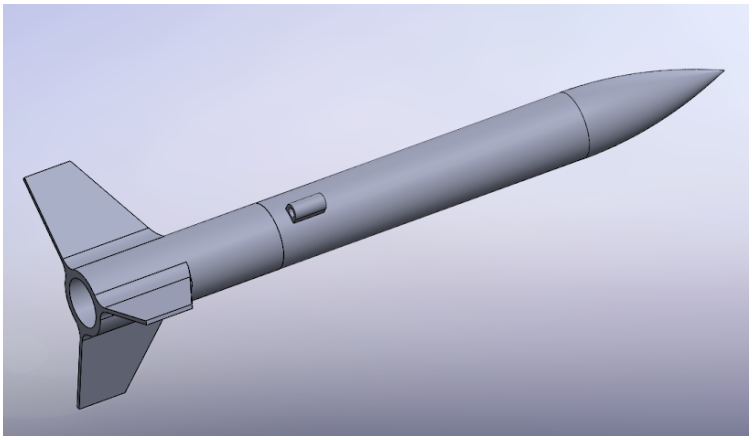
3D Printed Rocket Project (3DPR)

RISE - Fall 2022



Introduction

In groups of 2, you will be constructing a 3D printed, A-class rocket. This project aims to emphasise rapid prototyping, iterative design, rocket design, and manufacturing techniques.

Project Guidelines

Rocket Design

The main criteria for rocket design will be to create a stable design that is producible through 3D printing. All components of the rocket body, fins, and nosecone shall be made of 3D printing plastic material. The rocket must be able to retain an Estes A8-3 motor and contain a parachute that can be deployed using the built-in ejection charge. You will also be creating your own parachute with your own choice of material (cloth, plastic, etc.). Additionally, for safety reasons, a sharp tipped nosecone will not be permitted.

3D Printing Tolerancing and Iterative Design

3D Printing technologies allow for rapid prototyping and quick iterations of design. However, it does come with its limitations. Some of these limitations will arise when designing and manufacturing your rockets. Your rocket will most likely not be perfect the first time. That is alright and in fact preferred! An entire rocket can be printed in about 10 hours, so this allows for multiple versions to be created and tested before submitting your final design for launch. Some things to take into consideration include the following: printing tolerances and interference fitting, print orientation (warping), wall thickness for structural integrity, motor retention, launch

lug, flight ascent time (needs to be roughly 3.7 seconds for ejection charge), shock cord connection points, motor removal for safety, and mass/print time.

Some Guidelines for your OpenRocket Design

- Try to obtain a stability in the range 1.10 - 2.50
- Ensure your ejection of the parachute happens after the anticipated apogee. The ejection delay is 3 seconds after motor burnout. The motor burntime is 0.7 seconds.
- Lighter is usually better, but there can be a bit of a trade-off when looking at the location of your CG and stability
- No conical nosecones and no nosecones with a sharp point
- The rocket should weigh less than 3 ounces (including the mass of the motor)
- The maximum print dimensions are 12” x 12” x 11.8”

Some Guidelines for Dimensioning/Rocket CAD

*These are guidelines that should help make a usable rocket. They may not produce perfect fitment/alignment and you are free/encouraged to experiment with your own values

- Minimum recommended print wall thickness: 0.0625 in (1/16”)
- Diameter tolerancing for component fitment: 0.010”
- Unsupported components on the vertical axis will be printed with support material beneath them; consider feasibility of removing support & print time of support

Useful Dimensions for Rocket Design

- Motor (Estes A8-3)
  Diameter: 0.7087 in (18mm)
  Motor Length: 2.7559 in (70mm)
- Launch Lug:
  Inner Diameter: 0.150”
  Wall Thickness: $\geq$ 0.050” (yes, thinner than other parts)
  Length: $\simeq$0.500”

Available Materials

Raw Materials:
- 3D printing capabilities (ABS and PLA)
- Plastic bags
- Kevlar string
- Cardboard

Rocket Parts:
- Motor: Estes A8-3
- Ejection wadding
- Kevlar shock cord

Important Factors

OpenRocket Design Completeness and quality of rocket design
CAD Model Completeness, accuracy, quality, and printability of CAD model.
Rocket Print Sturdy & flightworthy airframe; aesthetic appeal & finishing touches (e.g. chamfers, bevels, rounded corners) Meets requirement for a safe flight
Rocket Innovation New and/or creative additions to your rocket design