* 1. The importance of aerodynamic studies

At the beginning of writing of this appendix, we would like to emphasize the importance of aerodynamic studies in case of designing the rocket. Not only do they decrease significantly the mass of the rocket but also they take a huge part in optimization of length and usage of materials, which are beneficial to our not so enormous budget. Apart from that, they increase the safety of the rocket in regards to testing its stability. Hence, by dint of these studies, you are capable of determining how the whole structure would behave before launching, which is necessary bearing in mind that we check the rocket that you can’t test very often. Our studies were mainly based on “The Modern Exterior Ballistic” written by Robert L. McCoy.

* 1. The problem of aerodynamic drag

Rockets have several aerodynamics characteristics that are worth attention in order to estimate the performance after launch. However, in the event of designing non-controlling aerodynamically rockets such as ours, the most crucial factor is aerodynamic drag coefficient. Thanks to this variable we can compare different configurations of the rocket so as to be able to choose the most lightest one. Although, our rocket doesn’t exceed 1 Mach, drag coefficient may slightly vary depending on velocity of the rocket. We calculated this variable using this formula:

Where: FD – drag force gained from aerodynamic simulations, cD – drag coefficient, ρ - air density, v- velocity of the rocket, S – projectile reference area.

After the transformation of the equation we obtain the formula of drag coefficient:

* 1. Tested models

Before we came up with final geometry of the rocket, we tested several different variations of the rocket in order to determine the optimal configuration. Firstly, we checked ‘PrawieR5’ which is the rocket from the last year’s edition of the competition. Then, we carried out the research of the impact of having the endcone on the aerodynamic parametrics, thanks to testing two models, one with endcone and the other one without. Both models had the same stability. For each set of simulations, computational domain mesh setting and graph of velocity and pressure for 0.6 Mach will be shown.

* 1. Summary

In conclusion, we determined that the configuration with endcone is way more beneficial than the one without regarding aerodynamic drag. What is more, our team was capable of successfully examining optimal geometry of endcone and fins which are slightly different than the final configuration.