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- Name
- School

Note: This webinar will be recorded

Christine/Rob

Introduction to RockSim Webinar

Trent Cybela, Mechanical Design Engineer
Sierra Space Corporation

ARTEMIS STUDENT CHALLENGES
nasa.gov/stem/artemis.html

Partner

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Meet the FNL Team

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•Kevin Harnack, Tripoli Assistant, Wisconsin Tripoli	

Rocket Build – Your First Level 1 Kit

Super DX3 - Madcow Rocketry

Single Deploy Rocket
38 mm I500, I600, J425R, J270W, or J250DM

Kit Features Include:

- Heavy Duty Airframe Tubing
- Precision Cut Plywood Fins & Rings
- Pre-slotted Airframe
- Nose Cone
- Payload Section
- Nylon Parachute Recovery
- Shock Cord Mount

Figure 2-1: Image of Super DX3 Kit (paint not included)

Handbook Reference: *2c. Workshop Supply List pg. 10-11*

Rocketry 101 – Single Deploy Flight Profile

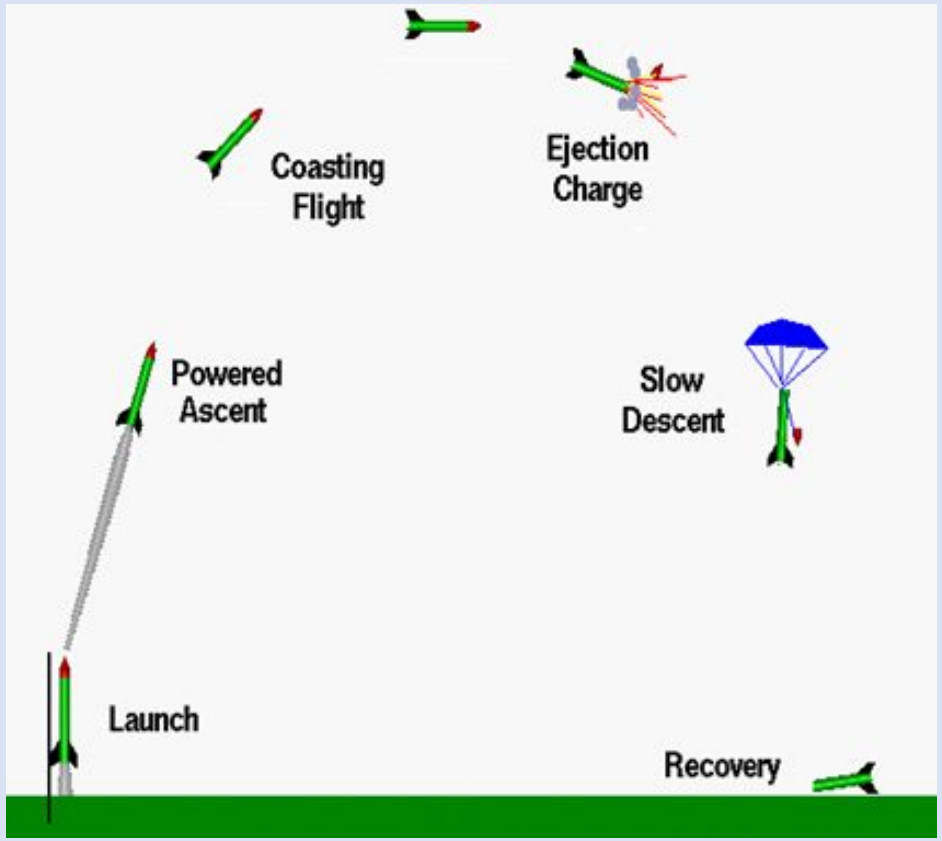


Figure 4-1: Single Deploy Flight Profile

1. Launch
2. Powered Ascent
3. Coasting Flight
4. Ejection Charge
5. Slow Descent
6. Recovery

Handbook Reference: *4b. Launch Profile Overview, pg 13*

Aaron/Trent

Rocketry 101 – Dual Deploy Flight Profile

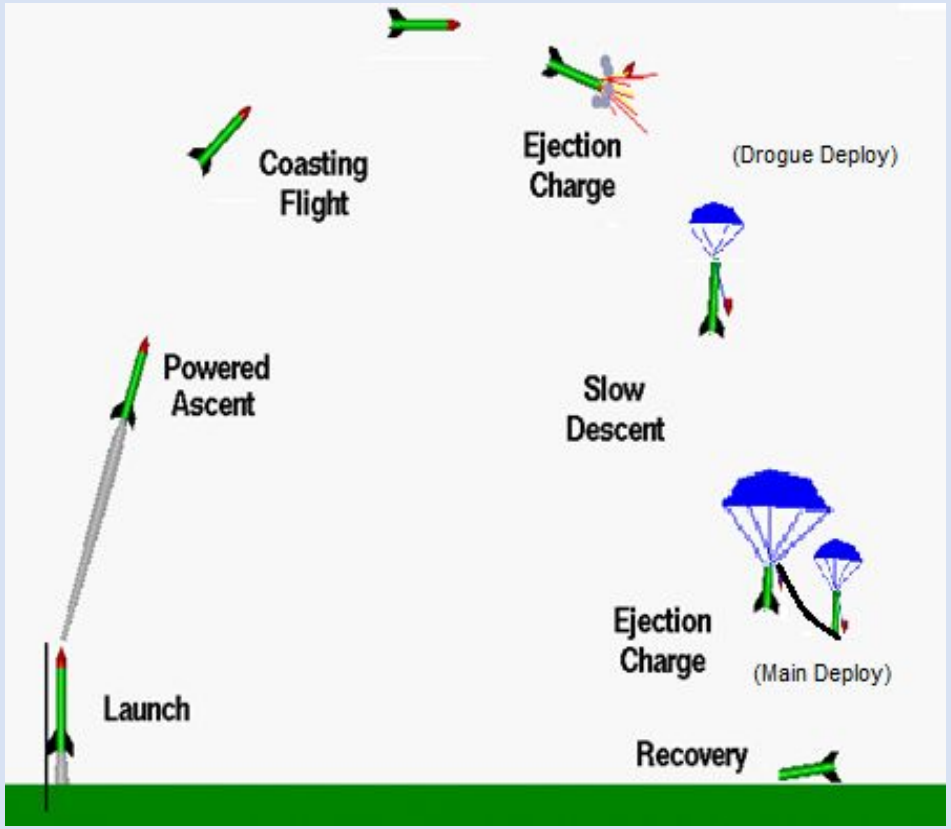


Figure 4-2: Dual Deploy Flight Profile

1. Launch
2. Powered Ascent
3. Coasting Flight
4. Ejection Charge / Drogue Deploy
5. Slow Descent
6. **Ejection Charge / Main Deploy**
7. Recovery

Handbook Reference: *4b. Launch Profile Overview, pg 13*

Aaron/Trent

Rocketry 101 – Flight Profile Differences

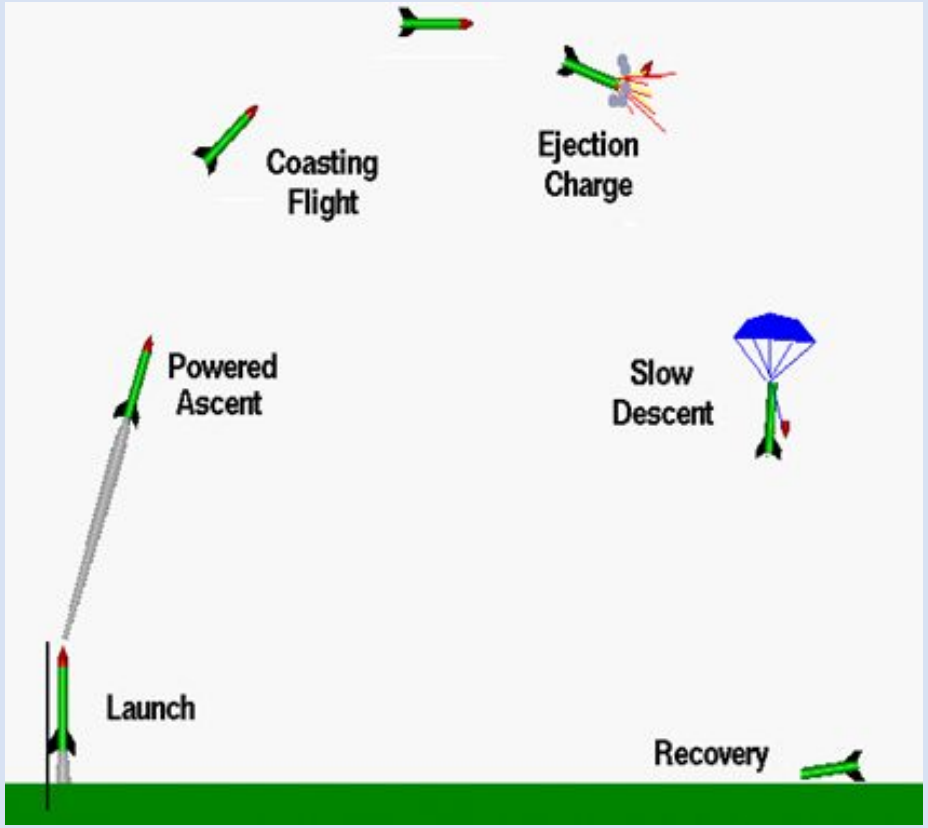


Figure 4-1: Single Deploy Flight Profile

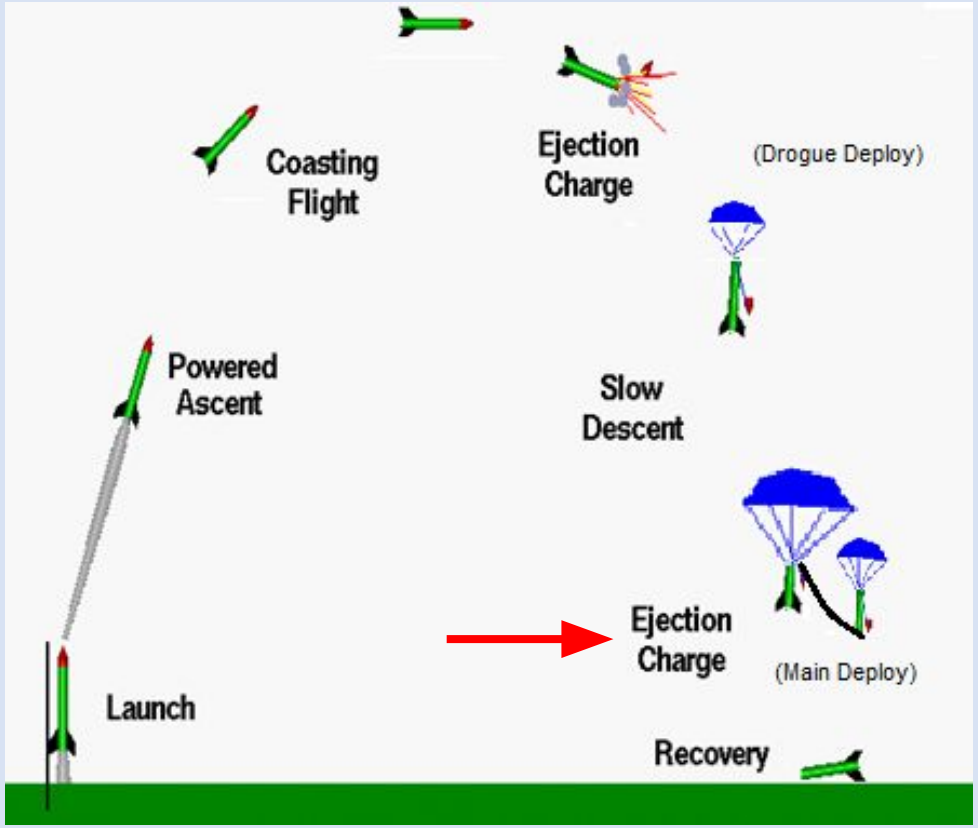
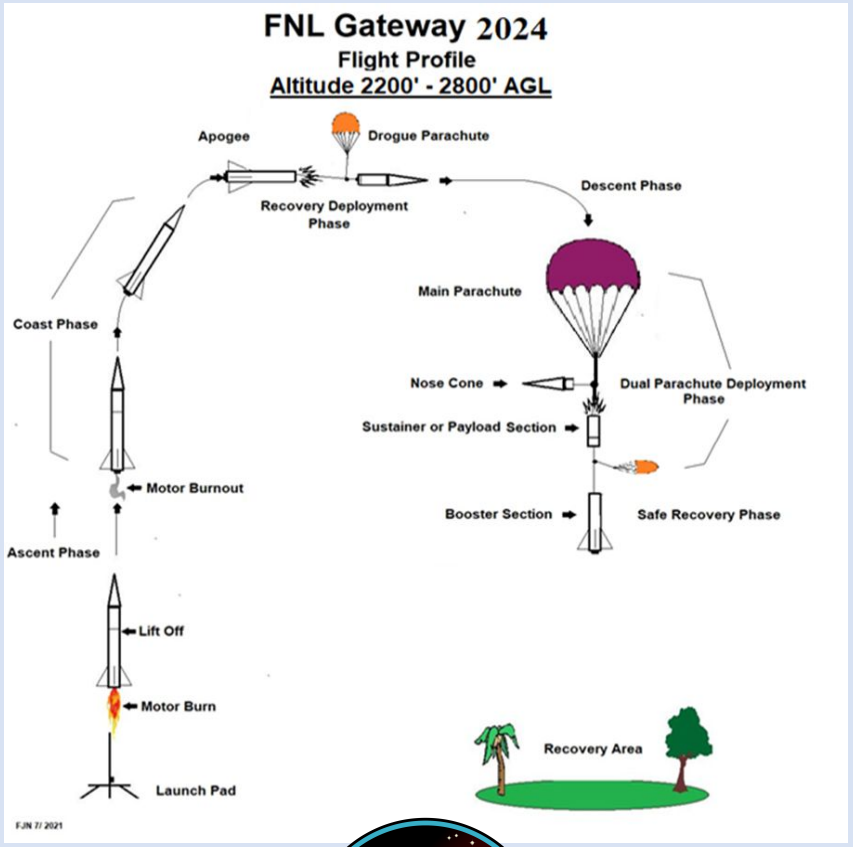


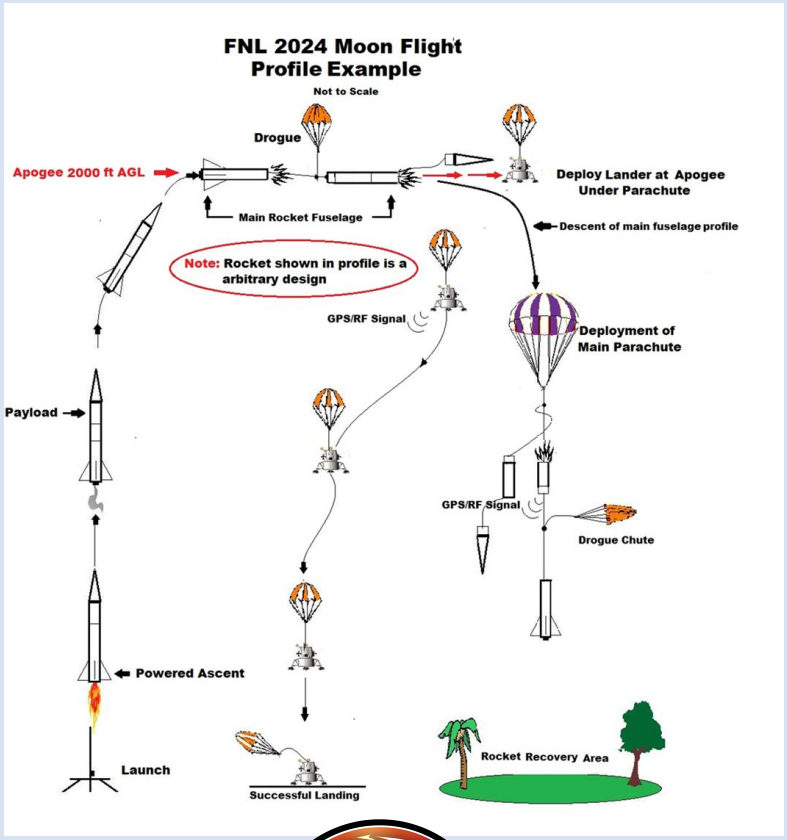
Figure 4-2: Dual Deploy Flight Profile

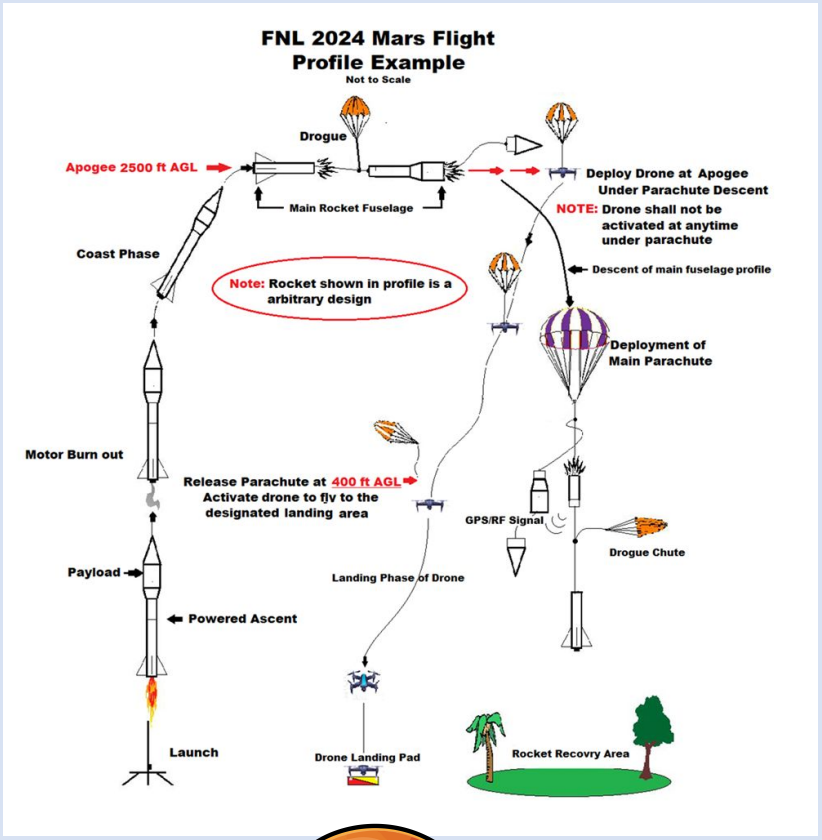
 Handbook Reference: *4b. Launch Profile Overview, pg 13*

Aaron/Trent

Rocketry 101 – Competition Flight







Rocketry 101 – Competition Flight

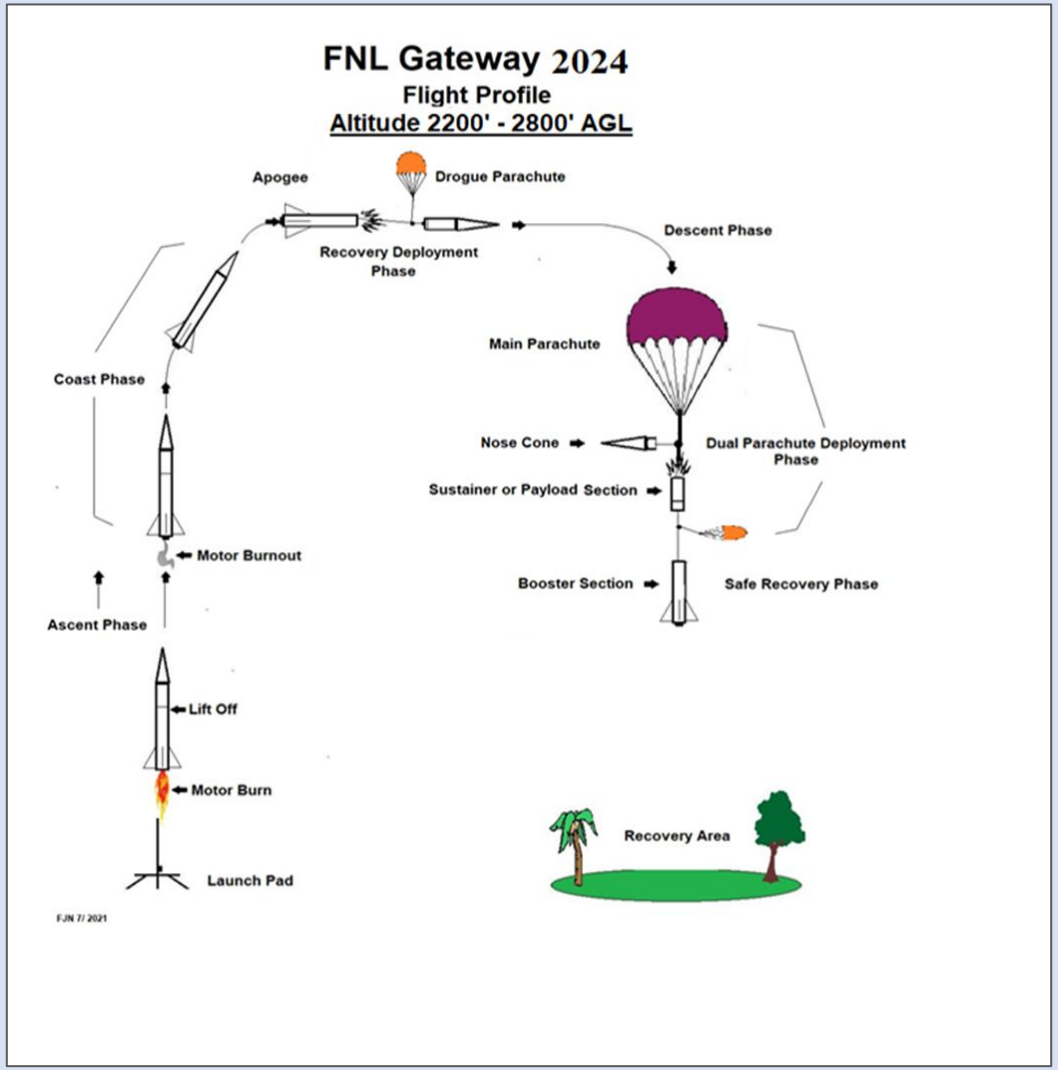


Figure 4-3: FNL 2023 Gateway Challenge

Rocketry 101 - Structures

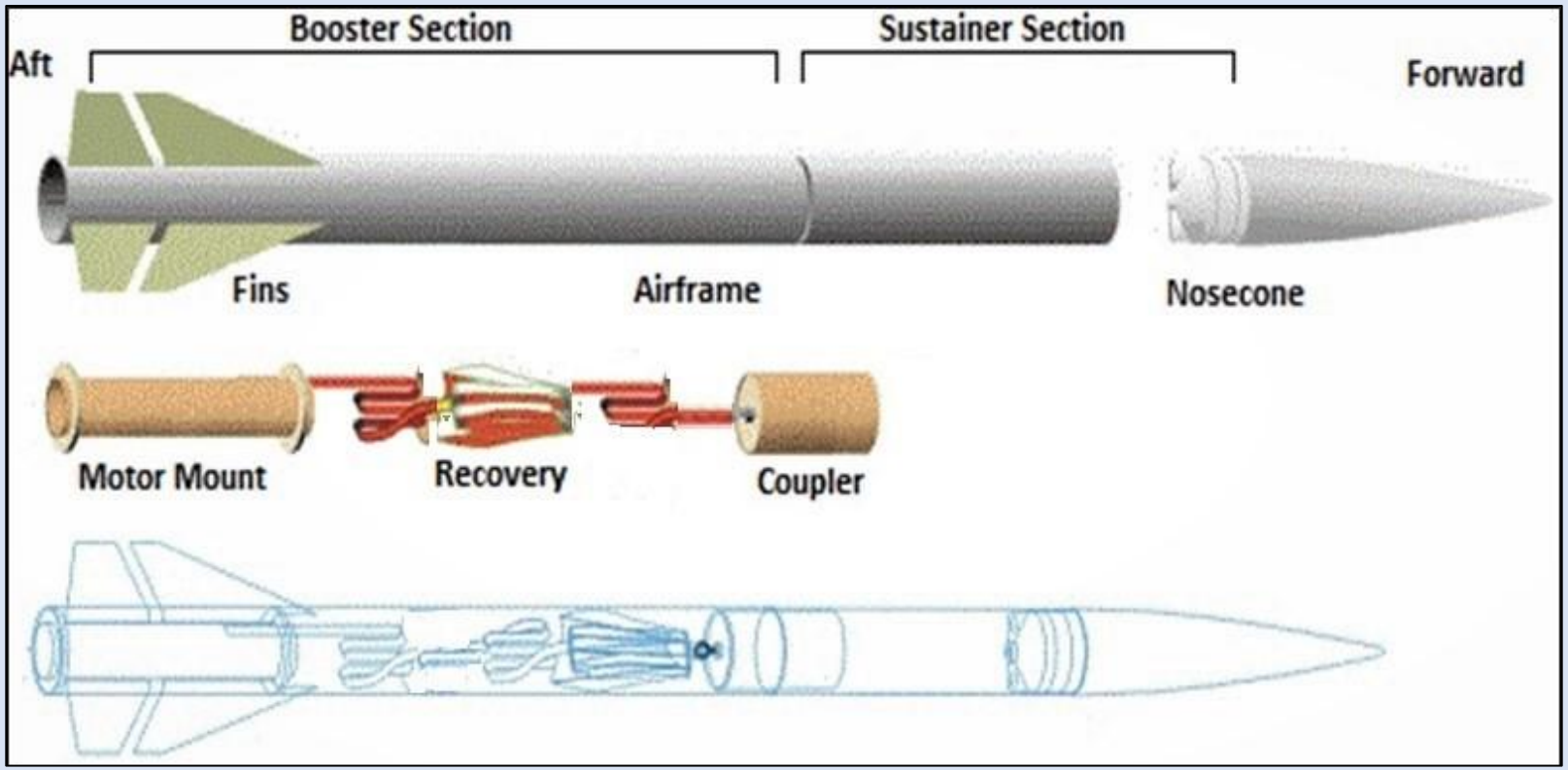


Figure 5-1: High-Power Rocket with Coupler

Handbook Reference: *5a. Structures, pg 15*

Aaron/Trent

Rocketry 101 – RockSim Introduction

- Creating a Model in RockSim 10
  - RockSim: http://www.apogeerockets.com/rocksim.asp

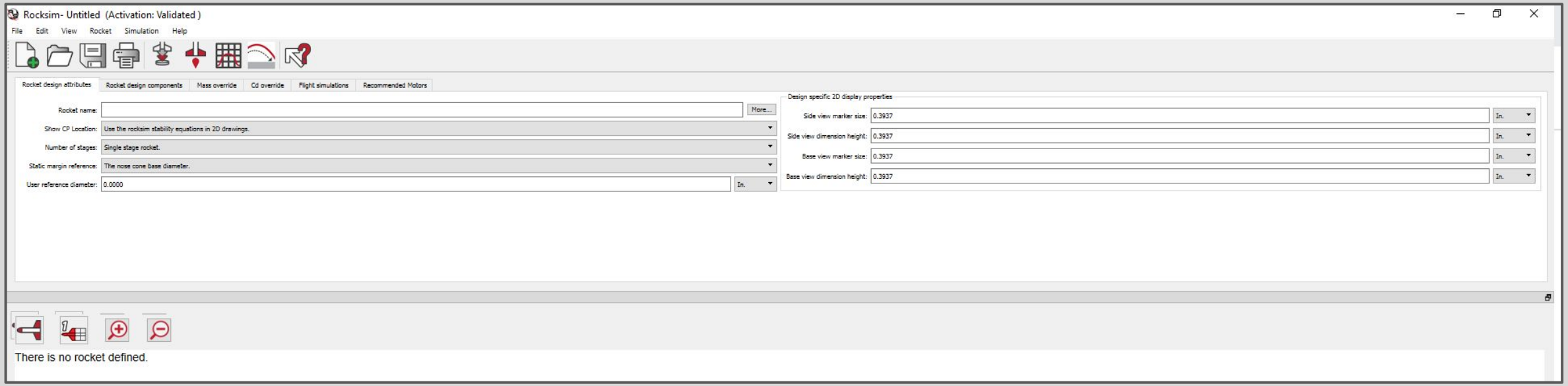


Figure 11-1: RockSim 10

Handbook Reference: *6f. Commercial Software Packages, RockSim Overview pg 24, 44*

Aaron/Trent

Rocketry 101 – RockSim Introduction

- Simulations are THE key component to high powered rocket design
  - Rocket Design Attributes
  - Rocket Design Components
  - Mass Override
  - CD Override
  - Flight Simulations
  - Recommended Motors

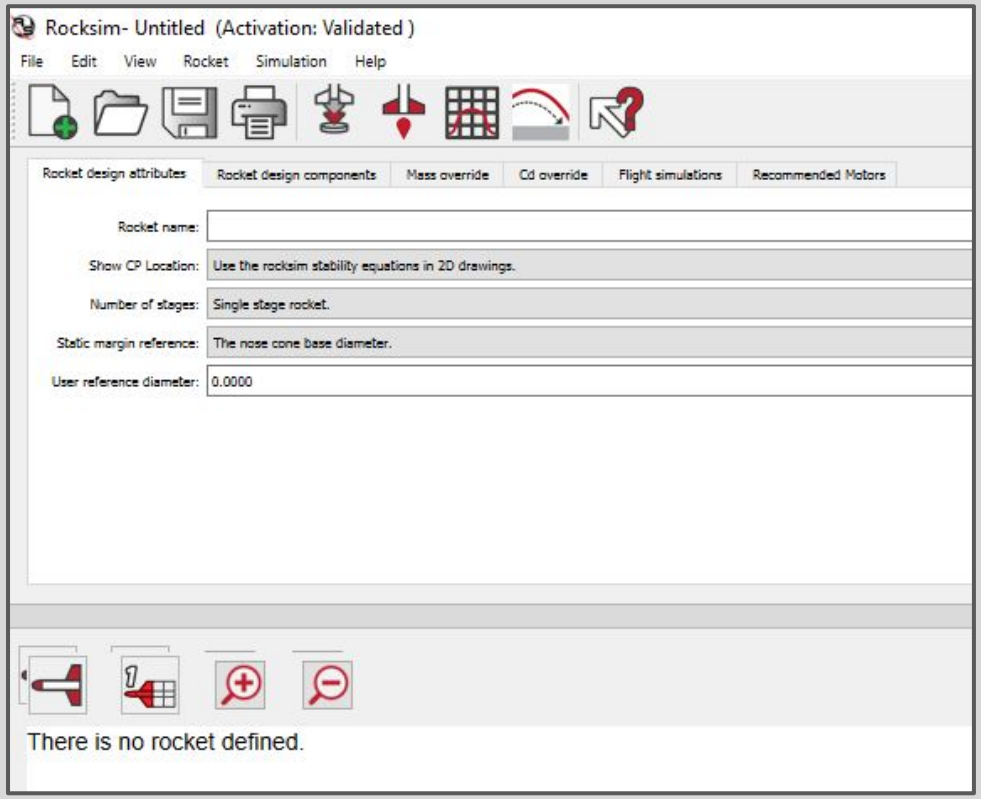


Figure 11-2: RockSim 10 Folders

Handbook Reference: *11a. RockSim Overview, pg 44*

Aaron/Trent

Rocketry 101 – RockSim Introduction

1. Download a pre-existing model of a Super DX3
   a. https://www.rocketreviews.com/rocksim-library.html
   b. Sort by Manufacturer
   c. Display RockSim files for Madcow Rocketry
   d. Download Super DX3

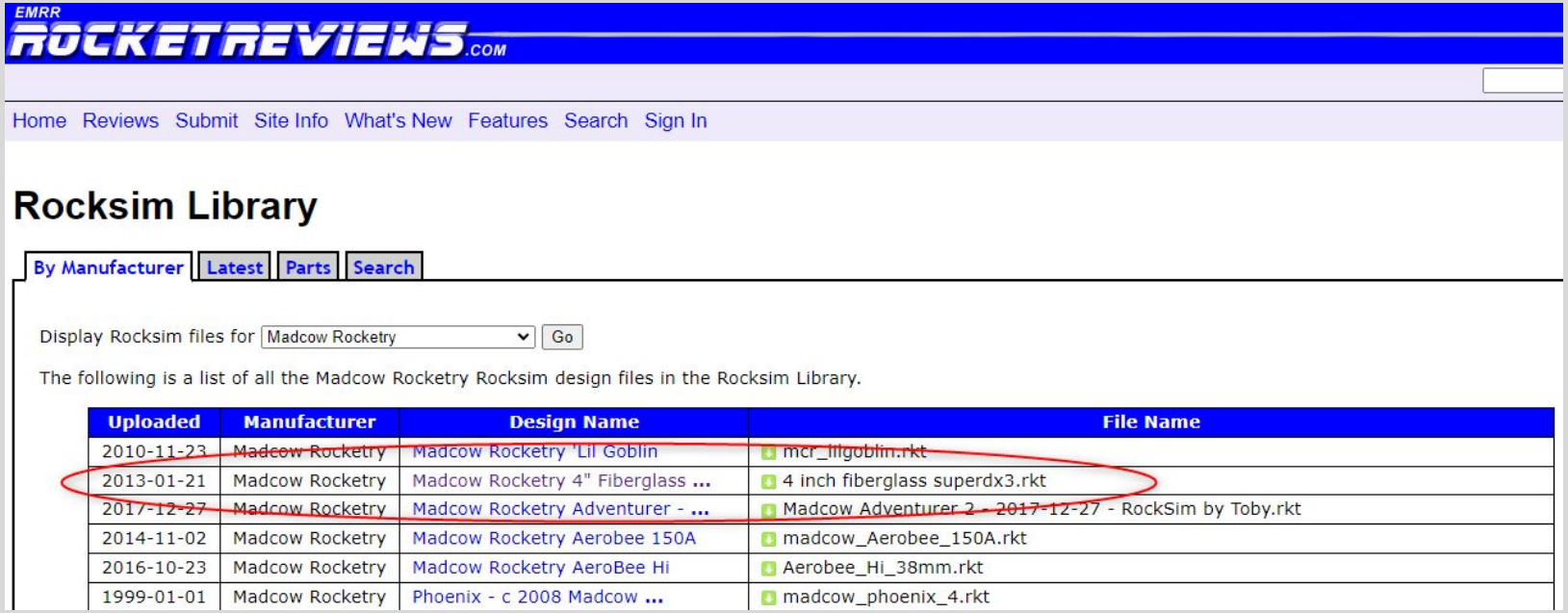


Figure 11-3: Rocket Reviews RockSim Library, Super DX3

Handbook Reference: *11a. RockSim Overview, pg 45*

Aaron/Trent

Rocketry 101 – RockSim Introduction

2. Import rocket file into RockSim 10
   a. Open the existing design file folder (Import Folder)
   b. Select mcr_superdx3.rkt file from download folder

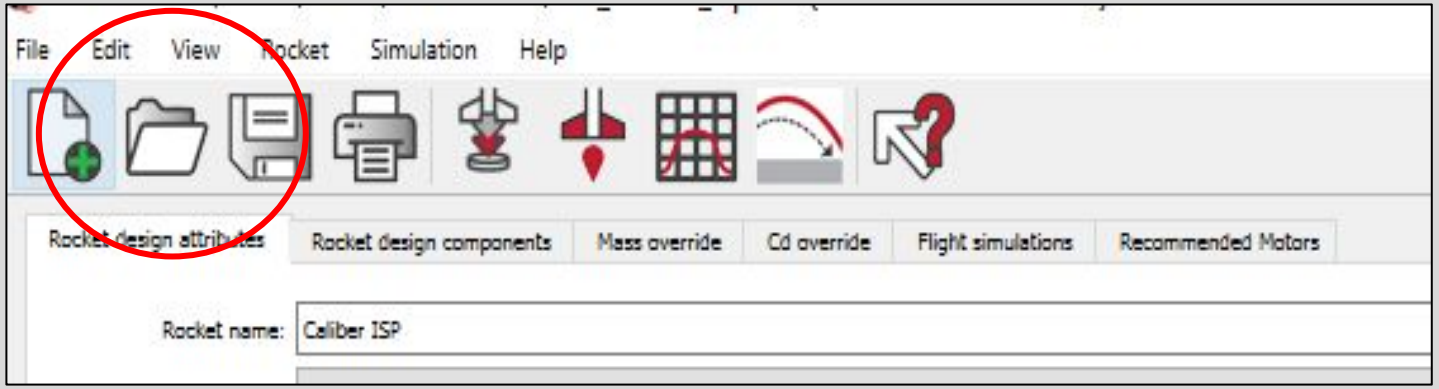


Figure 11-4: RockSim Import Folder

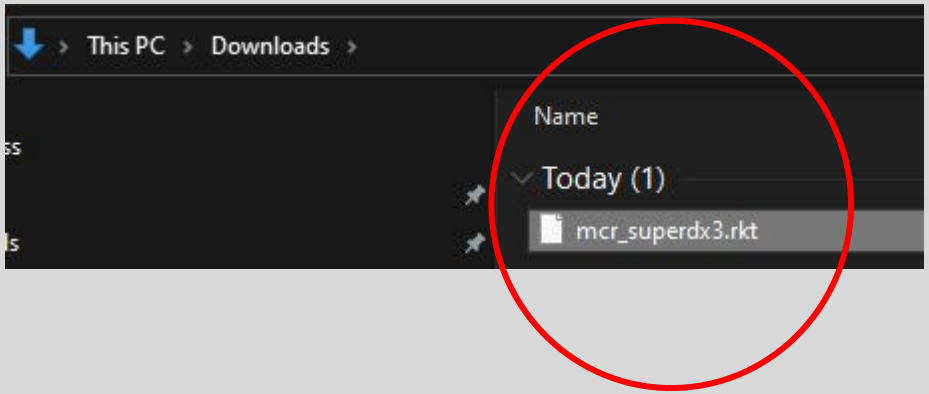


Figure 11-5: Select Rocket File from Download Folder on Computer

Handbook Reference: *11. RockSim Overview, pg 45*

Aaron/Trent

Rocketry 101 – RockSim Introduction

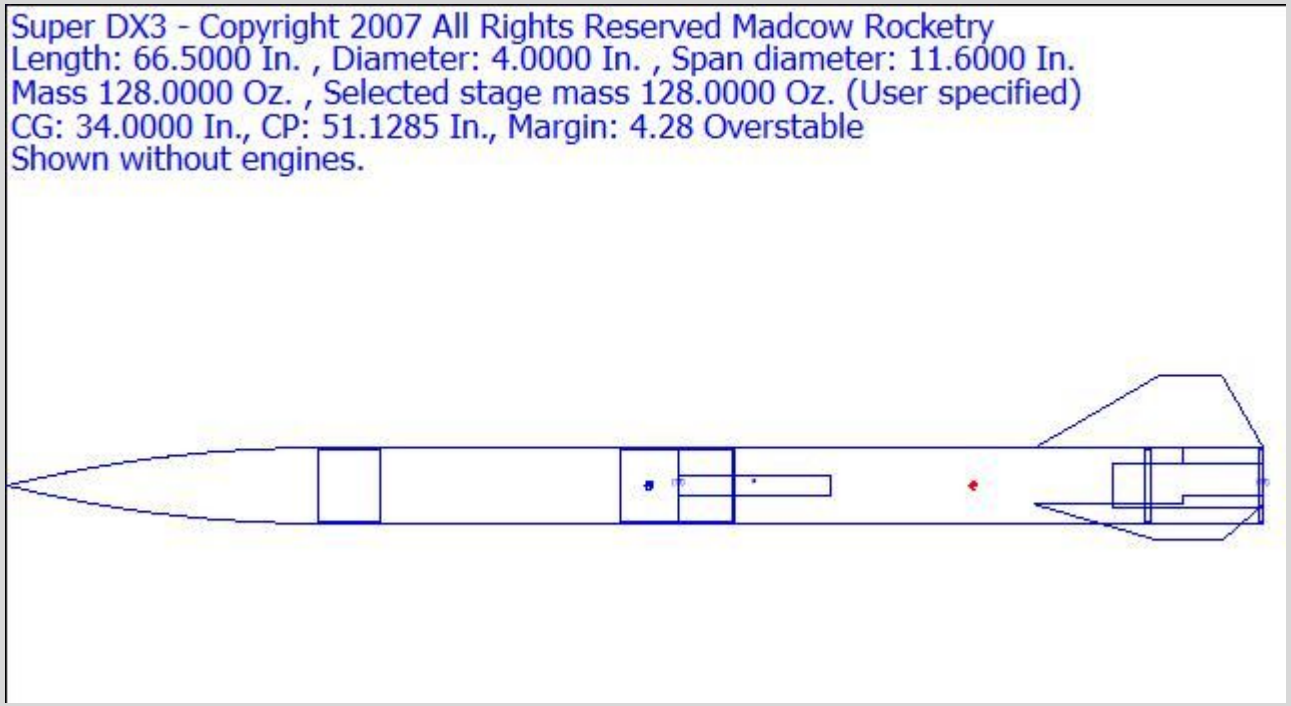


Figure 11-6: Super DX3 Stock File

Handbook Reference: *11. RockSim Overview, pg 45*

Aaron/Trent

Rocketry 101 – Propulsion Overview

Figure 6-1: Motor Kit Example

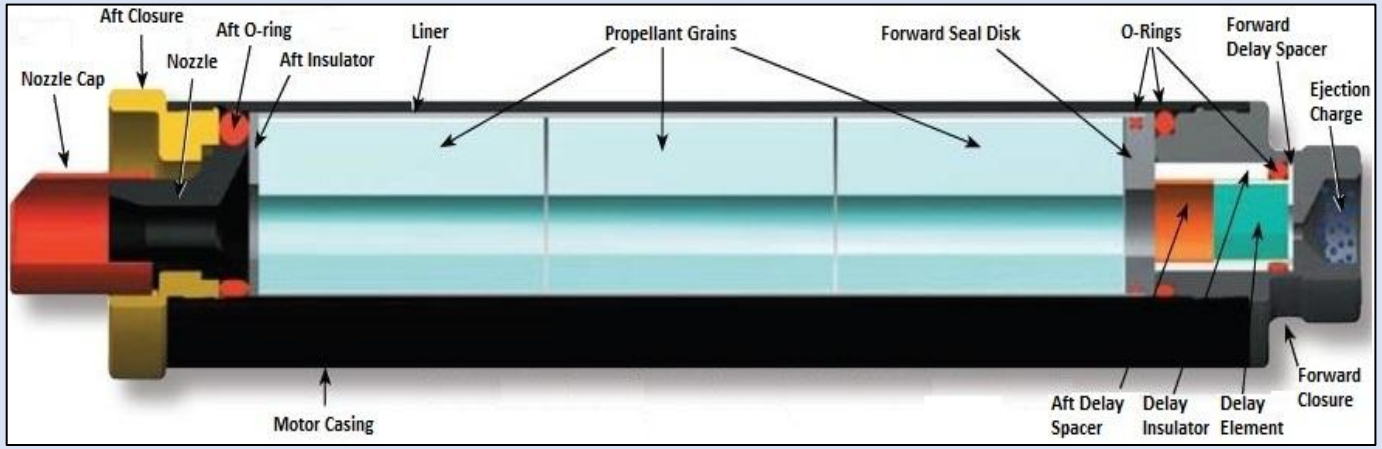


Figure 6-3: Cutaway Drawing of Typical Assembled RMS-Plus Motor

Figure 6-2: Cesaroni Motors

Figure 6-4: Aerotech Single Use Motor with Ignitor 2

Handbook Reference: *6b-c. Propulsion Systems, pg 22-23*

Aaron/Trent

Rocketry 101 - Propulsion Overview

Thrust to Weight Ratio

- At a minimum this is 5:1 (you need 5 times the amount of thrust per weight)
- If your rocket weighs 10 lbs, your motor needs to produce at least 50 lbs of (average) thrust

Thrust Curves

- Burn time
- Max thrust
- Average thrust
- Either Newtons or pounds

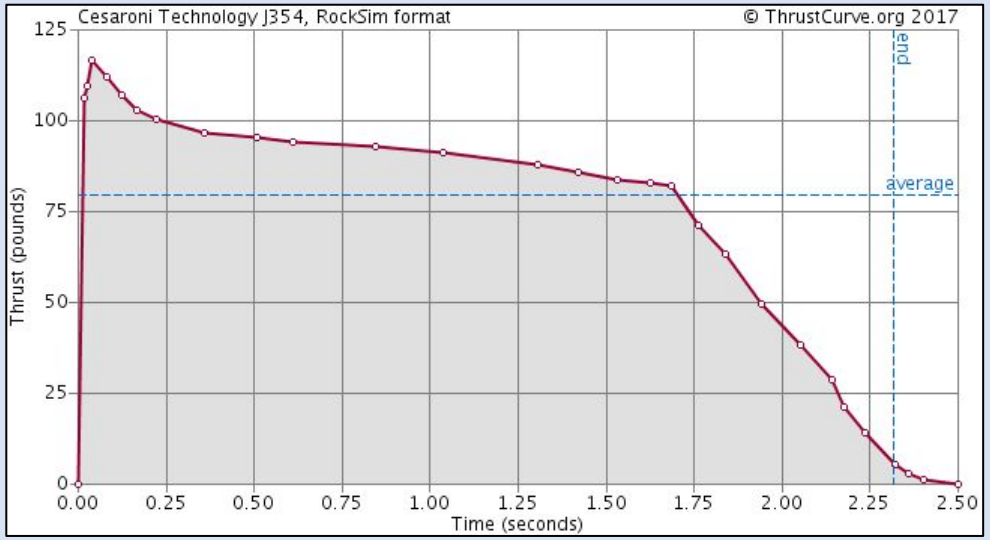


Figure 6-5: Thrust Curve Example

Handbook Reference: *6. Propulsion Systems, pg 23*

Aaron/Trent

Rocketry 101 - RockSim Motors

Motor – Aerotech 38mm I500

- http://www.thrustcurve.org/

What to do when there isn't an exact match

- https://www.youtube.com/watch?v=QIXN5jGysQg&feature=youtu.be

Handbook Reference: *11b. Selecting an Engine, pg 46*

Aaron/Trent

Rocketry 101 - RockSim Motors

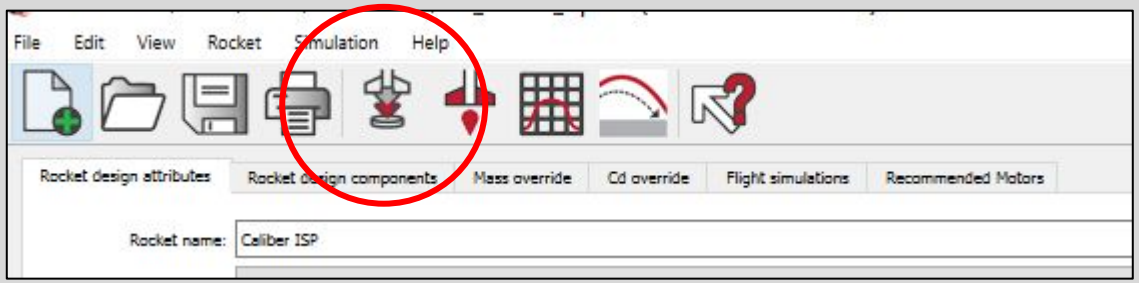


Figure 11-7: Prepare for Launch Icon

1. Select the ‘Prepare for Launch’ icon

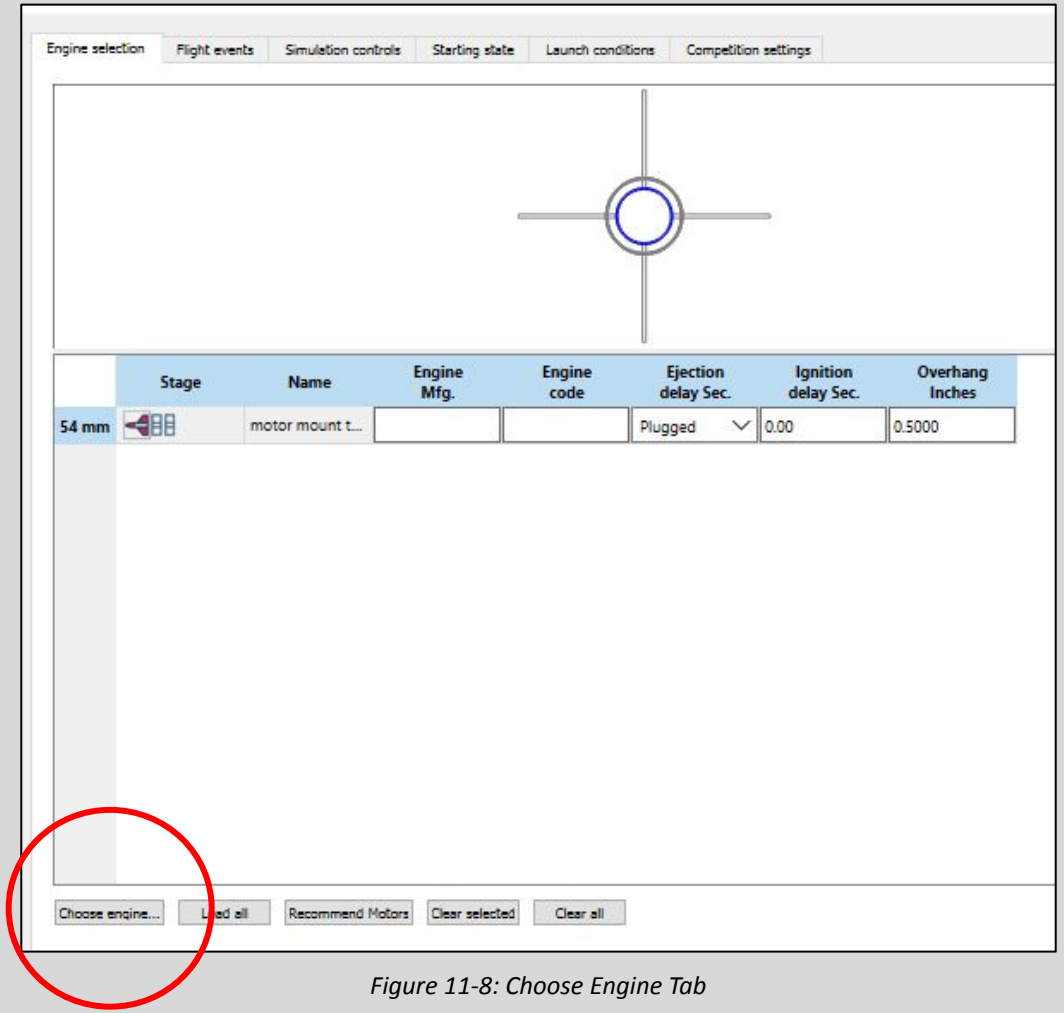


Figure 11-8: Choose Engine Tab

1. Select the ‘Choose Engine’ tab

Handbook Reference: *11b. Selecting an Engine, pg 46*

Aaron/Trent

Rocketry 101 - RockSim Motors

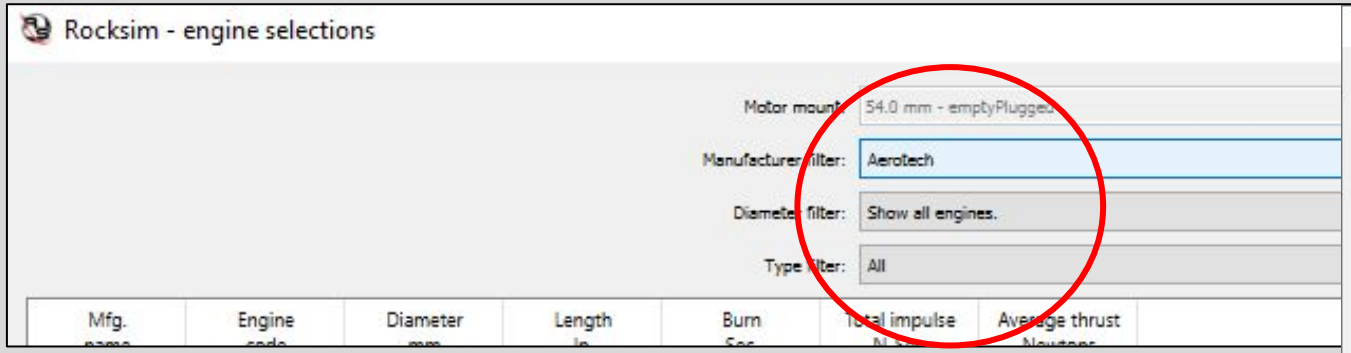
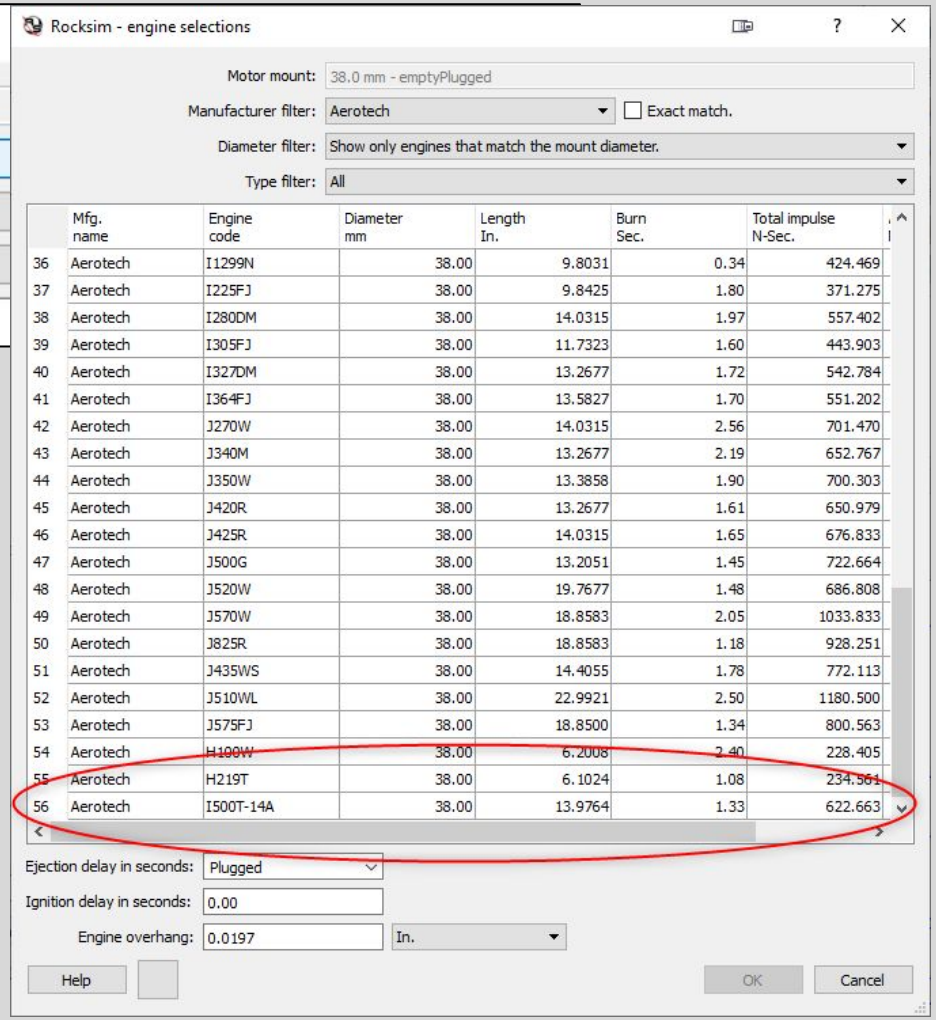


Figure 11-9: Manufacturer Field and Diameter Filter

3. Select ‘Aerotech’ in the Manufacturer Filter field

3. Select the ‘Show all engines’ in the Type Filter field

3. Double click on the H219T/ H100W -DMS motor



	Mfg. name	Engine code	Diameter mm	Length In.	Burn Sec.	Total impulse N-Sec.
36	Aerotech	I1299N	38.00	9.8031	0.34	424.469
37	Aerotech	I225FJ	38.00	9.8425	1.80	371.275
38	Aerotech	I280DM	38.00	14.0315	1.97	557.402
39	Aerotech	I305FJ	38.00	11.7323	1.60	443.903
40	Aerotech	I327DM	38.00	13.2677	1.72	542.784
41	Aerotech	I364FJ	38.00	13.5827	1.70	551.202
42	Aerotech	J270W	38.00	14.0315	2.56	701.470
43	Aerotech	J340M	38.00	13.2677	2.19	652.767
44	Aerotech	J350W	38.00	13.3858	1.90	700.303
45	Aerotech	J420R	38.00	13.2677	1.61	650.979
46	Aerotech	J425R	38.00	14.0315	1.65	676.833
47	Aerotech	J500G	38.00	13.2051	1.45	722.664
48	Aerotech	J520W	38.00	19.7677	1.48	686.808
49	Aerotech	J570W	38.00	18.8583	2.05	1033.833
50	Aerotech	J825R	38.00	18.8583	1.18	928.251
51	Aerotech	J435WS	38.00	14.4055	1.78	772.113
52	Aerotech	J510WL	38.00	22.9921	2.50	1180.500
53	Aerotech	J575FJ	38.00	18.8500	1.34	800.563
54	Aerotech	H100W	38.00	6.2008	2.40	228.405
55	Aerotech	H219T	38.00	6.1024	1.08	234.561
56	Aerotech	I500T-14A	38.00	13.9764	1.33	622.663

Figure 11-10: Aerotech I500 Motor Selection

Handbook Reference: *11b. Selecting an Engine, pg 46*

Rocketry 101 - RockSim Motors

The Aerotech I500 will automatically load into the RockSim software

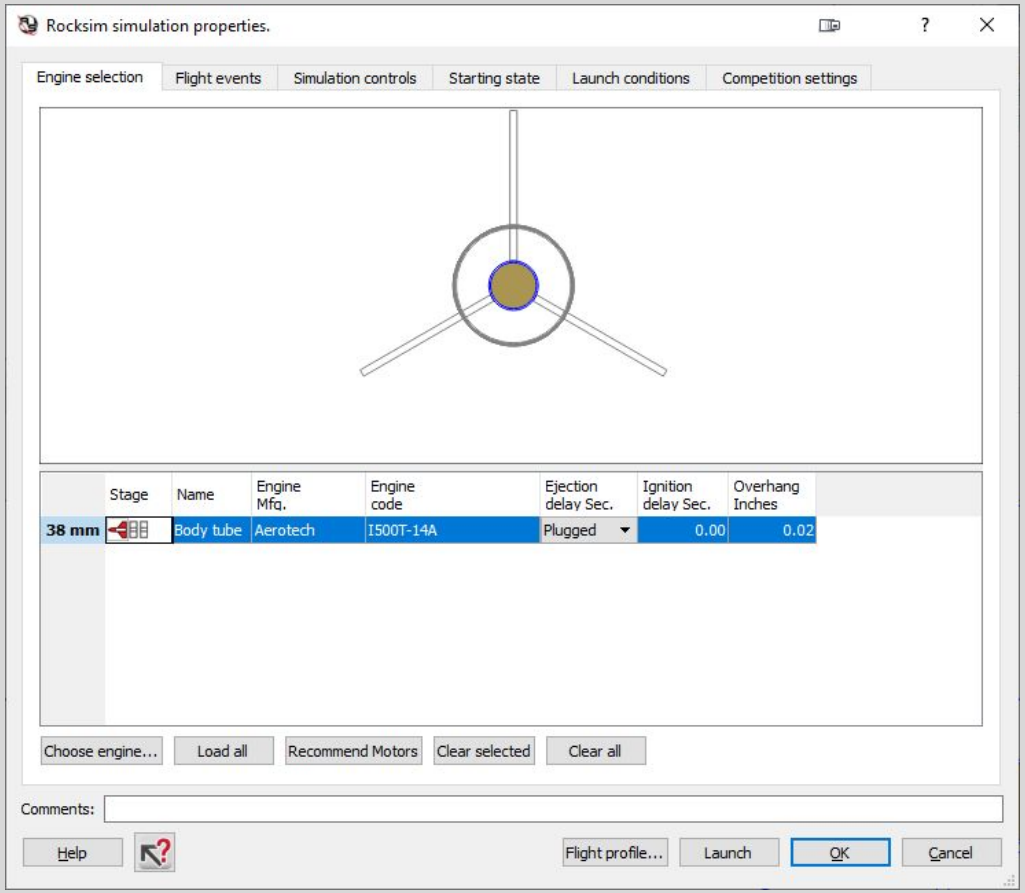


Figure 11-11: Motor Uploaded to RockSim

Handbook Reference: *11b. Selecting an Engine, pg 46*

Aaron/Trent

Rocketry 101 - Stability Overview

Center of Gravity (CG)

- What is it? Where is it?

Center of Pressure (CP)

- What is it? Where is it?

Stability Margin (SM)

- How do you determine the SM?

Remember: simulated CG and CP are not actual CG and CP (although they should be close!)

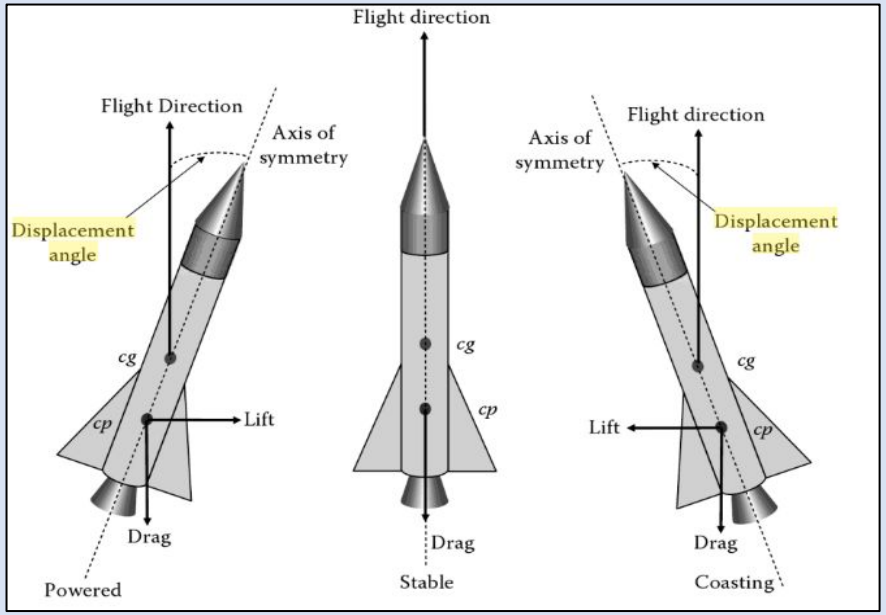
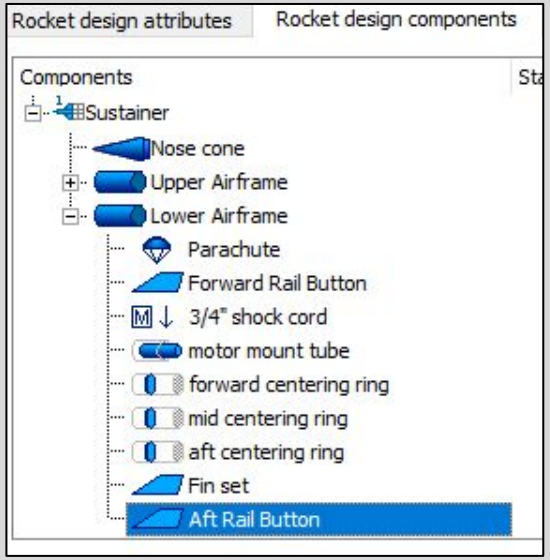


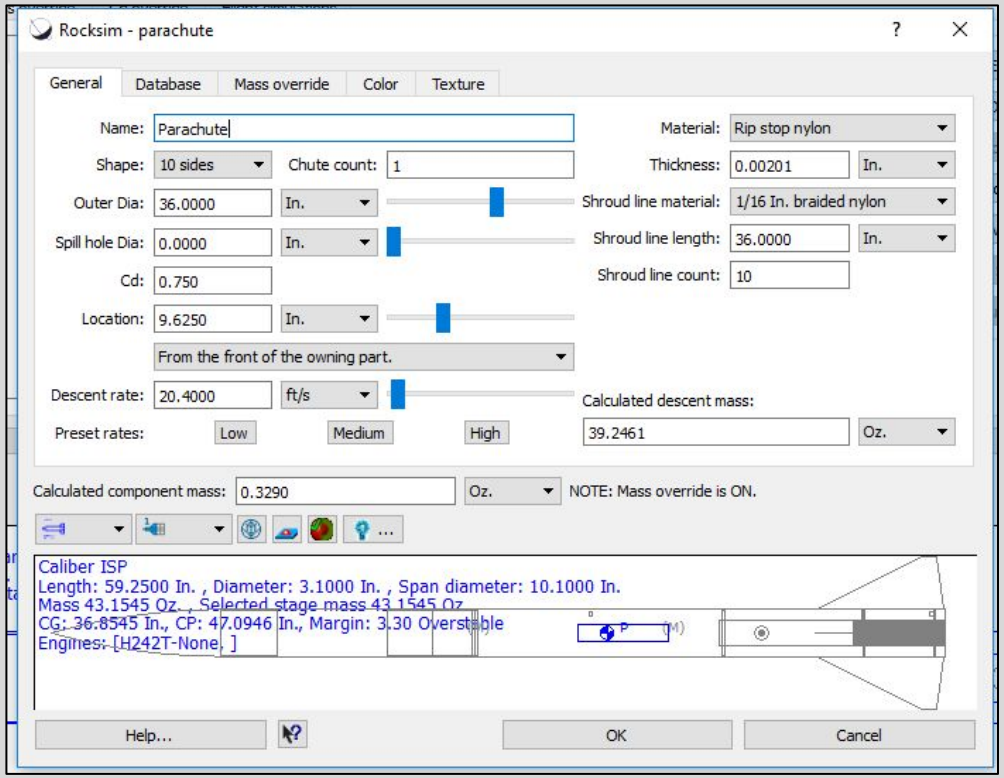
Figure 7-1: Rocket Stability Diagram

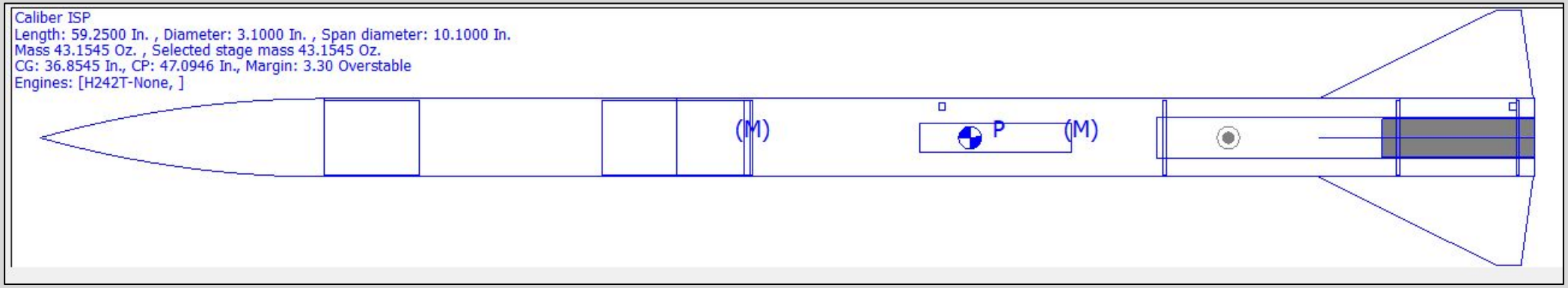
Handbook Reference: *7. Stability, pg 26*

Aaron/Trent

Rocketry 101 - Rail Buttons



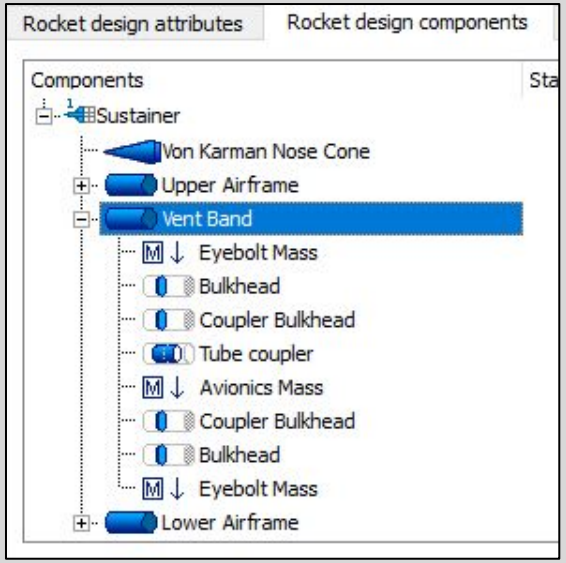


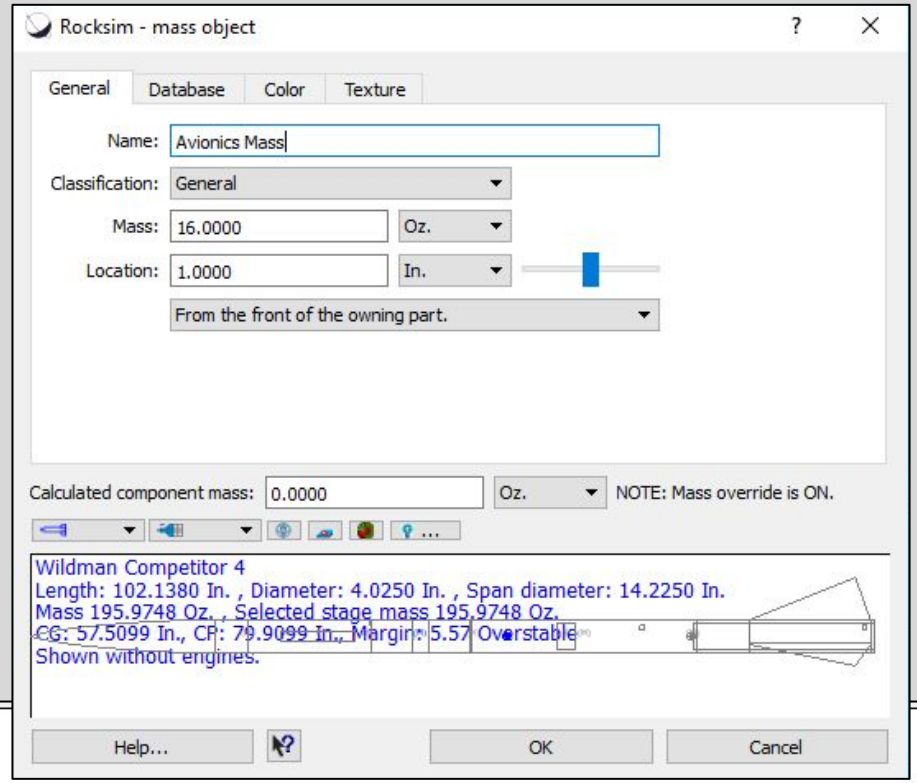


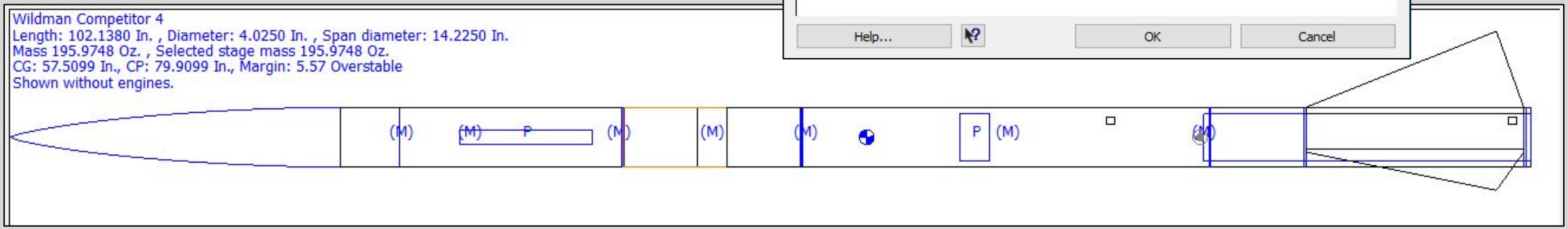
Handbook Reference: *11. RockSim Overview, pg 47*

Aaron/Trent

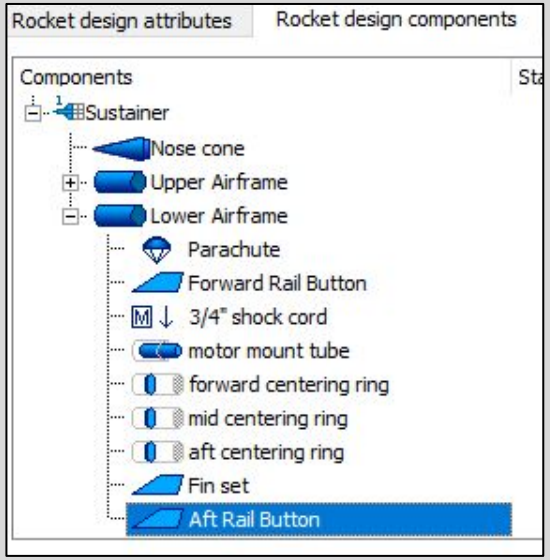
Rocketry 101 - Mass Objects

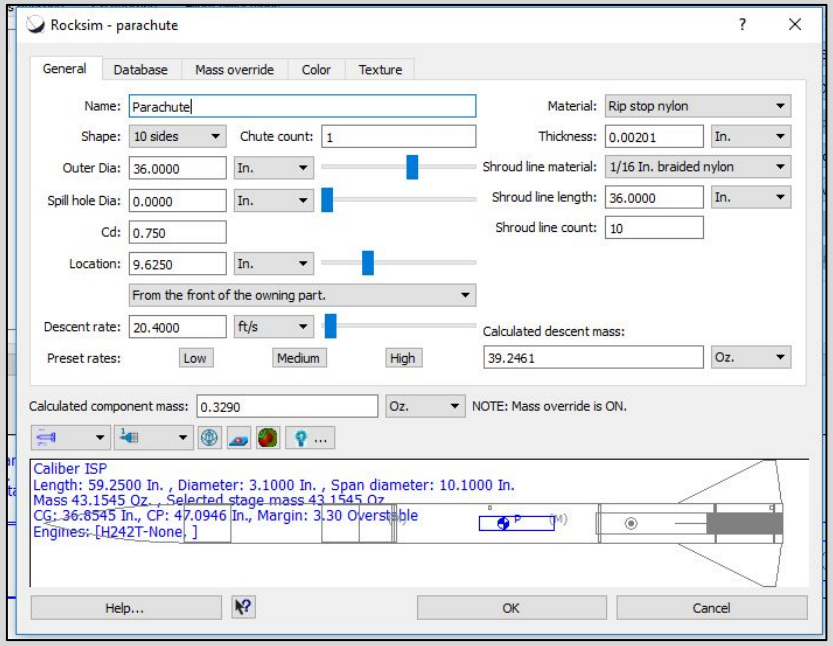


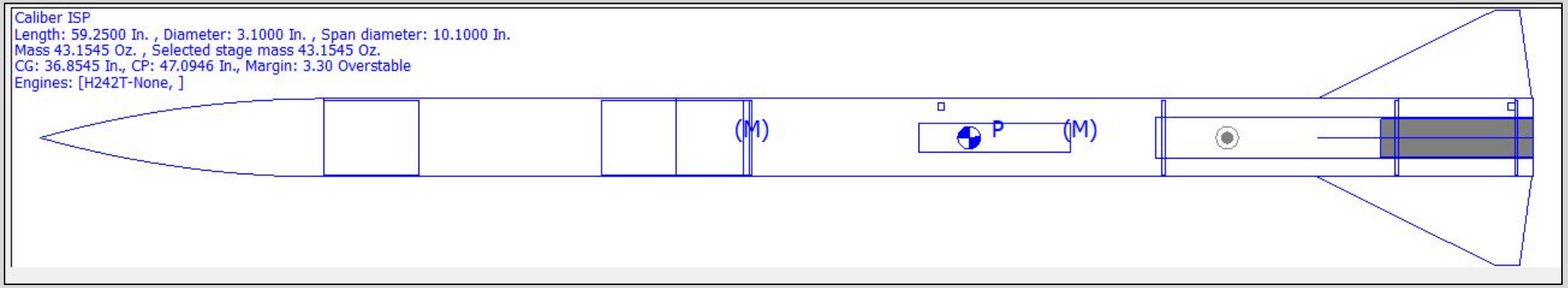




Rocketry 101 - RockSim Update







Handbook Reference: *11. RockSim Overview, pg 47*

Aaron/Trent

Rocketry 101 - Parachute Selection

There are two requirements to assist with parachute selection

- Descent Velocity – a safe rule of thumb to adhere to is a descent velocity (or descent rate) of approximately 20 ft/s

Most rocket simulators will determine the descent velocity for you

- The weight of the model must be as accurate as possible however
- Descent rate will also be affected by the motor selection (weight)

Figure 8-6: Example Recovery Simulation

Handbook Reference: *8c. Parachute Selection, pg 31*

Aaron/Trent

Additional Resources

- FNL Website:
  - Tools and Tips: https://spacegrant.carthage.edu/first-nations-launch/tools-and-tips/
  - Rocket Instructional Videos: https://spacegrant.carthage.edu/first-nations-launch/rocket-instructional-videoswebinars/
- Your team's rocketry mentor
- When all else fails:
  - Frank Nobile and Mark Abotossaway

Questions?