

Lab (S/L6) – Water Rocket Design, Building, and Operation

Learning Objectives

- Design of water rocket to maximize a performance metric
- Building of water rocket
- Participation in the *Unified Engineering Water Rocket Competition*

Competition Objective

The objective of the rocket competition is to maximize the performance of your vehicle based on a *Score*, which is defined as the product of altitude and payload mass:

$$Score = (h * m_p)_{\max} \quad [m * kg]$$

The payload mass m_p can be selected arbitrarily, including its location in the rocket.

During the competition flights, h will be measured with a sighting inclinometer, and m_p will be simply weighed before or after the flying.

The official competition *Score* will be the average of the two best flights.

Procedure and Reporting

1) Using your rocket simulation program from Labs 4 and 5, determine the set of the rocket parameters which maximize the *Score* value defined above.

All rockets will use an unmodified 2-liter soda bottle as the pressure vessel. All rockets will be operated with a charge pressure of $(p_c)_{\text{gauge}} = 4.137 \times 10^5 \text{ Pa} = 60 \text{ psi}$. There are no other restrictions on the rocket design or materials.

You are encouraged to iterate between calculation predictions, building of prototype rockets, measurement of C_D in the 1×1 wind tunnel, and test flying.

Performing at least one competition flight will earn 50% of the total grade for this lab.

2) Each team (same as in Lab 5) will submit a Design Brief with the following information:

- A dimensionally-accurate side-view and end-view drawing of your best final rocket design. Both views must be to the same scale. Include a dimension scale on the drawing.
- A rocket parameter table. For brevity, omit the obvious non-adjustable physical constants like g , ρ_w , p_{atm} , etc. Include the *Score* value predicted by your program.
- Briefly list the procedures and rationales you used to design your rocket.

The Design Brief is worth the remaining 50% of the grade for this lab.

3) Winning the *UE Water Rocket Competition* earns some serious bragging rights, and also a tacky embossed certificate suitable for framing.