9.9	3.301	-0.181	7.134	2.329	Airflow: 70 Angle: 10
12.673	70.41	9.9	3.314	-0.185	7.159	2.329	Airflow: 70 Angle: 10
12.662	70.38	9.9	3.314	-0.184	7.159	2.329	Airflow: 70 Angle: 10
12.584	70.16	8	3.222	-0.118	6.915	2.325	Airflow: 70 Angle: 8
12.584	70.16	8	3.215	-0.119	6.883	2.325	Airflow: 70 Angle: 8
12.584	70.16	8	3.211	-0.117	6.883	2.325	Airflow: 70 Angle: 8
12.59	70.17	8	3.208	-0.118	6.883	2.325	Airflow: 70 Angle: 8
12.595	70.19	8	3.211	-0.121	6.892	2.325	Airflow: 70 Angle: 8
12.6	70.2	8	3.212	-0.121	6.893	2.325	Airflow: 70 Angle: 8
12.616	70.25	8	3.206	-0.117	6.888	2.326	Airflow: 70 Angle: 8
12.636	70.3	8	3.22	-0.116	6.908	2.326	Airflow: 70 Angle: 8
12.652	70.35	8	3.221	-0.117	6.912	2.327	Airflow: 70 Angle: 8
12.662	70.38	8	3.238	-0.118	6.94	2.328	Airflow: 70 Angle: 8
12.746	70.61	6.1	2.869	-0.021	6.109	2.35	Airflow: 70 Angle: 6
12.735	70.58	6.1	2.889	-0.02	6.155	2.35	Airflow: 70 Angle: 6
12.74	70.59	6.1	2.889	-0.023	6.156	2.35	Airflow: 70 Angle: 6
12.74	70.59	6.1	2.889	-0.025	6.149	2.35	Airflow: 70 Angle: 6
12.735	70.58	6.1	2.86	-0.027	6.094	2.35	Airflow: 70 Angle: 6
12.74	70.59	6.1	2.86	-0.025	6.094	2.35	Airflow: 70 Angle: 6
12.735	70.58	6.1	2.864	-0.026	6.101	2.35	Airflow: 70 Angle: 6
12.72	70.54	6.1	2.865	-0.026	6.111	2.35	Airflow: 70 Angle: 6
12.72	70.54	6.1	2.87	-0.025	6.119	2.349	Airflow: 70 Angle: 6
12.709	70.51	6.1	2.868	-0.025	6.117	2.349	Airflow: 70 Angle: 6
12.699	70.48	4.2	2.245	0.102	4.676	2.351	Airflow: 70 Angle: 4
12.694	70.46	4.2	2.245	0.1	4.676	2.351	Airflow: 70 Angle: 4
12.678	70.42	4.2	2.245	0.1	4.676	2.35	Airflow: 70 Angle: 4
12.662	70.38	4.2	2.239	0.098	4.658	2.349	Airflow: 70 Angle: 4
12.642	70.32	4.2	2.227	0.096	4.632	2.348	Airflow: 70 Angle: 4
12.626	70.28	4.2	2.22	0.095	4.624	2.347	Airflow: 70 Angle: 4
12.605	70.22	4.2	2.22	0.097	4.624	2.345	Airflow: 70 Angle: 4
12.59	70.17	4.2	2.225	0.101	4.627	2.343	Airflow: 70 Angle: 4
12.574	70.13	4.2	2.232	0.101	4.65	2.341	Airflow: 70 Angle: 4
12.569	70.12	4.2	2.236	0.099	4.664	2.34	Airflow: 70 Angle: 4

12.787	70.72	2.2	1.688	0.162	3.293	2.351	Airflow: 70 Angle: 2
12.787	70.72	2.2	1.684	0.162	3.285	2.352	Airflow: 70 Angle: 2
12.782	70.71	2.2	1.675	0.166	3.281	2.353	Airflow: 70 Angle: 2
12.782	70.71	2.2	1.667	0.166	3.256	2.353	Airflow: 70 Angle: 2
12.782	70.71	2.2	1.665	0.167	3.249	2.354	Airflow: 70 Angle: 2
12.782	70.71	2.2	1.664	0.167	3.249	2.354	Airflow: 70 Angle: 2
12.777	70.69	2.2	1.666	0.167	3.25	2.355	Airflow: 70 Angle: 2
12.766	70.67	2.2	1.662	0.168	3.248	2.355	Airflow: 70 Angle: 2
12.756	70.64	2.2	1.658	0.168	3.237	2.355	Airflow: 70 Angle: 2
12.74	70.59	2.2	1.652	0.163	3.229	2.355	Airflow: 70 Angle: 2
12.751	70.62	0	1.142	0.176	2.063	2.352	Airflow: 70 Angle: 0
12.74	70.59	0	1.142	0.179	2.063	2.352	Airflow: 70 Angle: 0
12.725	70.55	0	1.14	0.177	2.056	2.353	Airflow: 70 Angle: 0
12.725	70.55	0	1.143	0.181	2.059	2.353	Airflow: 70 Angle: 0
12.735	70.58	0	1.143	0.181	2.066	2.353	Airflow: 70 Angle: 0
12.74	70.59	0	1.143	0.186	2.066	2.353	Airflow: 70 Angle: 0
12.735	70.58	0	1.145	0.186	2.075	2.353	Airflow: 70 Angle: 0
12.735	70.58	0	1.149	0.178	2.08	2.353	Airflow: 70 Angle: 0
12.735	70.58	0	1.149	0.178	2.08	2.353	Airflow: 70 Angle: 0
12.74	70.59	0	1.149	0.177	2.073	2.353	Airflow: 70 Angle: 0
12.657	70.36	-1.7	0.55	0.17	0.745	2.348	Airflow: 70 Angle: -2
12.652	70.35	-1.7	0.552	0.171	0.749	2.348	Airflow: 70 Angle: -2
12.657	70.36	-1.7	0.552	0.169	0.752	2.348	Airflow: 70 Angle: -2
12.657	70.36	-1.7	0.552	0.167	0.752	2.348	Airflow: 70 Angle: -2
12.657	70.36	-1.7	0.553	0.167	0.755	2.348	Airflow: 70 Angle: -2
12.657	70.36	-1.7	0.553	0.165	0.753	2.349	Airflow: 70 Angle: -2
12.657	70.36	-1.7	0.554	0.163	0.754	2.349	Airflow: 70 Angle: -2
12.657	70.36	-1.7	0.554	0.163	0.757	2.349	Airflow: 70 Angle: -2
12.662	70.38	-1.7	0.556	0.165	0.761	2.349	Airflow: 70 Angle: -2
12.668	70.39	-1.7	0.557	0.169	0.761	2.349	Airflow: 70 Angle: -2
12.699	70.48	-3.9	0.063	0.136	-0.392	2.35	Airflow: 70 Angle: -4
12.688	70.45	-3.9	0.062	0.141	-0.385	2.351	Airflow: 70 Angle: -4
12.688	70.45	-3.9	0.061	0.146	-0.386	2.351	Airflow: 70 Angle: -4
12.688	70.45	-3.9	0.062	0.141	-0.384	2.351	Airflow: 70 Angle: -4

12.688	70.45	-3.9	0.06	0.141	-0.386	2.352	Airflow: 70 Angle: -4
12.678	70.42	-3.9	0.059	0.141	-0.386	2.352	Airflow: 70 Angle: -4
12.683	70.43	-3.9	0.054	0.141	-0.395	2.352	Airflow: 70 Angle: -4
12.678	70.42	-3.9	0.054	0.143	-0.395	2.353	Airflow: 70 Angle: -4
12.668	70.39	-3.9	0.051	0.14	-0.402	2.352	Airflow: 70 Angle: -4
12.662	70.38	-3.9	0.051	0.141	-0.395	2.352	Airflow: 70 Angle: -4
12.61	70.23	-5.5	-0.434	0.089	-1.538	2.341	Airflow: 70 Angle: -6
12.621	70.26	-5.5	-0.434	0.087	-1.54	2.342	Airflow: 70 Angle: -6
12.631	70.29	-5.5	-0.435	0.089	-1.544	2.342	Airflow: 70 Angle: -6
12.636	70.3	-5.5	-0.43	0.091	-1.539	2.343	Airflow: 70 Angle: -6
12.636	70.3	-5.5	-0.43	0.101	-1.538	2.343	Airflow: 70 Angle: -6
12.636	70.3	-5.5	-0.429	0.101	-1.529	2.344	Airflow: 70 Angle: -6
12.636	70.3	-5.5	-0.427	0.098	-1.523	2.344	Airflow: 70 Angle: -6
12.636	70.3	-5.5	-0.43	0.098	-1.527	2.345	Airflow: 70 Angle: -6
12.636	70.3	-5.5	-0.427	0.097	-1.52	2.346	Airflow: 70 Angle: -6
12.642	70.32	-5.5	-0.431	0.097	-1.527	2.346	Airflow: 70 Angle: -6
12.657	70.36	-7.7	-1.038	0.105	-2.747	2.343	Airflow: 70 Angle: -8
12.657	70.36	-7.7	-1.03	0.105	-2.733	2.343	Airflow: 70 Angle: -8
12.662	70.38	-7.7	-1.03	0.104	-2.732	2.344	Airflow: 70 Angle: -8
12.662	70.38	-7.7	-1.027	0.104	-2.732	2.344	Airflow: 70 Angle: -8
12.662	70.38	-7.7	-1.024	0.103	-2.697	2.345	Airflow: 70 Angle: -8
12.662	70.38	-7.7	-1.027	0.103	-2.697	2.345	Airflow: 70 Angle: -8
12.673	70.41	-7.7	-1.024	0.098	-2.694	2.346	Airflow: 70 Angle: -8
12.678	70.42	-7.7	-1.03	0.098	-2.697	2.346	Airflow: 70 Angle: -8
12.688	70.45	-7.7	-1.035	0.104	-2.709	2.347	Airflow: 70 Angle: -8
12.704	70.49	-7.7	-1.036	0.107	-2.717	2.348	Airflow: 70 Angle: -8
12.6	70.2	-9.4	-1.467	0.139	-3.182	2.341	Airflow: 70 Angle: -10
12.605	70.22	-9.4	-1.501	0.139	-3.21	2.341	Airflow: 70 Angle: -10
12.61	70.23	-9.4	-1.496	0.134	-3.185	2.342	Airflow: 70 Angle: -10
12.605	70.22	-9.4	-1.465	0.135	-3.138	2.342	Airflow: 70 Angle: -10
12.61	70.23	-9.4	-1.496	0.134	-3.185	2.343	Airflow: 70 Angle: -10
12.61	70.23	-9.4	-1.484	0.134	-3.138	2.343	Airflow: 70 Angle: -10
12.616	70.25	-9.4	-1.484	0.136	-3.123	2.344	Airflow: 70 Angle: -10
12.61	70.23	-9.4	-1.477	0.137	-3.109	2.344	Airflow: 70 Angle: -10

12.61	70.23	-9.4	-1.399	0.147	-3.039	2.344	Airflow: 70 Angle: -10
12.61	70.23	-9.4	-1.399	0.148	-3.039	2.345	Airflow: 70 Angle: -10
12.584	70.16	-11.3	-1.601	0.172	-3.242	2.336	Airflow: 70 Angle: -12
12.595	70.19	-11.3	-1.601	0.176	-3.242	2.336	Airflow: 70 Angle: -12
12.626	70.28	-11.3	-1.605	0.181	-3.263	2.337	Airflow: 70 Angle: -12
12.642	70.32	-11.3	-1.617	0.175	-3.294	2.338	Airflow: 70 Angle: -12
12.657	70.36	-11.3	-1.602	0.174	-3.261	2.34	Airflow: 70 Angle: -12
12.668	70.39	-11.3	-1.55	0.179	-3.142	2.341	Airflow: 70 Angle: -12
12.678	70.42	-11.3	-1.544	0.18	-3.142	2.343	Airflow: 70 Angle: -12
12.688	70.45	-11.3	-1.514	0.182	-3.101	2.344	Airflow: 70 Angle: -12
12.699	70.48	-11.3	-1.544	0.181	-3.142	2.345	Airflow: 70 Angle: -12
12.694	70.46	-11.3	-1.563	0.174	-3.187	2.347	Airflow: 70 Angle: -12
12.553	70.07	-13.5	-1.585	0.168	-3.176	2.338	Airflow: 70 Angle: -14
12.564	70.1	-13.5	-1.585	0.173	-3.177	2.338	Airflow: 70 Angle: -14
12.579	70.14	-13.5	-1.592	0.172	-3.172	2.338	Airflow: 70 Angle: -14
12.579	70.14	-13.5	-1.574	0.173	-3.131	2.339	Airflow: 70 Angle: -14
12.574	70.13	-13.5	-1.587	0.168	-3.135	2.339	Airflow: 70 Angle: -14
12.569	70.12	-13.5	-1.572	0.168	-3.129	2.339	Airflow: 70 Angle: -14
12.569	70.12	-13.5	-1.572	0.162	-3.128	2.339	Airflow: 70 Angle: -14
12.574	70.13	-13.5	-1.561	0.17	-3.094	2.339	Airflow: 70 Angle: -14
12.574	70.13	-13.5	-1.568	0.163	-3.12	2.34	Airflow: 70 Angle: -14
12.564	70.1	-13.5	-1.568	0.169	-3.12	2.34	Airflow: 70 Angle: -14
12.636	70.3	-15.5	-1.685	0.16	-3.391	2.343	Airflow: 70 Angle: -16
12.642	70.32	-15.5	-1.685	0.16	-3.413	2.344	Airflow: 70 Angle: -16
12.636	70.3	-15.5	-1.682	0.158	-3.372	2.344	Airflow: 70 Angle: -16
12.631	70.29	-15.5	-1.704	0.162	-3.413	2.345	Airflow: 70 Angle: -16
12.636	70.3	-15.5	-1.724	0.158	-3.451	2.346	Airflow: 70 Angle: -16
12.621	70.26	-15.5	-1.724	0.157	-3.457	2.346	Airflow: 70 Angle: -16
12.616	70.25	-15.5	-1.719	0.158	-3.451	2.346	Airflow: 70 Angle: -16
12.616	70.25	-15.5	-1.706	0.158	-3.451	2.346	Airflow: 70 Angle: -16
12.616	70.25	-15.5	-1.705	0.158	-3.423	2.346	Airflow: 70 Angle: -16
12.616	70.25	-15.5	-1.705	0.153	-3.423	2.347	Airflow: 70 Angle: -16

Table D.5 – Oct 24th Prototype KFm 0012 Data

The testing data was taken on October 24th, 2024. The data timestamp, and orientation columns are not included

q	V_ref	Alpha	NF/SF	AF/AF2	PM/YM	P	Notes
[psf]	[mph]	[deg]	[lbf]	[lbf]	[in-lbf]	[inH2O]	
0	0	0	-0.133	-0.003	-0.525	-0.007	Degrees: 0
0	0	0	-0.134	-0.002	-0.525	-0.007	Degrees: 0
0	0	0	-0.133	-0.003	-0.525	-0.007	Degrees: 0
0	0	0	-0.134	-0.002	-0.523	-0.007	Degrees: 0
0	0	0	-0.134	-0.003	-0.525	-0.007	Degrees: 0
0	0	0	-0.134	-0.005	-0.525	-0.007	Degrees: 0
0	0	0	-0.134	-0.004	-0.525	-0.007	Degrees: 0
0	0	0	-0.133	-0.003	-0.525	-0.007	Degrees: 0
0	0	0	-0.134	-0.003	-0.524	-0.007	Degrees: 0
0	0	0	-0.135	-0.004	-0.523	-0.007	Degrees: 0
6.336	49.78	-15	-1.136	-0.071	-3.008	1.186	Degrees: -15
6.342	49.8	-15	-1.13	-0.071	-2.991	1.186	Degrees: -15
6.342	49.8	-15	-1.13	-0.071	-2.991	1.186	Degrees: -15
6.347	49.83	-15	-1.13	-0.075	-2.993	1.186	Degrees: -15
6.347	49.83	-15	-1.132	-0.077	-3.125	1.186	Degrees: -15
6.357	49.87	-15	-1.135	-0.077	-3.125	1.186	Degrees: -15
6.362	49.89	-15	-1.134	-0.073	-3.074	1.186	Degrees: -15
6.362	49.89	-15	-1.13	-0.071	-3.067	1.187	Degrees: -15
6.362	49.89	-15	-1.128	-0.073	-3.066	1.187	Degrees: -15
6.362	49.89	-15	-1.131	-0.075	-3.118	1.188	Degrees: -15
6.368	49.91	-12	-1.177	-0.115	-3.523	1.2	Degrees: -12
6.368	49.91	-12	-1.177	-0.111	-3.523	1.2	Degrees: -12
6.362	49.89	-12	-1.176	-0.115	-3.533	1.199	Degrees: -12
6.362	49.89	-12	-1.176	-0.115	-3.536	1.199	Degrees: -12
6.357	49.87	-12	-1.176	-0.119	-3.536	1.199	Degrees: -12
6.347	49.83	-12	-1.176	-0.121	-3.537	1.199	Degrees: -12
6.342	49.8	-12	-1.178	-0.119	-3.472	1.198	Degrees: -12
6.342	49.8	-12	-1.18	-0.119	-3.45	1.198	Degrees: -12

6.336	49.78	-12	-1.184	-0.119	-3.492	1.197	Degrees: -12
6.326	49.74	-12	-1.184	-0.12	-3.498	1.196	Degrees: -12
6.347	49.83	-9	-1.069	-0.184	-3.342	1.204	Degrees: -9
6.352	49.85	-9	-1.068	-0.184	-3.345	1.204	Degrees: -9
6.357	49.87	-9	-1.067	-0.183	-3.349	1.204	Degrees: -9
6.362	49.89	-9	-1.067	-0.183	-3.35	1.203	Degrees: -9
6.362	49.89	-9	-1.067	-0.188	-3.346	1.204	Degrees: -9
6.368	49.91	-9	-1.067	-0.188	-3.336	1.204	Degrees: -9
6.368	49.91	-9	-1.067	-0.188	-3.339	1.204	Degrees: -9
6.368	49.91	-9	-1.068	-0.188	-3.34	1.204	Degrees: -9
6.368	49.91	-9	-1.068	-0.188	-3.342	1.204	Degrees: -9
6.368	49.91	-9	-1.069	-0.185	-3.341	1.204	Degrees: -9
6.404	50.05	-6	-0.898	-0.05	-2.406	1.209	Degrees: -6
6.399	50.03	-6	-0.896	-0.049	-2.404	1.209	Degrees: -6
6.394	50.01	-6	-0.895	-0.049	-2.405	1.209	Degrees: -6
6.383	49.97	-6	-0.895	-0.045	-2.404	1.209	Degrees: -6
6.378	49.95	-6	-0.896	-0.044	-2.398	1.208	Degrees: -6
6.368	49.91	-6	-0.897	-0.041	-2.397	1.208	Degrees: -6
6.362	49.89	-6	-0.897	-0.045	-2.392	1.207	Degrees: -6
6.352	49.85	-6	-0.898	-0.049	-2.392	1.206	Degrees: -6
6.342	49.8	-6	-0.898	-0.046	-2.385	1.206	Degrees: -6
6.331	49.76	-6	-0.899	-0.049	-2.38	1.205	Degrees: -6
6.362	49.89	-3	-0.488	-0.004	-1.271	1.207	Degrees: -3
6.362	49.89	-3	-0.488	-0.004	-1.271	1.206	Degrees: -3
6.362	49.89	-3	-0.489	-0.005	-1.277	1.206	Degrees: -3
6.362	49.89	-3	-0.491	-0.006	-1.278	1.206	Degrees: -3
6.357	49.87	-3	-0.491	-0.006	-1.277	1.206	Degrees: -3
6.352	49.85	-3	-0.491	-0.005	-1.279	1.206	Degrees: -3
6.342	49.8	-3	-0.492	-0.003	-1.27	1.206	Degrees: -3
6.342	49.8	-3	-0.492	-0.003	-1.27	1.206	Degrees: -3
6.342	49.8	-3	-0.493	-0.005	-1.27	1.205	Degrees: -3
6.342	49.8	-3	-0.495	-0.007	-1.269	1.205	Degrees: -3
6.331	49.76	0	-0.028	0.019	-0.056	1.201	Degrees: 0
6.331	49.76	0	-0.028	0.024	-0.057	1.201	Degrees: 0

6.331	49.76	0	-0.028	0.024	-0.07	1.201	Degrees: 0
6.331	49.76	0	-0.028	0.024	-0.068	1.201	Degrees: 0
6.331	49.76	0	-0.029	0.019	-0.067	1.201	Degrees: 0
6.331	49.76	0	-0.029	0.022	-0.068	1.201	Degrees: 0
6.331	49.76	0	-0.031	0.022	-0.067	1.201	Degrees: 0
6.342	49.8	0	-0.029	0.019	-0.06	1.201	Degrees: 0
6.342	49.8	0	-0.027	0.022	-0.066	1.201	Degrees: 0
6.336	49.78	0	-0.027	0.023	-0.066	1.2	Degrees: 0
6.321	49.72	3	0.326	0.026	0.942	1.206	Degrees: 3
6.316	49.7	3	0.326	0.029	0.931	1.205	Degrees: 3
6.316	49.7	3	0.328	0.03	0.931	1.204	Degrees: 3
6.316	49.7	3	0.333	0.031	0.944	1.204	Degrees: 3
6.31	49.68	3	0.334	0.031	0.948	1.203	Degrees: 3
6.316	49.7	3	0.334	0.03	0.955	1.203	Degrees: 3
6.31	49.68	3	0.334	0.031	0.957	1.203	Degrees: 3
6.31	49.68	3	0.334	0.031	0.957	1.202	Degrees: 3
6.31	49.68	3	0.332	0.03	0.952	1.202	Degrees: 3
6.3	49.64	3	0.328	0.021	0.944	1.201	Degrees: 3
6.326	49.74	6	0.754	-0.005	2.044	1.201	Degrees: 6
6.336	49.78	6	0.752	-0.008	2.041	1.202	Degrees: 6
6.336	49.78	6	0.753	-0.008	2.044	1.202	Degrees: 6
6.336	49.78	6	0.753	-0.009	2.045	1.203	Degrees: 6
6.342	49.8	6	0.752	-0.012	2.041	1.203	Degrees: 6
6.342	49.8	6	0.753	-0.013	2.045	1.204	Degrees: 6
6.342	49.8	6	0.753	-0.012	2.048	1.204	Degrees: 6
6.347	49.83	6	0.756	-0.007	2.055	1.204	Degrees: 6
6.347	49.83	6	0.757	-0.007	2.057	1.205	Degrees: 6
6.352	49.85	6	0.758	-0.006	2.06	1.205	Degrees: 6
6.222	49.33	9	1.037	0.028	2.71	1.184	Degrees: 9
6.232	49.37	9	1.036	0.025	2.7	1.185	Degrees: 9
6.238	49.39	9	1.036	0.022	2.707	1.185	Degrees: 9
6.248	49.44	9	1.036	0.025	2.707	1.186	Degrees: 9
6.258	49.48	9	1.036	0.022	2.7	1.187	Degrees: 9
6.264	49.5	9	1.036	0.023	2.707	1.188	Degrees: 9

6.269	49.52	9	1.037	0.025	2.697	1.189	Degrees: 9
6.279	49.56	9	1.037	0.022	2.697	1.189	Degrees: 9
6.29	49.6	9	1.037	0.022	2.698	1.19	Degrees: 9
6.3	49.64	9	1.037	0.022	2.702	1.192	Degrees: 9
6.258	49.48	12	0.887	0.192	1.92	1.19	Degrees: 12
6.258	49.48	12	0.845	0.195	1.804	1.19	Degrees: 12
6.258	49.48	12	0.84	0.196	1.766	1.19	Degrees: 12
6.264	49.5	12	0.84	0.198	1.756	1.191	Degrees: 12
6.274	49.54	12	0.835	0.203	1.752	1.191	Degrees: 12
6.279	49.56	12	0.84	0.206	1.756	1.192	Degrees: 12
6.284	49.58	12	0.853	0.207	1.789	1.193	Degrees: 12
6.284	49.58	12	0.869	0.209	1.844	1.193	Degrees: 12
6.29	49.6	12	0.868	0.205	1.846	1.194	Degrees: 12
6.295	49.62	12	0.862	0.205	1.848	1.195	Degrees: 12
6.31	49.68	15	0.979	0.252	2.068	1.199	Degrees: 15
6.31	49.68	15	0.979	0.248	2.068	1.199	Degrees: 15
6.31	49.68	15	0.978	0.248	2.056	1.199	Degrees: 15
6.305	49.66	15	0.956	0.247	2.019	1.2	Degrees: 15
6.305	49.66	15	0.944	0.245	2.001	1.2	Degrees: 15
6.3	49.64	15	0.944	0.245	2.005	1.2	Degrees: 15
6.3	49.64	15	0.923	0.244	1.943	1.2	Degrees: 15
6.31	49.68	15	0.923	0.244	1.945	1.2	Degrees: 15
6.31	49.68	15	0.94	0.246	1.984	1.2	Degrees: 15
6.316	49.7	15	0.951	0.25	1.992	1.201	Degrees: 15
6.258	49.48	18	1.056	0.283	2.27	1.183	Degrees: 18
6.274	49.54	18	1.061	0.283	2.273	1.184	Degrees: 18
6.284	49.58	18	1.052	0.279	2.27	1.185	Degrees: 18
6.295	49.62	18	1.052	0.279	2.254	1.187	Degrees: 18
6.305	49.66	18	1.047	0.287	2.231	1.188	Degrees: 18
6.31	49.68	18	1.047	0.287	2.247	1.19	Degrees: 18
6.316	49.7	18	1.036	0.289	2.216	1.191	Degrees: 18
6.321	49.72	18	1.041	0.285	2.222	1.192	Degrees: 18
6.331	49.76	18	1.062	0.286	2.247	1.194	Degrees: 18
6.336	49.78	18	1.046	0.285	2.208	1.195	Degrees: 18

6.264	49.5	21	1.156	0.329	2.438	1.191	Degrees: 21
6.269	49.52	21	1.159	0.329	2.451	1.192	Degrees: 21
6.269	49.52	21	1.163	0.33	2.464	1.192	Degrees: 21
6.269	49.52	21	1.167	0.326	2.464	1.192	Degrees: 21
6.269	49.52	21	1.162	0.341	2.463	1.192	Degrees: 21
6.274	49.54	21	1.163	0.341	2.474	1.193	Degrees: 21
6.279	49.56	21	1.169	0.326	2.499	1.193	Degrees: 21
6.284	49.58	21	1.176	0.331	2.499	1.193	Degrees: 21
6.295	49.62	21	1.176	0.331	2.512	1.194	Degrees: 21
6.295	49.62	21	1.169	0.335	2.495	1.194	Degrees: 21
6.16	49.08	24	1.271	0.343	2.73	1.177	Degrees: 24
6.16	49.08	24	1.276	0.339	2.767	1.177	Degrees: 24
6.165	49.11	24	1.292	0.328	2.788	1.177	Degrees: 24
6.165	49.11	24	1.311	0.345	2.836	1.177	Degrees: 24
6.175	49.15	24	1.307	0.353	2.835	1.178	Degrees: 24
6.186	49.19	24	1.307	0.355	2.832	1.178	Degrees: 24
6.18	49.17	24	1.307	0.355	2.832	1.179	Degrees: 24
6.191	49.21	24	1.306	0.365	2.8	1.18	Degrees: 24
6.196	49.23	24	1.307	0.362	2.811	1.18	Degrees: 24
6.201	49.25	24	1.294	0.356	2.784	1.181	Degrees: 24
6.305	49.66	27	1.429	0.369	3.084	1.195	Degrees: 27
6.295	49.62	27	1.432	0.379	3.115	1.195	Degrees: 27
6.295	49.62	27	1.465	0.368	3.144	1.196	Degrees: 27
6.3	49.64	27	1.461	0.368	3.153	1.196	Degrees: 27
6.3	49.64	27	1.461	0.368	3.153	1.197	Degrees: 27
6.3	49.64	27	1.46	0.364	3.151	1.197	Degrees: 27
6.295	49.62	27	1.449	0.363	3.135	1.197	Degrees: 27
6.3	49.64	27	1.443	0.363	3.127	1.197	Degrees: 27
6.3	49.64	27	1.451	0.363	3.147	1.197	Degrees: 27
6.295	49.62	27	1.449	0.366	3.135	1.197	Degrees: 27
12.506	69.94	27	3.081	0.537	6.669	2.305	Degrees: 27
12.506	69.94	27	3.029	0.535	6.669	2.306	Degrees: 27
12.506	69.94	27	3.021	0.543	6.645	2.307	Degrees: 27
12.517	69.97	27	3.09	0.544	6.736	2.308	Degrees: 27

12.527	70	27	3.121	0.546	6.783	2.309	Degrees: 27
12.538	70.03	27	3.109	0.513	6.789	2.31	Degrees: 27
12.532	70.01	27	3.099	0.476	6.787	2.311	Degrees: 27
12.532	70.01	27	3.101	0.533	6.758	2.313	Degrees: 27
12.512	69.96	27	3.041	0.51	6.707	2.313	Degrees: 27
12.506	69.94	27	3.014	0.508	6.626	2.313	Degrees: 27
12.605	70.22	24	2.646	0.456	5.962	2.344	Degrees: 24
12.6	70.2	24	2.646	0.455	5.953	2.344	Degrees: 24
12.584	70.16	24	2.684	0.456	6.03	2.344	Degrees: 24
12.579	70.14	24	2.683	0.458	5.999	2.343	Degrees: 24
12.558	70.09	24	2.681	0.439	5.992	2.342	Degrees: 24
12.553	70.07	24	2.68	0.458	5.991	2.34	Degrees: 24
12.553	70.07	24	2.676	0.449	5.987	2.339	Degrees: 24
12.553	70.07	24	2.668	0.461	5.985	2.338	Degrees: 24
12.543	70.04	24	2.668	0.461	5.986	2.338	Degrees: 24
12.558	70.09	24	2.681	0.448	6.004	2.338	Degrees: 24
12.605	70.22	21	2.418	0.429	5.448	2.347	Degrees: 21
12.621	70.26	21	2.418	0.426	5.448	2.349	Degrees: 21
12.626	70.28	21	2.414	0.423	5.448	2.35	Degrees: 21
12.642	70.32	21	2.428	0.414	5.478	2.352	Degrees: 21
12.647	70.33	21	2.428	0.424	5.478	2.353	Degrees: 21
12.647	70.33	21	2.422	0.41	5.472	2.355	Degrees: 21
12.657	70.36	21	2.422	0.41	5.451	2.356	Degrees: 21
12.668	70.39	21	2.419	0.418	5.42	2.358	Degrees: 21
12.683	70.43	21	2.419	0.411	5.432	2.36	Degrees: 21
12.694	70.46	21	2.387	0.422	5.363	2.362	Degrees: 21
12.61	70.23	18	2.118	0.383	4.797	2.362	Degrees: 18
12.616	70.25	18	2.105	0.382	4.745	2.362	Degrees: 18
12.616	70.25	18	2.105	0.382	4.745	2.362	Degrees: 18
12.621	70.26	18	2.122	0.382	4.798	2.362	Degrees: 18
12.626	70.28	18	2.122	0.377	4.799	2.362	Degrees: 18
12.631	70.29	18	2.136	0.374	4.813	2.362	Degrees: 18
12.631	70.29	18	2.119	0.375	4.782	2.363	Degrees: 18
12.626	70.28	18	2.093	0.37	4.754	2.363	Degrees: 18

12.61	70.23	18	2.096	0.373	4.758	2.363	Degrees: 18
12.605	70.22	18	2.033	0.37	4.612	2.363	Degrees: 18
12.527	70	15	1.934	0.318	4.398	2.358	Degrees: 15
12.527	70	15	1.927	0.326	4.361	2.356	Degrees: 15
12.512	69.96	15	1.912	0.325	4.308	2.355	Degrees: 15
12.512	69.96	15	1.917	0.325	4.361	2.354	Degrees: 15
12.512	69.96	15	1.948	0.331	4.388	2.354	Degrees: 15
12.506	69.94	15	2.002	0.349	4.565	2.353	Degrees: 15
12.506	69.94	15	2.029	0.35	4.568	2.353	Degrees: 15
12.496	69.91	15	1.954	0.344	4.446	2.352	Degrees: 15
12.48	69.87	15	2.013	0.338	4.54	2.351	Degrees: 15
12.465	69.83	15	2.013	0.331	4.541	2.349	Degrees: 15
12.636	70.3	12	1.81	0.287	4.107	2.364	Degrees: 12
12.642	70.32	12	1.801	0.287	4.102	2.365	Degrees: 12
12.657	70.36	12	1.784	0.286	4.093	2.366	Degrees: 12
12.668	70.39	12	1.778	0.285	4.088	2.367	Degrees: 12
12.673	70.41	12	1.835	0.291	4.187	2.368	Degrees: 12
12.678	70.42	12	1.845	0.291	4.204	2.369	Degrees: 12
12.673	70.41	12	1.866	0.292	4.207	2.37	Degrees: 12
12.657	70.36	12	1.866	0.287	4.208	2.37	Degrees: 12
12.652	70.35	12	1.81	0.284	4.127	2.37	Degrees: 12
12.631	70.29	12	1.791	0.277	4.052	2.369	Degrees: 12
12.584	70.16	9	2.189	-0.118	5.885	2.383	Degrees: 9
12.584	70.16	9	2.192	-0.116	5.908	2.381	Degrees: 9
12.569	70.12	9	2.211	-0.122	5.932	2.379	Degrees: 9
12.558	70.09	9	2.222	-0.124	5.973	2.377	Degrees: 9
12.558	70.09	9	2.225	-0.122	5.983	2.375	Degrees: 9
12.558	70.09	9	2.222	-0.125	5.983	2.373	Degrees: 9
12.558	70.09	9	2.225	-0.129	5.985	2.372	Degrees: 9
12.558	70.09	9	2.212	-0.126	5.931	2.371	Degrees: 9
12.558	70.09	9	2.197	-0.126	5.904	2.37	Degrees: 9
12.553	70.07	9	2.192	-0.125	5.904	2.369	Degrees: 9
12.522	69.99	6	1.703	-0.041	4.625	2.357	Degrees: 6
12.517	69.97	6	1.706	-0.041	4.625	2.357	Degrees: 6

12.506	69.94	6	1.702	-0.036	4.615	2.357	Degrees: 6
12.501	69.93	6	1.702	-0.033	4.615	2.356	Degrees: 6
12.496	69.91	6	1.696	-0.036	4.6	2.355	Degrees: 6
12.486	69.88	6	1.694	-0.033	4.599	2.355	Degrees: 6
12.48	69.87	6	1.696	-0.036	4.608	2.354	Degrees: 6
12.475	69.85	6	1.705	-0.035	4.633	2.353	Degrees: 6
12.48	69.87	6	1.708	-0.034	4.639	2.352	Degrees: 6
12.48	69.87	6	1.712	-0.037	4.652	2.352	Degrees: 6
12.496	69.91	3	0.915	0.056	2.668	2.355	Degrees: 3
12.496	69.91	3	0.915	0.057	2.668	2.354	Degrees: 3
12.501	69.93	3	0.915	0.058	2.666	2.354	Degrees: 3
12.506	69.94	3	0.922	0.057	2.674	2.354	Degrees: 3
12.506	69.94	3	0.925	0.055	2.684	2.354	Degrees: 3
12.506	69.94	3	0.926	0.057	2.698	2.354	Degrees: 3
12.491	69.9	3	0.925	0.057	2.698	2.353	Degrees: 3
12.48	69.87	3	0.925	0.056	2.698	2.353	Degrees: 3
12.465	69.83	3	0.915	0.051	2.663	2.352	Degrees: 3
12.46	69.81	3	0.912	0.051	2.659	2.351	Degrees: 3
12.48	69.87	0	0.36	0.087	0.501	2.361	Degrees: 0
12.465	69.83	0	0.357	0.087	0.513	2.359	Degrees: 0
12.449	69.78	0	0.356	0.088	0.513	2.358	Degrees: 0
12.439	69.75	0	0.355	0.086	0.517	2.356	Degrees: 0
12.433	69.74	0	0.357	0.091	0.517	2.355	Degrees: 0
12.428	69.72	0	0.357	0.086	0.517	2.353	Degrees: 0
12.418	69.69	0	0.358	0.086	0.514	2.352	Degrees: 0
12.413	69.68	0	0.359	0.089	0.516	2.351	Degrees: 0
12.407	69.66	0	0.36	0.092	0.512	2.349	Degrees: 0
12.407	69.66	0	0.36	0.092	0.513	2.348	Degrees: 0
12.413	69.68	-3	-0.384	0.048	-1.678	2.355	Degrees: -3
12.397	69.64	-3	-0.383	0.047	-1.681	2.353	Degrees: -3
12.387	69.61	-3	-0.383	0.048	-1.684	2.352	Degrees: -3
12.376	69.58	-3	-0.383	0.051	-1.681	2.35	Degrees: -3
12.371	69.56	-3	-0.388	0.054	-1.68	2.348	Degrees: -3
12.366	69.55	-3	-0.389	0.052	-1.676	2.347	Degrees: -3

12.355	69.52	-3	-0.389	0.051	-1.676	2.345	Degrees: -3
12.355	69.52	-3	-0.389	0.046	-1.682	2.344	Degrees: -3
12.361	69.53	-3	-0.389	0.046	-1.682	2.342	Degrees: -3
12.371	69.56	-3	-0.389	0.05	-1.682	2.341	Degrees: -3
12.558	70.09	-6	-1.097	-0.062	-3.847	2.364	Degrees: -6
12.548	70.06	-6	-1.097	-0.06	-3.849	2.364	Degrees: -6
12.543	70.04	-6	-1.098	-0.06	-3.855	2.363	Degrees: -6
12.532	70.01	-6	-1.098	-0.061	-3.855	2.363	Degrees: -6
12.522	69.99	-6	-1.098	-0.061	-3.844	2.362	Degrees: -6
12.506	69.94	-6	-1.098	-0.061	-3.836	2.361	Degrees: -6
12.486	69.88	-6	-1.098	-0.064	-3.834	2.359	Degrees: -6
12.47	69.84	-6	-1.097	-0.066	-3.835	2.358	Degrees: -6
12.465	69.83	-6	-1.096	-0.07	-3.842	2.356	Degrees: -6
12.465	69.83	-6	-1.096	-0.065	-3.857	2.354	Degrees: -6
12.548	70.06	-9	-1.705	-0.239	-6.001	2.36	Degrees: -9
12.553	70.07	-9	-1.705	-0.237	-6.026	2.361	Degrees: -9
12.553	70.07	-9	-1.704	-0.239	-6.037	2.362	Degrees: -9
12.548	70.06	-9	-1.704	-0.239	-6.037	2.363	Degrees: -9
12.543	70.04	-9	-1.705	-0.239	-6.03	2.363	Degrees: -9
12.543	70.04	-9	-1.71	-0.237	-5.972	2.364	Degrees: -9
12.532	70.01	-9	-1.711	-0.237	-5.963	2.364	Degrees: -9
12.538	70.03	-9	-1.711	-0.237	-5.963	2.364	Degrees: -9
12.532	70.01	-9	-1.711	-0.24	-5.966	2.364	Degrees: -9
12.538	70.03	-9	-1.712	-0.24	-5.972	2.364	Degrees: -9
12.433	69.74	-12	-2.178	-0.222	-6.771	2.336	Degrees: -12
12.444	69.77	-12	-2.18	-0.223	-6.865	2.337	Degrees: -12
12.46	69.81	-12	-2.174	-0.217	-6.893	2.339	Degrees: -12
12.465	69.83	-12	-2.216	-0.211	-6.893	2.34	Degrees: -12
12.475	69.85	-12	-2.214	-0.209	-6.772	2.342	Degrees: -12
12.486	69.88	-12	-2.198	-0.213	-6.676	2.343	Degrees: -12
12.486	69.88	-12	-2.224	-0.186	-6.655	2.345	Degrees: -12
12.48	69.87	-12	-2.22	-0.199	-6.655	2.346	Degrees: -12
12.465	69.83	-12	-2.22	-0.191	-6.655	2.346	Degrees: -12
12.454	69.8	-12	-2.221	-0.187	-6.676	2.347	Degrees: -12

12.381	69.59	-15	-2.106	-0.066	-5.857	2.338	Degrees: -15
12.371	69.56	-15	-2.107	-0.059	-5.893	2.337	Degrees: -15
12.376	69.58	-15	-2.12	-0.059	-5.905	2.336	Degrees: -15
12.376	69.58	-15	-2.122	-0.057	-5.905	2.336	Degrees: -15
12.381	69.59	-15	-2.123	-0.057	-5.893	2.336	Degrees: -15
12.387	69.61	-15	-2.134	-0.056	-5.918	2.336	Degrees: -15
12.397	69.64	-15	-2.132	-0.055	-5.826	2.336	Degrees: -15
12.418	69.69	-15	-2.159	-0.056	-5.826	2.337	Degrees: -15
12.433	69.74	-15	-2.159	-0.053	-5.826	2.338	Degrees: -15
12.454	69.8	-15	-2.133	-0.053	-5.881	2.339	Degrees: -15
0	0	0	-0.067	-0.045	-0.458	0.057	Degrees: 0
0	0	0	-0.068	-0.044	-0.459	0.057	Degrees: 0
0	0	0	-0.068	-0.045	-0.459	0.056	Degrees: 0
0	0	0	-0.068	-0.045	-0.46	0.056	Degrees: 0
0	0	0	-0.068	-0.045	-0.46	0.055	Degrees: 0
0	0	0	-0.068	-0.045	-0.46	0.055	Degrees: 0
0	0	0	-0.068	-0.045	-0.46	0.055	Degrees: 0
0	0	0	-0.068	-0.044	-0.461	0.054	Degrees: 0
0	0	0	-0.069	-0.044	-0.462	0.054	Degrees: 0
0	0	0	-0.067	-0.043	-0.462	0.054	Degrees: 0

Table D.6 – Oct 10th Prototype KFm 0012 Data

The testing data was taken on October 10th, 2024. The data timestamp, and orientation columns are not included

q	V_ref	Alpha	NF/SF	AF/AF2	PM/YM	P
[psf]	[mph]	[deg]	[lbf]	[lbf]	[in-lbf]	[inH2O]
6.212	49.29	-14.9	-1.157	-0.075	-2.46	0.924
6.222	49.33	-14.9	-1.141	-0.074	-2.44	0.926
6.227	49.35	-14.9	-1.135	-0.082	-2.42	0.929
6.238	49.39	-14.9	-1.134	-0.082	-2.42	0.931
6.243	49.41	-14.9	-1.132	-0.075	-2.419	0.933
6.253	49.46	-14.9	-1.14	-0.08	-2.434	0.935
6.269	49.52	-14.9	-1.176	-0.083	-2.514	0.937

6.279	49.56	-14.9	-1.183	-0.075	-2.529	0.939
6.295	49.62	-14.9	-1.197	-0.075	-2.554	0.941
6.31	49.68	-14.9	-1.209	-0.085	-2.58	0.943
6.368	49.91	-12.1	-1.356	-0.11	-3.006	0.982
6.368	49.91	-12.1	-1.342	-0.108	-2.944	0.982
6.368	49.91	-12.1	-1.342	-0.107	-2.944	0.982
6.368	49.91	-12.1	-1.282	-0.103	-2.785	0.982
6.362	49.89	-12.1	-1.257	-0.093	-2.75	0.982
6.362	49.89	-12.1	-1.257	-0.093	-2.745	0.982
6.362	49.89	-12.1	-1.227	-0.092	-2.722	0.982
6.357	49.87	-12.1	-1.228	-0.09	-2.745	0.982
6.362	49.89	-12.1	-1.276	-0.092	-2.774	0.982
6.362	49.89	-12.1	-1.271	-0.092	-2.774	0.982
6.342	49.8	-9	-1.254	-0.216	-3.137	0.99
6.331	49.76	-9	-1.259	-0.216	-3.151	0.989
6.326	49.74	-9	-1.267	-0.213	-3.171	0.988
6.326	49.74	-9	-1.27	-0.213	-3.178	0.987
6.326	49.74	-9	-1.271	-0.217	-3.179	0.986
6.321	49.72	-9	-1.272	-0.217	-3.181	0.985
6.316	49.7	-9	-1.271	-0.22	-3.182	0.984
6.321	49.72	-9	-1.271	-0.222	-3.182	0.984
6.326	49.74	-9	-1.271	-0.219	-3.182	0.983
6.326	49.74	-9	-1.271	-0.222	-3.182	0.983
6.409	50.07	-6	-0.905	-0.121	-2.204	0.995
6.409	50.07	-6	-0.905	-0.117	-2.197	0.995
6.404	50.05	-6	-0.901	-0.117	-2.197	0.995
6.399	50.03	-6	-0.895	-0.114	-2.19	0.995
6.394	50.01	-6	-0.894	-0.113	-2.182	0.995
6.388	49.99	-6	-0.896	-0.114	-2.185	0.994
6.388	49.99	-6	-0.892	-0.112	-2.171	0.993
6.388	49.99	-6	-0.894	-0.111	-2.182	0.993
6.388	49.99	-6	-0.895	-0.113	-2.184	0.992
6.394	50.01	-6	-0.902	-0.114	-2.205	0.992
6.373	49.93	-3	-0.489	-0.034	-1.146	0.99

6.373	49.93	-3	-0.491	-0.034	-1.152	0.989
6.368	49.91	-3	-0.494	-0.035	-1.155	0.989
6.368	49.91	-3	-0.494	-0.034	-1.155	0.988
6.368	49.91	-3	-0.494	-0.033	-1.155	0.988
6.362	49.89	-3	-0.49	-0.031	-1.155	0.988
6.362	49.89	-3	-0.489	-0.031	-1.151	0.988
6.362	49.89	-3	-0.49	-0.035	-1.151	0.987
6.362	49.89	-3	-0.489	-0.035	-1.14	0.987
6.357	49.87	-3	-0.488	-0.034	-1.135	0.987
6.373	49.93	0	-0.005	0.031	0.108	0.987
6.378	49.95	0	-0.005	0.033	0.108	0.987
6.378	49.95	0	-0.004	0.031	0.108	0.987
6.383	49.97	0	-0.004	0.032	0.109	0.988
6.388	49.99	0	-0.004	0.031	0.109	0.989
6.388	49.99	0	-0.003	0.032	0.113	0.989
6.388	49.99	0	-0.003	0.032	0.109	0.99
6.388	49.99	0	0	0.031	0.11	0.99
6.388	49.99	0	0	0.03	0.11	0.99
6.383	49.97	0	-0.003	0.026	0.106	0.99
6.42	50.11	2.9	0.498	0.05	1.388	0.992
6.414	50.09	2.9	0.498	0.051	1.389	0.992
6.409	50.07	2.9	0.499	0.054	1.394	0.992
6.404	50.05	2.9	0.498	0.056	1.391	0.992
6.399	50.03	2.9	0.496	0.056	1.391	0.992
6.394	50.01	2.9	0.493	0.047	1.388	0.992
6.388	49.99	2.9	0.496	0.044	1.384	0.992
6.388	49.99	2.9	0.496	0.043	1.384	0.992
6.388	49.99	2.9	0.497	0.048	1.387	0.991
6.388	49.99	2.9	0.499	0.053	1.398	0.991
6.347	49.83	6	0.904	0.047	2.358	0.986
6.347	49.83	6	0.904	0.046	2.36	0.985
6.347	49.83	6	0.909	0.034	2.377	0.985
6.352	49.85	6	0.914	0.035	2.392	0.984
6.357	49.87	6	0.918	0.035	2.403	0.984

6.357	49.87	6	0.92	0.04	2.415	0.985
6.357	49.87	6	0.92	0.05	2.415	0.985
6.362	49.89	6	0.92	0.049	2.411	0.985
6.362	49.89	6	0.919	0.049	2.408	0.985
6.362	49.89	6	0.916	0.045	2.398	0.985
6.331	49.76	9	1.071	0.094	2.609	0.981
6.331	49.76	9	1.071	0.094	2.601	0.981
6.331	49.76	9	1.071	0.096	2.601	0.981
6.336	49.78	9	1.057	0.096	2.562	0.981
6.336	49.78	9	1.054	0.099	2.562	0.981
6.342	49.8	9	1.053	0.098	2.534	0.982
6.342	49.8	9	1.048	0.098	2.528	0.982
6.342	49.8	9	1.051	0.099	2.522	0.982
6.342	49.8	9	1.048	0.098	2.517	0.982
6.342	49.8	9	1.044	0.096	2.516	0.982
6.368	49.91	12	0.963	0.227	2.097	0.984
6.368	49.91	12	0.967	0.228	2.108	0.984
6.362	49.89	12	0.967	0.228	2.123	0.985
6.368	49.91	12	0.964	0.231	2.107	0.985
6.373	49.93	12	0.966	0.235	2.107	0.985
6.373	49.93	12	0.966	0.235	2.107	0.985
6.373	49.93	12	0.964	0.239	2.107	0.986
6.373	49.93	12	0.964	0.234	2.107	0.986
6.368	49.91	12	0.983	0.239	2.13	0.986
6.368	49.91	12	0.983	0.234	2.143	0.986
6.368	49.91	15	1.08	0.284	2.346	0.992
6.368	49.91	15	1.067	0.283	2.307	0.992
6.368	49.91	15	1.067	0.283	2.307	0.991
6.368	49.91	15	1.063	0.282	2.301	0.991
6.368	49.91	15	1.067	0.282	2.307	0.991
6.368	49.91	15	1.117	0.283	2.398	0.991
6.373	49.93	15	1.117	0.285	2.397	0.991
6.373	49.93	15	1.119	0.283	2.423	0.991
6.378	49.95	15	1.119	0.285	2.423	0.991

6.388	49.99	15	1.099	0.284	2.382	0.991
6.321	49.72	18	1.156	0.33	2.517	0.976
6.326	49.74	18	1.155	0.33	2.515	0.977
6.326	49.74	18	1.147	0.319	2.501	0.977
6.336	49.78	18	1.144	0.318	2.479	0.978
6.342	49.8	18	1.149	0.319	2.493	0.979
6.347	49.83	18	1.152	0.32	2.516	0.979
6.352	49.85	18	1.152	0.326	2.516	0.98
6.357	49.87	18	1.153	0.32	2.516	0.981
6.362	49.89	18	1.148	0.32	2.516	0.982
6.368	49.91	18	1.144	0.31	2.507	0.983
6.414	50.09	21	1.334	0.342	2.831	0.98
6.425	50.13	21	1.335	0.344	2.83	0.982
6.435	50.17	21	1.31	0.348	2.796	0.984
6.44	50.19	21	1.305	0.348	2.792	0.985
6.446	50.21	21	1.32	0.333	2.803	0.987
6.446	50.21	21	1.322	0.334	2.818	0.989
6.44	50.19	21	1.323	0.33	2.825	0.99
6.44	50.19	21	1.317	0.328	2.814	0.991
6.446	50.21	21	1.308	0.321	2.792	0.992
6.451	50.23	21	1.307	0.325	2.78	0.993
6.362	49.89	24	1.487	0.366	3.161	0.978
6.373	49.93	24	1.493	0.368	3.169	0.979
6.373	49.93	24	1.493	0.366	3.161	0.979
6.378	49.95	24	1.47	0.373	3.15	0.98
6.388	49.99	24	1.47	0.375	3.144	0.981
6.404	50.05	24	1.469	0.372	3.135	0.983
6.414	50.09	24	1.485	0.362	3.175	0.984
6.43	50.15	24	1.513	0.374	3.237	0.985
6.446	50.21	24	1.527	0.375	3.244	0.987
6.451	50.23	24	1.513	0.38	3.237	0.988
6.227	49.35	27	1.621	0.396	3.383	0.96
6.232	49.37	27	1.636	0.409	3.429	0.961
6.238	49.39	27	1.641	0.403	3.456	0.961

6.238	49.39	27	1.639	0.403	3.456	0.962
6.243	49.41	27	1.652	0.396	3.469	0.963
6.253	49.46	27	1.652	0.398	3.472	0.964
6.258	49.48	27	1.652	0.404	3.471	0.965
6.253	49.46	27	1.658	0.407	3.49	0.965
6.253	49.46	27	1.658	0.405	3.49	0.966
6.248	49.44	27	1.646	0.404	3.474	0.967
12.522	69.99	27	3.308	0.554	6.977	2.108
12.506	69.94	27	3.19	0.547	6.829	2.108
12.491	69.9	27	3.238	0.528	6.873	2.107
12.491	69.9	27	3.274	0.544	6.949	2.106
12.486	69.88	27	3.274	0.531	6.95	2.106
12.486	69.88	27	3.274	0.524	6.933	2.105
12.491	69.9	27	3.294	0.545	6.99	2.104
12.48	69.87	27	3.307	0.526	7.028	2.104
12.48	69.87	27	3.307	0.514	7.028	2.103
12.475	69.85	27	3.309	0.532	7.027	2.103
12.647	70.33	23.9	2.969	0.494	6.403	2.122
12.652	70.35	23.9	2.93	0.479	6.308	2.125
12.642	70.32	23.9	2.884	0.491	6.201	2.126
12.631	70.29	23.9	2.859	0.468	6.155	2.127
12.626	70.28	23.9	2.873	0.476	6.182	2.128
12.605	70.22	23.9	2.873	0.49	6.178	2.129
12.61	70.23	23.9	2.907	0.471	6.226	2.129
12.584	70.16	23.9	2.915	0.492	6.247	2.129
12.584	70.16	23.9	2.945	0.482	6.293	2.128
12.584	70.16	23.9	2.948	0.496	6.314	2.128
12.439	69.75	21	2.597	0.449	5.611	2.111
12.444	69.77	21	2.597	0.473	5.61	2.11
12.439	69.75	21	2.597	0.449	5.618	2.109
12.444	69.77	21	2.578	0.45	5.618	2.109
12.444	69.77	21	2.575	0.449	5.557	2.108
12.444	69.77	21	2.613	0.446	5.636	2.108
12.449	69.78	21	2.637	0.457	5.699	2.107

12.433	69.74	21	2.64	0.457	5.7	2.107
12.418	69.69	21	2.637	0.466	5.698	2.107
12.402	69.65	21	2.622	0.468	5.676	2.106
12.387	69.61	18	2.505	0.395	5.52	2.105
12.392	69.62	18	2.515	0.383	5.557	2.105
12.381	69.59	18	2.514	0.383	5.557	2.105
12.376	69.58	18	2.509	0.393	5.545	2.105
12.376	69.58	18	2.509	0.39	5.546	2.105
12.371	69.56	18	2.487	0.391	5.453	2.105
12.355	69.52	18	2.487	0.388	5.454	2.104
12.361	69.53	18	2.472	0.388	5.492	2.104
12.371	69.56	18	2.516	0.398	5.529	2.104
12.366	69.55	18	2.499	0.402	5.53	2.104
12.496	69.91	15	2.306	0.346	5.084	2.125
12.491	69.9	15	2.282	0.345	5.04	2.125
12.486	69.88	15	2.359	0.341	5.193	2.125
12.475	69.85	15	2.306	0.34	5.076	2.124
12.465	69.83	15	2.306	0.34	5.076	2.124
12.449	69.78	15	2.322	0.345	5.132	2.123
12.444	69.77	15.1	2.309	0.345	5.086	2.122
12.454	69.8	15.1	2.322	0.345	5.132	2.121
12.454	69.8	15.1	2.317	0.345	5.132	2.12
12.454	69.8	15.1	2.341	0.351	5.153	2.12
12.652	70.35	12	2.169	0.245	4.941	2.158
12.642	70.32	11.9	2.218	0.257	5.011	2.157
12.636	70.3	11.9	2.218	0.256	5.011	2.156
12.636	70.3	11.9	2.254	0.258	5.095	2.155
12.626	70.28	11.9	2.217	0.256	5.011	2.153
12.61	70.23	12	2.217	0.259	5.028	2.151
12.59	70.17	12	2.148	0.25	4.856	2.15
12.574	70.13	12	2.138	0.249	4.832	2.147
12.564	70.1	12	2.146	0.245	4.856	2.145
12.553	70.07	12	2.146	0.243	4.856	2.143
12.428	69.72	9	2.287	0.063	5.526	2.121

12.433	69.74	9	2.297	0.068	5.537	2.122
12.444	69.77	9	2.373	0.071	5.675	2.122
12.46	69.81	9	2.385	0.073	5.718	2.123
12.47	69.84	9	2.424	0.074	5.803	2.124
12.475	69.85	9	2.414	0.073	5.741	2.125
12.491	69.9	9	2.409	0.07	5.757	2.126
12.501	69.93	9	2.401	0.068	5.735	2.127
12.501	69.93	9	2.343	0.055	5.676	2.128
12.512	69.96	9	2.292	0.052	5.501	2.129
12.46	69.81	6	1.928	0.001	4.897	2.124
12.46	69.81	6	1.928	-0.004	4.897	2.124
12.454	69.8	6	1.924	0	4.892	2.123
12.444	69.77	6	1.917	-0.001	4.875	2.123
12.439	69.75	6	1.911	-0.001	4.862	2.123
12.428	69.72	6	1.911	0	4.859	2.122
12.428	69.72	6	1.911	0	4.859	2.122
12.423	69.71	6	1.917	-0.003	4.869	2.122
12.423	69.71	6	1.919	-0.007	4.879	2.121
12.428	69.72	6	1.91	-0.008	4.868	2.121
12.46	69.81	3	1.09	0.077	2.887	2.123
12.47	69.84	3	1.095	0.077	2.892	2.123
12.465	69.83	3	1.09	0.076	2.879	2.123
12.46	69.81	3	1.088	0.076	2.878	2.123
12.46	69.81	3	1.089	0.079	2.877	2.123
12.454	69.8	3	1.086	0.082	2.872	2.123
12.439	69.75	3	1.086	0.08	2.864	2.122
12.433	69.74	3	1.083	0.079	2.864	2.122
12.418	69.69	3	1.082	0.078	2.864	2.122
12.413	69.68	3	1.081	0.078	2.863	2.121
12.407	69.66	0	0.162	0.092	0.488	2.116
12.402	69.65	0	0.161	0.095	0.481	2.116
12.407	69.66	0	0.156	0.092	0.476	2.115
12.413	69.68	0	0.155	0.094	0.478	2.115
12.413	69.68	0	0.154	0.091	0.481	2.116

12.413	69.68	0	0.153	0.094	0.476	2.116
12.418	69.69	0	0.156	0.094	0.481	2.116
12.428	69.72	0	0.157	0.095	0.481	2.116
12.433	69.74	0	0.157	0.095	0.481	2.116
12.433	69.74	0	0.163	0.098	0.484	2.117
12.402	69.65	-3	-0.835	-0.016	-2.349	2.114
12.402	69.65	-3	-0.834	-0.018	-2.352	2.115
12.402	69.65	-3	-0.834	-0.016	-2.352	2.115
12.407	69.66	-3	-0.833	-0.016	-2.353	2.115
12.402	69.65	-3	-0.834	-0.013	-2.35	2.115
12.402	69.65	-3	-0.834	-0.014	-2.35	2.115
12.402	69.65	-3	-0.833	-0.015	-2.342	2.115
12.402	69.65	-3	-0.835	-0.013	-2.341	2.115
12.397	69.64	-3	-0.835	-0.015	-2.337	2.115
12.402	69.65	-3	-0.835	-0.015	-2.332	2.115
12.392	69.62	-6	-1.579	-0.158	-4.417	2.109
12.397	69.64	-6	-1.58	-0.151	-4.433	2.109
12.397	69.64	-6	-1.581	-0.151	-4.433	2.109
12.407	69.66	-6	-1.582	-0.156	-4.439	2.11
12.418	69.69	-6	-1.583	-0.156	-4.447	2.11
12.428	69.72	-6	-1.586	-0.155	-4.454	2.111
12.444	69.77	-6	-1.586	-0.153	-4.457	2.112
12.454	69.8	-6	-1.586	-0.153	-4.469	2.114
12.465	69.83	-6	-1.588	-0.153	-4.472	2.115
12.47	69.84	-6	-1.59	-0.153	-4.469	2.116
12.413	69.68	-9	-2.261	-0.343	-6.384	2.111
12.418	69.69	-9	-2.261	-0.345	-6.384	2.112
12.413	69.68	-9	-2.262	-0.345	-6.392	2.112
12.407	69.66	-9	-2.265	-0.346	-6.364	2.113
12.413	69.68	-9	-2.266	-0.343	-6.357	2.113
12.418	69.69	-9	-2.266	-0.343	-6.343	2.113
12.423	69.71	-9	-2.266	-0.342	-6.335	2.114
12.428	69.72	-9	-2.266	-0.341	-6.323	2.114
12.433	69.74	-9	-2.265	-0.339	-6.315	2.115

12.439	69.75	-9	-2.265	-0.341	-6.313	2.116
12.449	69.78	-12	-2.524	-0.098	-5.668	2.122
12.439	69.75	-12	-2.544	-0.098	-5.668	2.122
12.444	69.77	-12	-2.544	-0.097	-5.668	2.123
12.439	69.75	-12	-2.544	-0.098	-5.657	2.123
12.423	69.71	-12	-2.544	-0.099	-5.656	2.123
12.407	69.66	-12	-2.549	-0.11	-5.655	2.123
12.402	69.65	-12	-2.574	-0.118	-5.717	2.122
12.407	69.66	-12	-2.578	-0.119	-5.736	2.122
12.418	69.69	-12	-2.564	-0.117	-5.717	2.122
12.418	69.69	-12	-2.608	-0.117	-5.741	2.122
12.428	69.72	-14.9	-2.551	-0.058	-5.442	2.104
12.428	69.72	-14.9	-2.55	-0.056	-5.427	2.106
12.428	69.72	-14.9	-2.431	-0.05	-5.259	2.108
12.423	69.71	-14.9	-2.452	-0.048	-5.32	2.11
12.418	69.69	-14.9	-2.426	-0.047	-5.2	2.112
12.423	69.71	-14.9	-2.492	-0.059	-5.354	2.113
12.428	69.72	-14.9	-2.518	-0.06	-5.384	2.114
12.428	69.72	-14.9	-2.551	-0.062	-5.446	2.115
12.433	69.74	-14.9	-2.554	-0.05	-5.496	2.116
12.449	69.78	-14.9	-2.537	-0.042	-5.396	2.117

Appendix E - Calculated Results

Table E.1 – NACA 0012 Calculated Results

Info		Raw			Matrix Corrected			Weight Corrected (True)			Calculated		Result	
V	Alpha	N	A	M	N	A	M	N	A	M	L	D	CL	CD
mph	deg	lbf	lbf	in-lbf	lbf	lbf	in-lbf	lbf	lbf	in-lbf	lbf	lbf	-	-
0.000	0.000	-0.303	0.003	-0.494	-0.300	0.001	-0.497	0.003	-0.302	-0.993	-0.277	-0.302		
49.978	-15.700	-1.356	-0.095	-2.579	-1.345	-0.087	-2.615	-1.053	-0.378	-3.093	-1.396	0.221	-0.995	0.157
50.506	-13.500	-1.483	-0.115	-2.886	-1.470	-0.105	-2.928	-1.176	-0.399	-3.410	-1.516	0.187	-1.058	0.130
50.126	-11.900	-1.487	-0.187	-3.236	-1.475	-0.165	-3.294	-1.179	-0.461	-3.780	-1.529	0.092	-1.083	0.065
50.010	-9.700	-1.343	-0.175	-2.982	-1.332	-0.154	-3.036	-1.034	-0.453	-3.525	-1.375	0.028	-0.979	0.020
50.214	-8.000	-1.130	-0.113	-2.459	-1.121	-0.101	-2.498	-0.821	-0.400	-2.990	-1.149	0.018	-0.811	0.013
50.256	-5.800	-0.915	-0.064	-1.916	-0.907	-0.059	-1.942	-0.606	-0.360	-2.436	-0.919	0.003	-0.648	0.002
50.170	-4.100	-0.667	-0.017	-1.303	-0.661	-0.018	-1.316	-0.359	-0.320	-1.811	-0.661	0.007	-0.468	0.005
50.184	-1.900	-0.367	0.025	-0.622	-0.363	0.019	-0.622	-0.061	-0.283	-1.119	-0.350	0.019	-0.248	0.013
50.256	0.000	-0.021	0.045	0.137	-0.020	0.038	0.146	0.282	-0.265	-0.350	0.002	0.035	0.002	0.025
50.054	1.900	0.267	0.057	0.799	0.265	0.049	0.816	0.568	-0.254	0.320	0.296	0.065	0.210	0.046
50.090	3.600	0.511	0.046	1.378	0.508	0.041	1.398	0.810	-0.261	0.902	0.544	0.090	0.386	0.064
50.132	5.800	0.755	0.026	1.957	0.749	0.025	1.978	1.050	-0.276	1.484	0.793	0.131	0.562	0.093
50.440	7.400	0.946	0.026	2.387	0.939	0.025	2.411	1.239	-0.275	1.919	0.984	0.187	0.689	0.131
50.152	9.600	0.978	0.168	2.089	0.970	0.147	2.135	1.268	-0.151	1.645	0.996	0.362	0.705	0.256
49.994	11.600	0.922	0.219	1.917	0.914	0.190	1.970	1.211	-0.106	1.484	0.927	0.439	0.660	0.313
49.924	13.500	0.890	0.273	1.808	0.882	0.236	1.869	1.177	-0.058	1.387	0.878	0.518	0.627	0.370
49.660	15.700	0.880	0.310	1.755	0.872	0.267	1.822	1.163	-0.024	1.344	0.846	0.591	0.611	0.427

50.046	17.300	0.916	0.332	1.811	0.907	0.286	1.882	1.196	-0.003	1.408	0.863	0.653	0.613	0.464
50.036	19.600	0.991	0.357	1.976	0.982	0.308	2.053	1.267	0.023	1.585	0.906	0.747	0.644	0.531
49.632	21.500	1.065	0.375	2.113	1.055	0.323	2.194	1.336	0.042	1.732	0.948	0.829	0.685	0.599
70.132	21.800	2.424	0.529	4.731	2.403	0.460	4.858	2.684	0.179	4.397	1.725	1.423	0.624	0.515
70.583	19.600	2.283	0.506	4.452	2.262	0.440	4.574	2.547	0.155	4.106	1.648	1.261	0.589	0.450
70.397	17.300	2.067	0.476	4.029	2.048	0.414	4.142	2.337	0.125	3.668	1.495	1.074	0.537	0.386
70.671	15.700	2.116	0.462	4.144	2.097	0.402	4.255	2.388	0.111	3.777	1.569	1.013	0.559	0.361
70.364	13.500	2.121	0.388	4.178	2.103	0.339	4.277	2.397	0.045	3.794	1.620	0.863	0.583	0.310
70.225	11.600	2.065	0.327	4.124	2.047	0.287	4.213	2.344	-0.009	3.726	1.598	0.722	0.577	0.261
70.225	9.600	2.227	0.212	4.623	2.208	0.190	4.696	2.506	-0.108	4.206	1.789	0.571	0.646	0.206
70.190	7.700	2.327	-0.070	5.560	2.310	-0.050	5.594	2.610	-0.350	5.102	1.934	0.263	0.699	0.095
69.931	5.800	1.914	-0.021	4.557	1.900	-0.010	4.591	2.201	-0.311	4.097	1.521	0.173	0.554	0.063
70.106	3.900	1.468	0.037	3.445	1.457	0.037	3.480	1.759	-0.264	2.984	1.072	0.116	0.388	0.042
70.048	1.900	1.146	0.085	2.242	1.137	0.077	2.274	1.439	-0.225	1.778	0.746	0.083	0.271	0.030
70.119	0.000	0.547	0.097	0.922	0.542	0.085	0.945	0.844	-0.217	0.449	0.144	0.043	0.052	0.015
70.195	-1.900	-0.074	0.080	-0.387	-0.074	0.068	-0.377	0.228	-0.234	-0.873	-0.479	0.018	-0.173	0.007
70.115	-4.100	-0.666	0.031	-1.812	-0.662	0.024	-1.823	-0.360	-0.278	-2.318	-1.079	0.009	-0.391	0.003
70.201	-5.800	-1.183	-0.024	-2.988	-1.175	-0.025	-3.017	-0.874	-0.326	-3.511	-1.602	0.024	-0.579	0.009
70.126	-8.000	-1.673	-0.141	-4.204	-1.661	-0.126	-4.264	-1.362	-0.425	-4.755	-2.108	0.028	-0.763	0.010
70.247	-9.700	-2.115	-0.272	-5.417	-2.100	-0.239	-5.510	-1.802	-0.537	-5.999	-2.567	0.034	-0.926	0.012
70.299	-11.600	-2.407	-0.369	-6.233	-2.390	-0.322	-6.350	-2.094	-0.619	-6.836	-2.875	0.075	-1.036	0.027
69.781	-13.500	-2.654	-0.138	-5.724	-2.633	-0.128	-5.793	-2.338	-0.423	-6.276	-3.072	0.395	-1.123	0.144
70.121	-15.700	-2.306	-0.026	-4.575	-2.287	-0.033	-4.615	-1.995	-0.324	-5.093	-2.709	0.488	-0.981	0.177

Table E.2 – Kfm 0012 Calculated Results

Info		Raw			Matrix Corrected			Weight Corrected (True)			Calculated		Result	
V	Alpha	N	A	M	N	A	M	N	A	M	L	D	CL	CD
mph	deg	lbf	lbf	in-lbf	lbf	lbf	in-lbf	lbf	lbf	in-lbf	lbf	lbf	-	-
0.000	0.000	-0.255	0.010	-0.402	-0.252	0.007	-0.403	0.002	-0.248	-0.807	-0.278	0.052		
50.058	-16.000	-1.370	-0.081	-2.539	-1.358	-0.075	-2.572	-1.113	-0.320	-2.960	-1.438	0.299	-1.022	0.212
49.882	-14.100	-1.429	-0.074	-2.717	-1.416	-0.070	-2.751	-1.169	-0.317	-3.142	-1.491	0.277	-1.067	0.199
50.116	-11.800	-1.460	-0.124	-2.978	-1.448	-0.112	-3.023	-1.198	-0.361	-3.418	-1.527	0.191	-1.082	0.136
49.950	-10.000	-1.355	-0.157	-2.940	-1.344	-0.139	-2.990	-1.093	-0.390	-3.388	-1.425	0.106	-1.016	0.075
50.200	-7.700	-1.140	-0.104	-2.427	-1.131	-0.094	-2.465	-0.878	-0.346	-2.865	-1.197	0.075	-0.845	0.053
50.082	-5.500	-0.880	-0.044	-1.815	-0.873	-0.041	-1.837	-0.619	-0.295	-2.239	-0.925	0.066	-0.656	0.047
49.744	-3.900	-0.588	0.010	-1.155	-0.583	0.006	-1.162	-0.329	-0.248	-1.564	-0.625	0.075	-0.450	0.054
49.968	-1.700	-0.327	0.052	-0.534	-0.324	0.042	-0.529	-0.069	-0.212	-0.932	-0.355	0.090	-0.253	0.064
50.078	0.000	-0.050	0.073	0.089	-0.049	0.062	0.103	0.206	-0.193	-0.301	-0.074	0.107	-0.053	0.076
49.964	2.200	0.212	0.088	0.701	0.211	0.075	0.723	0.465	-0.179	0.320	0.192	0.139	0.137	0.099
49.776	4.200	0.493	0.075	1.366	0.490	0.065	1.391	0.744	-0.189	0.989	0.476	0.166	0.342	0.119
49.890	6.100	0.723	0.052	1.860	0.718	0.047	1.884	0.971	-0.207	1.483	0.708	0.198	0.506	0.142
49.912	8.000	0.914	0.037	2.282	0.907	0.035	2.308	1.159	-0.217	1.908	0.898	0.246	0.642	0.176
49.556	9.900	0.777	0.212	1.592	0.770	0.184	1.641	1.021	-0.067	1.243	0.738	0.409	0.535	0.297
50.086	11.600	0.798	0.251	1.627	0.791	0.217	1.683	1.041	-0.033	1.288	0.746	0.477	0.530	0.339
49.824	13.800	0.830	0.278	1.684	0.823	0.240	1.745	1.070	-0.007	1.353	0.761	0.548	0.546	0.393
49.702	16.000	0.895	0.302	1.800	0.887	0.260	1.866	1.132	0.015	1.478	0.804	0.627	0.579	0.452
49.800	17.600	0.932	0.321	1.880	0.923	0.277	1.950	1.166	0.034	1.565	0.821	0.685	0.589	0.492

50.030	19.800	1.014	0.344	2.027	1.004	0.296	2.102	1.244	0.057	1.723	0.871	0.775	0.620	0.551
49.324	21.800	1.076	0.353	2.146	1.067	0.305	2.224	1.303	0.068	1.849	0.905	0.847	0.662	0.620
70.509	21.800	2.505	0.510	4.928	2.483	0.445	5.054	2.720	0.208	4.680	1.748	1.463	0.626	0.524
70.419	19.800	2.253	0.490	4.441	2.233	0.427	4.560	2.473	0.187	4.180	1.564	1.274	0.561	0.457
70.420	17.600	2.097	0.468	4.146	2.079	0.407	4.259	2.321	0.164	3.875	1.463	1.118	0.525	0.401
70.432	16.000	2.010	0.444	3.962	1.992	0.386	4.069	2.237	0.141	3.681	1.411	1.012	0.506	0.363
70.567	13.800	1.947	0.403	3.809	1.930	0.351	3.908	2.178	0.104	3.516	1.390	0.880	0.497	0.315
70.271	11.900	1.848	0.363	3.631	1.832	0.317	3.722	2.081	0.068	3.327	1.322	0.755	0.477	0.272
70.103	9.900	1.897	0.323	3.764	1.881	0.283	3.849	2.132	0.032	3.451	1.395	0.658	0.505	0.238
70.237	7.700	2.174	-0.034	5.153	2.158	-0.021	5.189	2.411	-0.273	4.789	1.725	0.312	0.623	0.113
70.305	6.100	1.826	0.017	4.360	1.812	0.021	4.399	2.066	-0.232	3.998	1.379	0.249	0.497	0.090
70.129	4.110	1.331	0.085	3.261	1.321	0.078	3.303	1.575	-0.177	2.901	0.884	0.197	0.320	0.071
70.139	2.200	0.711	0.127	1.910	0.706	0.110	1.948	0.960	-0.144	1.545	0.265	0.153	0.096	0.055
70.413	0.000	0.233	0.127	0.754	0.231	0.108	0.782	0.486	-0.147	0.379	-0.214	0.113	-0.077	0.041
70.347	-1.700	-0.347	0.106	-0.573	-0.344	0.088	-0.559	-0.089	-0.166	-0.962	-0.794	0.096	-0.286	0.035
70.087	-3.900	-0.877	0.057	-1.811	-0.870	0.045	-1.816	-0.616	-0.210	-2.218	-1.329	0.093	-0.481	0.034
70.384	-5.500	-1.427	-0.011	-3.065	-1.415	-0.015	-3.092	-1.162	-0.269	-3.493	-1.882	0.103	-0.676	0.037
70.250	-7.700	-2.005	-0.132	-4.397	-1.989	-0.120	-4.455	-1.736	-0.373	-4.855	-2.470	0.123	-0.891	0.044
70.217	-9.400	-2.477	-0.251	-5.487	-2.457	-0.223	-5.575	-2.206	-0.475	-5.973	-2.954	0.152	-1.066	0.055
70.296	-11.300	-2.853	-0.284	-6.226	-2.830	-0.253	-6.325	-2.580	-0.503	-6.721	-3.329	0.272	-1.199	0.098
70.233	-13.300	-2.714	-0.069	-5.231	-2.691	-0.071	-5.283	-2.443	-0.319	-5.675	-3.151	0.511	-1.137	0.184
69.889	-15.500	-2.602	-0.045	-4.874	-2.580	-0.050	-4.919	-2.334	-0.296	-5.307	-3.028	0.599	-1.104	0.218

Table E.3 – NACA 4412 Calculated Results

Info		Raw			Matrix Corrected			Weight Corrected (True)			Calculated		Result	
V	Alpha	N	A	M	N	A	M	N	A	M	L	D	CL	CD
mph	deg	lbf	lbf	in-lbf	lbf	lbf	in-lbf	lbf	lbf	in-lbf	lbf	lbf	-	-
0.000	0.000	-0.296	0.005	-0.501	-0.293	0.003	-0.504	0.058	-0.348	-1.050	0.058	0.002		
50.266	-16.000	-0.562	-0.010	-2.061	-0.560	-0.009	-2.081	-0.222	-0.346	-2.606	-0.309	0.078	-0.218	0.055
50.328	-14.100	-0.573	-0.007	-2.035	-0.570	-0.008	-2.054	-0.230	-0.348	-2.584	-0.308	0.069	-0.216	0.048
50.254	-12.000	-0.568	0.000	-1.995	-0.565	-0.001	-2.013	-0.222	-0.344	-2.547	-0.289	0.060	-0.204	0.042
50.404	-9.400	-0.555	0.006	-1.979	-0.552	0.004	-1.996	-0.206	-0.342	-2.535	-0.260	0.046	-0.182	0.032
50.306	-7.700	-0.493	-0.011	-2.060	-0.491	-0.010	-2.081	-0.144	-0.358	-2.622	-0.190	0.015	-0.134	0.010
49.956	-5.500	-0.418	-0.020	-1.323	-0.416	-0.018	-1.338	-0.067	-0.367	-1.881	-0.102	-0.009	-0.073	-0.006
50.250	-3.900	-0.135	0.022	-0.553	-0.135	0.019	-0.554	0.215	-0.331	-1.099	0.192	0.005	0.136	0.003
50.092	-1.700	0.137	0.038	0.112	0.136	0.033	0.119	0.486	-0.317	-0.427	0.477	0.019	0.338	0.013
50.226	0.000	0.402	0.044	0.769	0.398	0.039	0.782	0.749	-0.311	0.236	0.749	0.039	0.529	0.027
50.220	2.200	0.697	0.040	1.526	0.691	0.037	1.545	1.042	-0.313	0.999	1.053	0.077	0.743	0.054
49.980	4.200	1.017	0.023	2.180	1.009	0.024	2.201	1.358	-0.326	1.657	1.379	0.124	0.982	0.089
50.458	6.100	1.313	-0.024	2.874	1.303	-0.015	2.893	1.652	-0.364	2.350	1.681	0.164	1.175	0.115
50.310	7.700	1.531	-0.080	3.416	1.519	-0.061	3.430	1.867	-0.409	2.888	1.905	0.195	1.340	0.137
50.112	9.900	1.614	-0.110	3.696	1.602	-0.087	3.708	1.948	-0.432	3.170	1.993	0.259	1.413	0.184
50.084	11.800	1.649	-0.124	3.800	1.637	-0.099	3.810	1.980	-0.442	3.276	2.029	0.322	1.440	0.229
49.895	13.800	1.312	0.222	2.133	1.299	0.195	2.186	1.640	-0.146	1.656	1.627	0.600	1.164	0.429
50.084	15.800	1.309	0.265	2.193	1.296	0.232	2.255	1.634	-0.106	1.729	1.601	0.693	1.136	0.492
50.124	17.600	1.317	0.279	2.293	1.305	0.243	2.358	1.639	-0.091	1.837	1.590	0.759	1.127	0.538

49.992	19.800	1.335	0.300	2.412	1.322	0.261	2.481	1.652	-0.069	1.968	1.578	0.845	1.124	0.602
49.899	22.000	1.411	0.320	2.609	1.398	0.279	2.684	1.723	-0.046	2.178	1.615	0.953	1.155	0.681
69.832	22.000	2.933	0.408	5.473	2.907	0.361	5.585	3.232	0.035	5.079	2.983	1.584	1.089	0.578
70.178	19.800	2.866	0.400	5.301	2.841	0.354	5.410	3.171	0.024	4.896	2.975	1.436	1.075	0.519
69.957	17.600	2.724	0.371	5.001	2.699	0.328	5.103	3.034	-0.006	4.582	2.893	1.251	1.052	0.455
70.579	16.000	2.668	0.346	4.865	2.644	0.307	4.961	2.981	-0.031	4.436	2.874	1.132	1.027	0.405
69.793	13.800	2.687	0.203	5.141	2.663	0.185	5.216	3.004	-0.156	4.686	2.954	0.906	1.080	0.331
69.930	11.900	3.465	-0.381	7.983	3.440	-0.310	7.982	3.783	-0.653	7.448	3.836	0.481	1.397	0.175
69.988	9.900	3.442	-0.336	7.833	3.416	-0.271	7.839	3.762	-0.617	7.301	3.812	0.379	1.385	0.138
70.184	8.000	3.385	-0.252	7.471	3.360	-0.200	7.487	3.707	-0.547	6.947	3.747	0.314	1.354	0.113
70.146	6.100	3.095	-0.149	6.608	3.070	-0.113	6.636	3.419	-0.462	6.093	3.449	0.244	1.248	0.088
69.805	4.200	2.827	-0.022	5.300	2.803	-0.005	5.336	3.152	-0.355	4.792	3.170	0.217	1.158	0.079
70.036	2.200	2.359	0.075	3.932	2.337	0.075	3.974	2.688	-0.275	3.428	2.696	0.168	0.979	0.061
70.052	0.000	1.869	0.122	2.595	1.851	0.114	2.633	2.201	-0.237	2.087	2.201	0.103	0.799	0.037
69.834	-1.700	1.332	0.130	1.156	1.317	0.118	1.183	1.668	-0.232	0.637	1.660	0.058	0.606	0.021
70.035	-3.900	0.879	0.127	-0.027	0.867	0.114	-0.011	1.217	-0.236	-0.556	1.198	0.022	0.435	0.008
69.967	-5.500	0.357	0.088	-1.331	0.348	0.079	-1.332	0.698	-0.270	-1.875	0.668	0.004	0.243	0.002
70.093	-7.700	-0.329	0.054	-2.942	-0.332	0.047	-2.962	0.016	-0.300	-3.503	-0.025	0.041	-0.009	0.015
69.847	-9.400	-1.011	0.097	-3.472	-1.007	0.080	-3.486	-0.661	-0.266	-4.025	-0.695	0.185	-0.254	0.068
69.784	-11.600	-1.153	0.093	-3.690	-1.147	0.075	-3.707	-0.804	-0.268	-4.242	-0.841	0.239	-0.308	0.087
69.797	-13.300	-1.164	0.126	-3.511	-1.158	0.104	-3.520	-0.816	-0.237	-4.051	-0.849	0.297	-0.310	0.108
69.564	-15.500	-1.172	0.122	-3.507	-1.165	0.100	-3.516	-0.827	-0.238	-4.043	-0.861	0.332	-0.317	0.122

Table E.4 – Kfm 4412 Calculated Results

Info		Raw			Matrix Corrected			Weight Corrected (True)			Calculated		Result	
V	Alpha	N	A	M	N	A	M	N	A	M	L	D	CL	CD
mph	deg	lbf	lbf	in-lbf	lbf	lbf	in-lbf	lbf	lbf	in-lbf	lbf	lbf	-	-
0.000	0.000	-0.272	0.003	-0.434	-0.269	0.001	-0.436	0.003	-0.270	-0.873	0.003	0.080		
50.184	-15.500	-0.981	-0.015	-1.913	-0.973	-0.017	-1.931	-0.711	-0.279	-2.351	-0.760	0.272	-0.537	0.192
50.356	-13.300	-0.947	-0.003	-1.846	-0.939	-0.007	-1.861	-0.675	-0.271	-2.286	-0.719	0.242	-0.505	0.170
50.583	-11.300	-0.909	0.012	-1.772	-0.901	0.006	-1.783	-0.635	-0.260	-2.211	-0.673	0.219	-0.469	0.152
50.416	-9.400	-0.834	0.004	-1.676	-0.827	0.000	-1.689	-0.559	-0.268	-2.119	-0.595	0.177	-0.417	0.124
50.414	-7.700	-0.732	0.001	-1.643	-0.726	-0.003	-1.656	-0.457	-0.272	-2.089	-0.489	0.142	-0.343	0.099
50.567	-5.500	-0.427	-0.006	-1.130	-0.424	-0.007	-1.140	-0.154	-0.277	-1.575	-0.180	0.089	-0.125	0.062
50.068	-3.900	-0.171	0.026	-0.534	-0.170	0.021	-0.534	0.101	-0.249	-0.969	0.083	0.094	0.059	0.067
50.042	-1.700	0.087	0.045	0.060	0.086	0.038	0.068	0.357	-0.233	-0.368	0.350	0.107	0.249	0.076
50.442	0.000	0.372	0.066	0.704	0.368	0.057	0.720	0.640	-0.214	0.284	0.640	0.136	0.448	0.095
50.008	2.200	0.569	0.071	1.148	0.564	0.063	1.169	0.835	-0.208	0.733	0.842	0.174	0.600	0.124
50.052	3.900	0.809	0.057	1.711	0.803	0.052	1.735	1.073	-0.219	1.299	1.086	0.204	0.772	0.145
50.076	6.100	1.164	0.008	2.616	1.155	0.011	2.638	1.425	-0.259	2.204	1.445	0.244	1.026	0.173
50.214	7.700	1.392	-0.043	3.135	1.381	-0.031	3.153	1.650	-0.300	2.720	1.676	0.274	1.183	0.193
50.330	9.900	1.475	-0.076	3.327	1.464	-0.058	3.341	1.731	-0.326	2.911	1.762	0.327	1.238	0.230
50.158	11.900	1.553	-0.094	3.538	1.541	-0.074	3.551	1.807	-0.339	3.124	1.838	0.390	1.300	0.276
50.092	13.800	1.117	0.209	2.165	1.107	0.183	2.218	1.371	-0.081	1.794	1.350	0.598	0.958	0.424
49.948	15.700	1.155	0.254	2.223	1.145	0.221	2.283	1.406	-0.040	1.863	1.364	0.692	0.974	0.493
50.056	17.600	1.182	0.272	2.274	1.172	0.236	2.338	1.430	-0.023	1.922	1.370	0.761	0.974	0.541

49.944	19.800	1.283	0.307	2.460	1.271	0.267	2.532	1.527	0.012	2.121	1.432	0.878	1.022	0.627
50.062	21.800	1.371	0.337	2.612	1.359	0.293	2.690	1.611	0.041	2.285	1.481	0.986	1.052	0.700
70.695	21.800	2.981	0.426	5.612	2.955	0.376	5.728	3.207	0.124	5.323	2.931	1.646	1.044	0.586
71.225	19.800	2.820	0.417	5.307	2.795	0.367	5.419	3.051	0.112	5.008	2.833	1.479	0.994	0.519
70.688	17.600	2.689	0.389	5.055	2.666	0.343	5.161	2.924	0.084	4.745	2.762	1.304	0.984	0.465
70.475	16.000	2.587	0.370	4.864	2.564	0.326	4.965	2.825	0.065	4.545	2.697	1.181	0.967	0.423
70.403	13.800	2.543	0.311	4.819	2.521	0.276	4.909	2.785	0.012	4.485	2.701	1.016	0.970	0.365
70.520	11.900	3.518	-0.277	7.683	3.491	-0.220	7.697	3.757	-0.486	7.270	3.776	0.639	1.352	0.229
70.489	9.900	3.326	-0.184	7.191	3.301	-0.142	7.217	3.568	-0.409	6.787	3.585	0.550	1.284	0.197
70.232	8.000	3.216	-0.118	6.900	3.191	-0.087	6.935	3.460	-0.355	6.502	3.476	0.470	1.254	0.169
70.571	6.100	2.872	-0.024	6.121	2.850	-0.008	6.165	3.119	-0.278	5.731	3.131	0.395	1.119	0.141
70.298	4.200	2.233	0.099	4.651	2.215	0.094	4.705	2.486	-0.177	4.269	2.492	0.346	0.898	0.124
70.687	2.200	1.668	0.166	3.258	1.654	0.148	3.311	1.925	-0.123	2.875	1.928	0.291	0.687	0.104
70.581	0.000	1.145	0.180	2.068	1.134	0.158	2.115	1.406	-0.113	1.678	1.406	0.227	0.502	0.081
70.364	-1.700	0.553	0.167	0.754	0.547	0.145	0.788	0.819	-0.127	0.351	0.815	0.189	0.293	0.068
70.432	-3.900	0.058	0.141	-0.391	0.056	0.121	-0.371	0.327	-0.150	-0.806	0.316	0.168	0.113	0.060
70.290	-5.500	-0.431	0.095	-1.533	-0.429	0.080	-1.530	-0.159	-0.191	-1.964	-0.176	0.165	-0.064	0.060
70.401	-7.700	-1.030	0.103	-2.716	-1.023	0.084	-2.721	-0.754	-0.185	-3.153	-0.772	0.258	-0.277	0.093
70.227	-9.400	-1.467	0.138	-3.135	-1.455	0.111	-3.136	-1.188	-0.157	-3.567	-1.197	0.379	-0.432	0.137
70.351	-11.300	-1.574	0.177	-3.202	-1.562	0.144	-3.196	-1.295	-0.123	-3.624	-1.294	0.474	-0.466	0.170
70.118	-13.500	-1.576	0.169	-3.138	-1.564	0.136	-3.134	-1.300	-0.128	-3.558	-1.294	0.519	-0.468	0.188
70.277	-15.500	-1.704	0.158	-3.425	-1.690	0.127	-3.424	-1.429	-0.135	-3.845	-1.413	0.592	-0.509	0.213