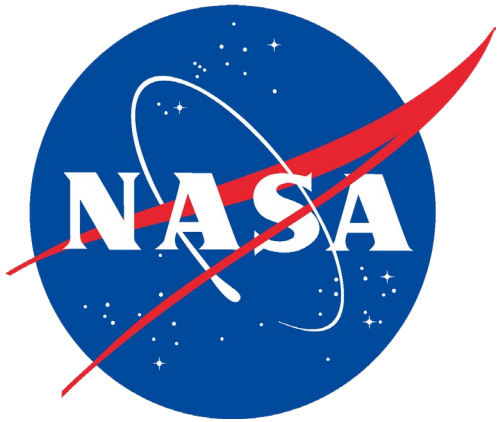
Launch 2 Learn



Introductory Rocket Workshop

Collegiate Rocket Launch - November 15-16, 2024
First Nations Launch - January 17-18, 2025

Brought to you by Wisconsin Space Grant Consortium and Tripoli Rocketry Association

This session will be recorded

Introductions

Wisconsin Space Grant Consortium

Christine Bolz, *WSGC Assistant Director, FNL Program Director*
Rob Cannon, *FNL Program Manager*
Connie Engberg, *WSGC Project Support Assistant*

Tripoli Rocketry Association

Frank Nobile, *CRL & FNL Technical Advisor*
Bob Justus, *IL Tripoli Assistant*

Collegiate Rocket Launch

Glenn Spiczak, *WSGC Collegiate Rocket Launch Director*

AIAA-Wisconsin Section

Trent Cybela, *WSGC CRL Alumni/Vice President/Volunteer Support*
Adrian Guither, *WSGC CRL Alumni/Volunteer Support*

Faculty, Student, Judge's Introductions

Name
Area of instruction/study
Rocket experience
Goals/expectations for the workshop

External Evaluation

Steve Everett, *The Everett Group*

Workshop Presentation – Formatting Note

Rocketry Overview & Fundamentals
- Colored / Highlighted blue

Rocket Workshop Build
- Colored / Highlighted green

Rocketry Simulations
- Colored / Highlighted grey

Competition Support
- Colored / Highlighted yellow

Additional Information Not Found in Handbook
- Colored red

Weekend Workshop Schedule

Friday Evening

- Introduction & Overview
- Workshop Supply List/Level 1 Kit
- RockSim Intro
- Pre-Fit Check Overview & Build
- Epoxy & Pre-Fit Check Overview
- Motor Mount Assembly & Build
- Review/Prep for Saturday

Saturday Morning

- Introduction
- Coupler Assembly & Build
- Motor Mount Assembly & Build
- Propulsion Overview
- RockSim Overview
- Nosecone Installation & Build
- Rail Button Alignment, Vent Hole Installation, & Build
- Morning Session Review

LUNCH BREAK

Saturday Afternoon

- Inner Fin Installation Overview & Build
- Stability Overview
- Outer Fin Installation Overview & Build
- RockSim Update

BREAK

- Aft Centering Ring Installation Overview & Build
- Rail Button Installation Overview & Build
- RockSim Update
- Recovery Installation & Build
- Parachute Preparation & Build
- Launch Preparation Overview
- Recovery, Motor, Launch Pad, Rocket Retrieval
- Certification Launch Requirements
- Certification Flight, Rocket Transport
- Workshop Review, Survey, Q&A

Workshop Expectations

Zoom Platform

- Rob and Connie will be our workshop moderators, helping you with technical difficulties
- Profile should include First and Last Name, School
- Keep your camera/video on - we MUST see you/your workspace/rocket
  - Allows you to actively participate and ask for help
  - If you need to step away for a break, turn off camera
  - Raise hand feature, use of chat, and verbal questions are all encouraged
- Keep your audio muted during overviews, unmuted during build activities
- Breakout rooms may be used for additional support
- View Options
  - Spotlighting - Moderator will spotlight build camera
  - Pinning - Allows you to focus on key individuals
  - Gallery vs. Speaker option

Workshop Expectations

Launch 2 Learn Handbook

- Handbook reference on bottom left-hand corner of slide
- Take notes
- Overview (sections 1-12), build (section 13), launch preparation (section 14), certification (section 15), page references (section 16) and evaluation questionnaire (section 17)

RockSim

- RockSim should be already installed and activated with the “key” provided by WSGC
- The instructors will walk you through RockSim during sections of the build – You will walk through each step with them

Rocket Build

- Instructors will walk you through each build section
- You will complete your build in real time with the instructors

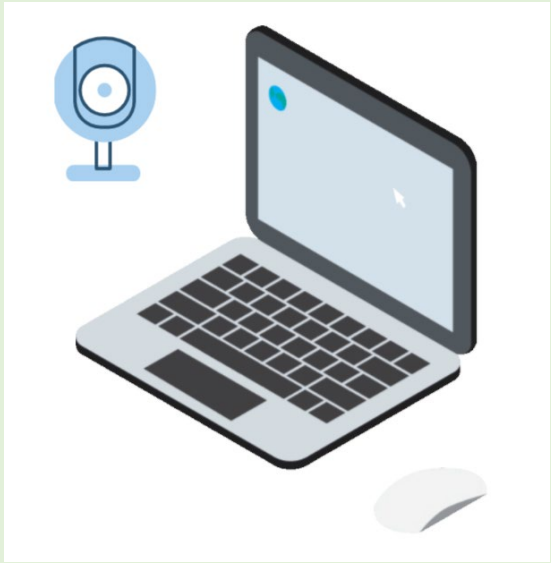
Workshop Objectives

- Introduce design, build, fly concepts of high-powered rocket
  - Remember this is only an introductory workshop, there is not enough time to cover all aspects in greater detail
- Build a Level 1 high-powered single deploy kit rocket
  - We will build the LOC Precision Caliber-ISP kit
- Develop basic understanding of rocket flight simulation
  - Import the Caliber kit rocket into RockSim and analyze a flight
- Understand Tripoli Level 1 certification
  - Certification process and how to complete your launch

Workshop Materials & Supplies

ITEM DESCRIPTION:	QUANTITY:	RECEIVED:
Launch 2 Learn Handbook*	1	
Alcohol Wipes	15	
Awl, drill and bits	1	
Craft Sticks, Wooden	15	
Cups, Plastic	15	
18” Wooden Dowel	1	
Epoxy	1	
Nitrile Gloves	6 pr.	
Masking Tape	1	
Paper Plates	2	
Paper Towels	bundle	
Pencil	1	
Ruler	1	
Sandpaper	1	
Screwdriver set	1	
Table Covering	1	
Utility Knife	1	

ROCKSIM



NASA WISCONSIN SPACE GRANT CONSORTIUM

WISCONSIN SPACE GRANT CONSORTIUM WSGC

Launch 2 Learn
Introductory Rocket Workshop Handbook

Brought to you by Wisconsin Space Grant Consortium, Tripoli Rocketry Association and AIAA
Funded through NASA Cooperative Agreement #80NSSC20M0123

Rocket Build – Your First Level 1 Kit

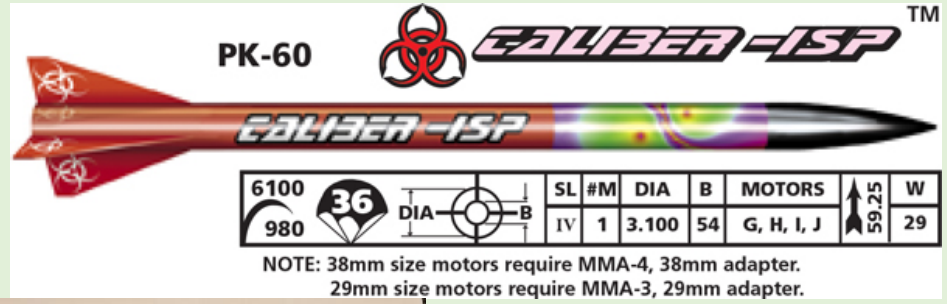
Loc Precision Caliber – ISP

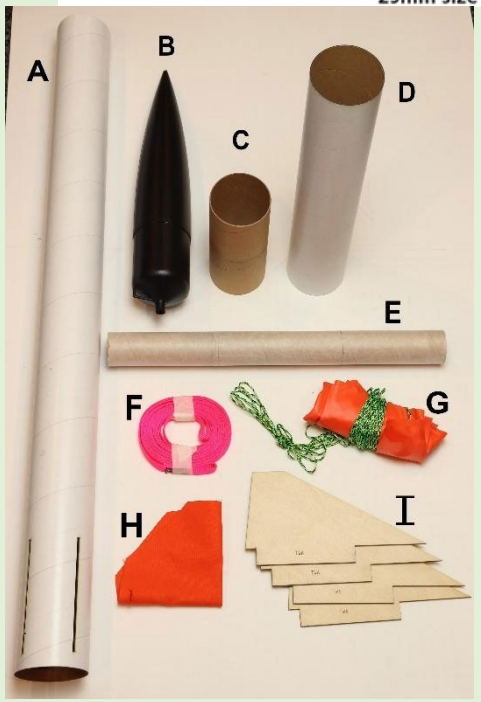
Single Deploy Rocket

38 mm H219T - DMS/ H100W -DMS

Kit Features Include:

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





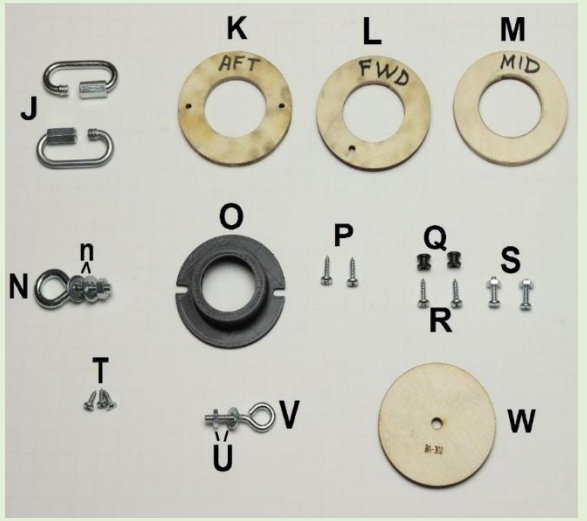


Figure 2- SEQ Figure 1: Parts included with the LOC Precision – 3.10" Caliber ISP Rocket Kit (labels correspond to parts list in Handbook Table 2-2)

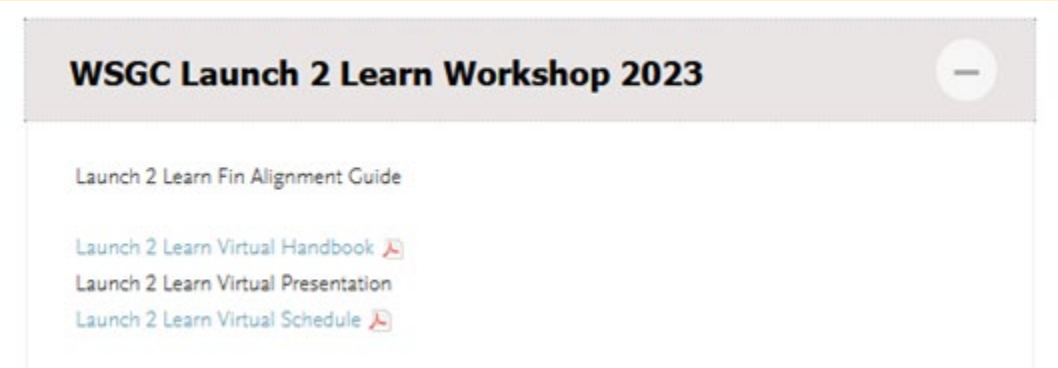
Workshop Materials & Supplies

ITEM DESCRIPTION:	QUANTITY:	RECEIVED:
LOC Precision – 3.10" Caliber ISP Rocket Kit*:	1	
Booster Airframe	1	
Nose Cone	1	
Coupler	1	
Payload Section	1	
38mm Motor Mount Tube	1	
Recovery Strap	1	
Parachute	1	
Parachute Protector	1	
Fin	4	
Quick Link	2	

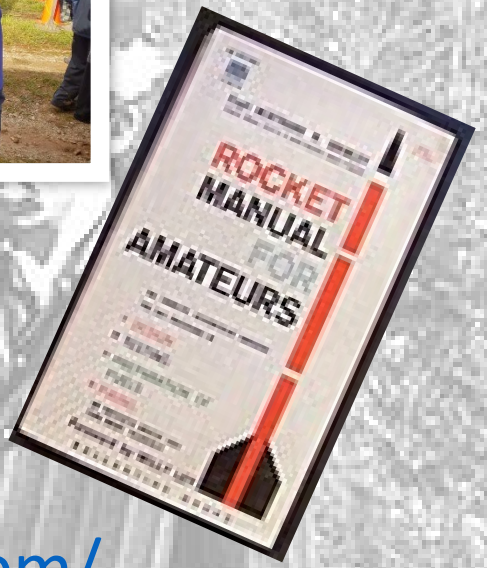
Centering Ring Bag:		
Centering Ring with 2 Small Holes	1	
Centering Ring with 1 Small Hole	1	
Centering Ring with 0 Small Holes	1	
Eyebolt	1	
Washer	2	
#8 Wood Screws	2	
Machine Screw	2	
Motor Retention Cap	1	
Rail Button Bag:		
Rail Button	2	
Nut	2	
Machine Screw	2	
Wood Screw	2	
Bulk Plate Bag:		
Bulk Plate	1	
Eyebolt	1	
Nut	2	

Students - Tools & Tips

https://spacegrant.carthage.edu/students/tools-and-tips/



High-Power Rocketry History



- *Scientific American Article (1957)*
  - Design, propellant formulations, and launching techniques
- *Rocket Manual for Amateurs (1960)*
- Homer Hickam - *Rocket Boys(1998)* https://homerhickam.com/
- National Organizations and Regulation
  - National Association of Rocketry (NAR) https://www.nar.org
  - Tripoli Rocketry Association (TRA) http://www.tripoli.org
- First amateur high-powered rocket into space (2004) @ 72 miles
- University of Southern California sets world record (2017)
  - Highest altitude a student built and designed rocket reaches: 144,000' apogee


TODD WEHR CENTER

Rocketry 101 – Single Deploy Flight Profile

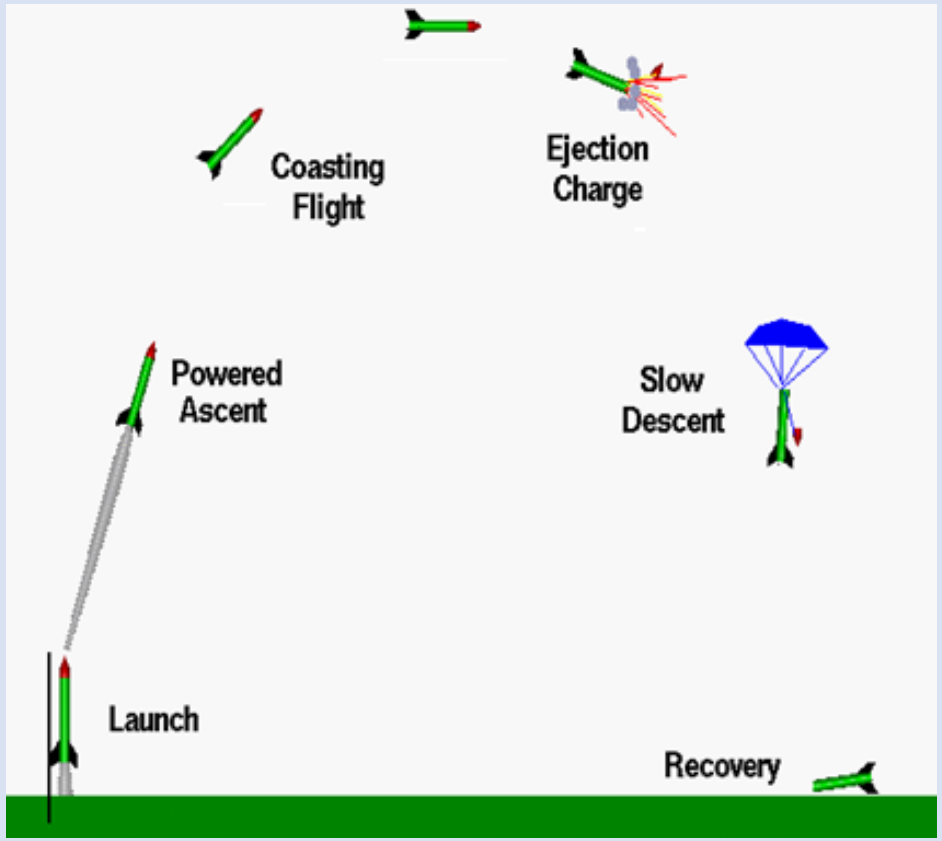


Figure 4-1: Single Deploy Flight Profile

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

Rocketry 101 – Dual Deploy Flight Profile

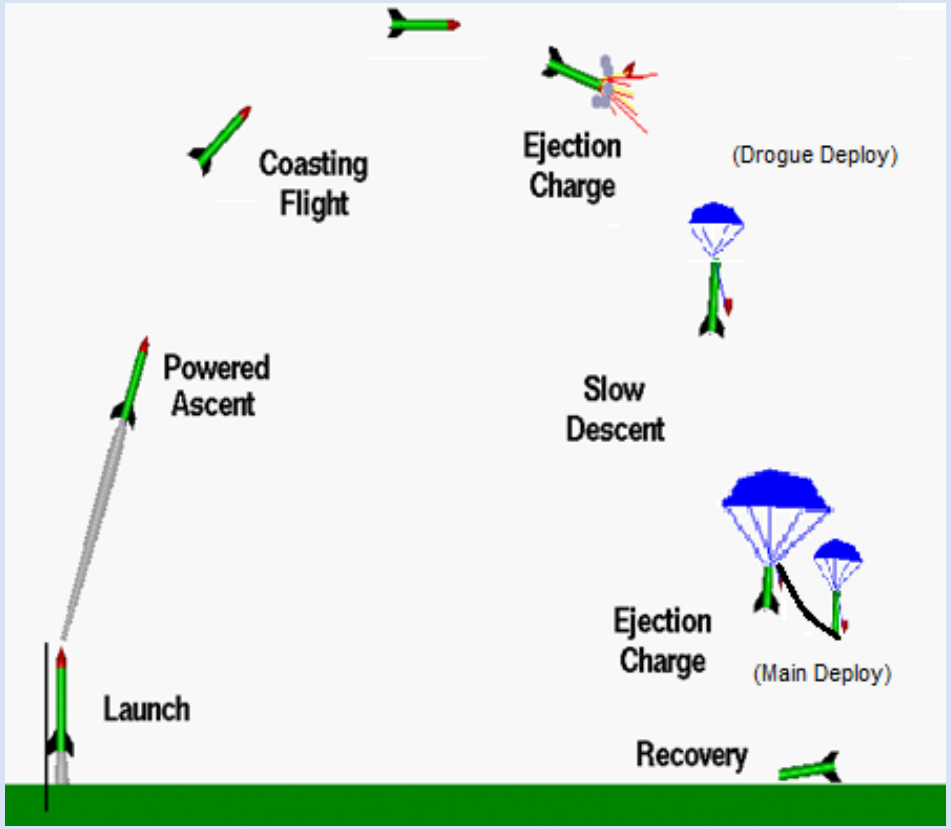


Figure 4-2: Dual Deploy Flight Profile

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

Rocketry 101 – Flight Profile Differences

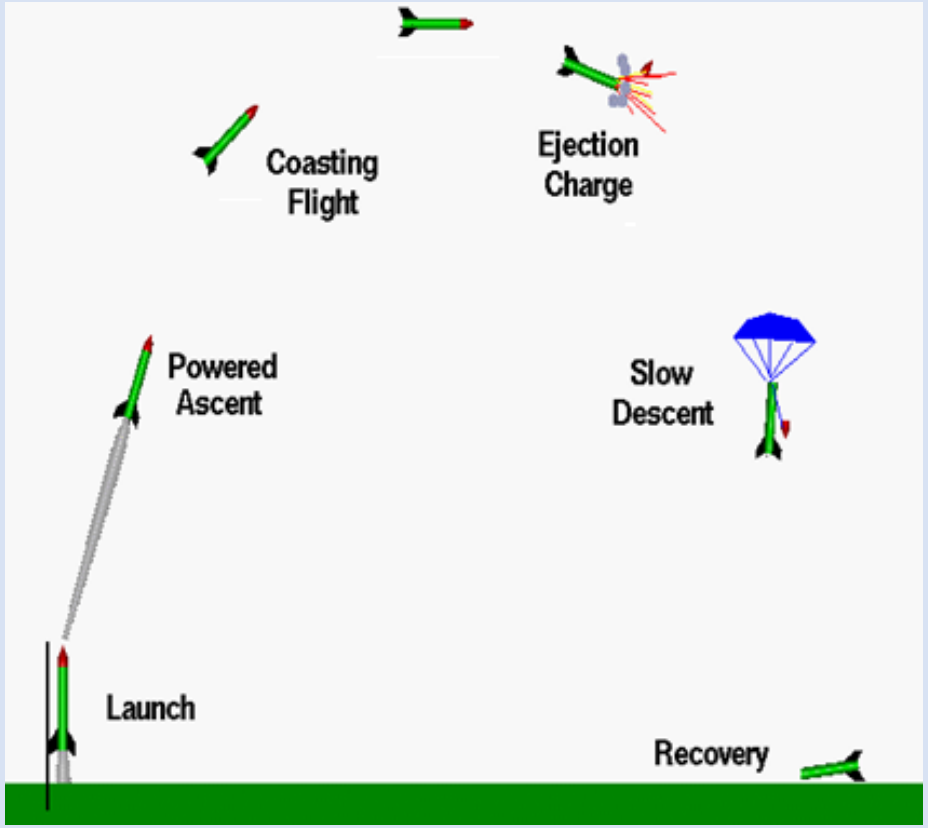


Figure 4-1: Single Deploy Flight Profile

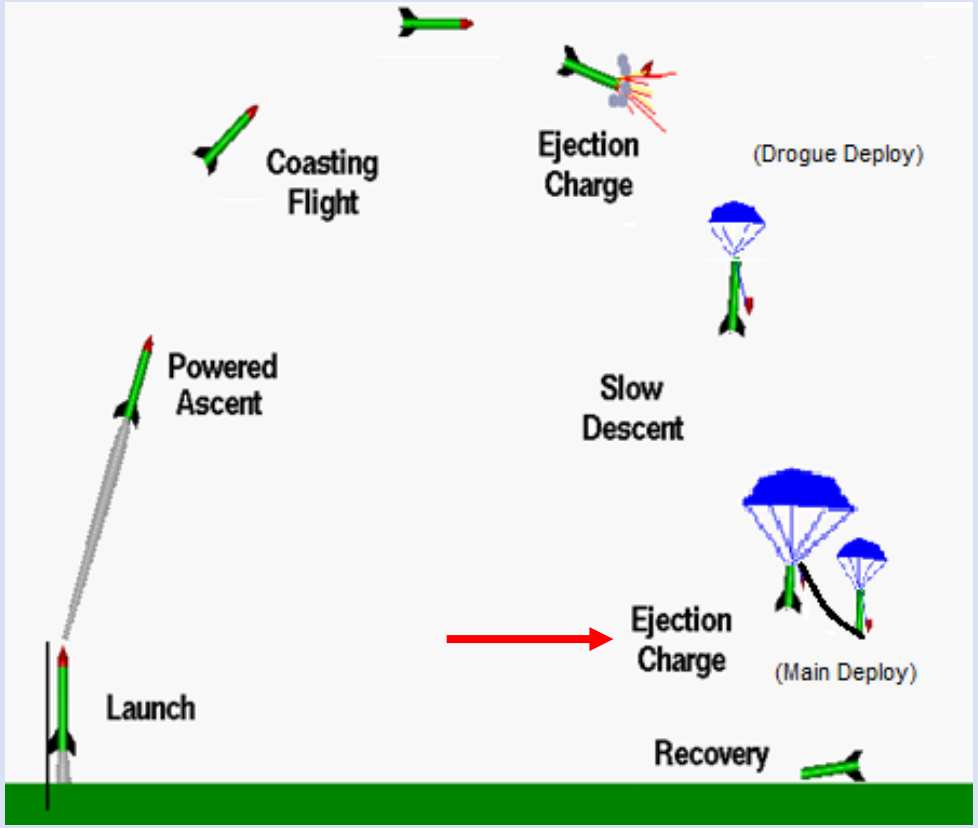
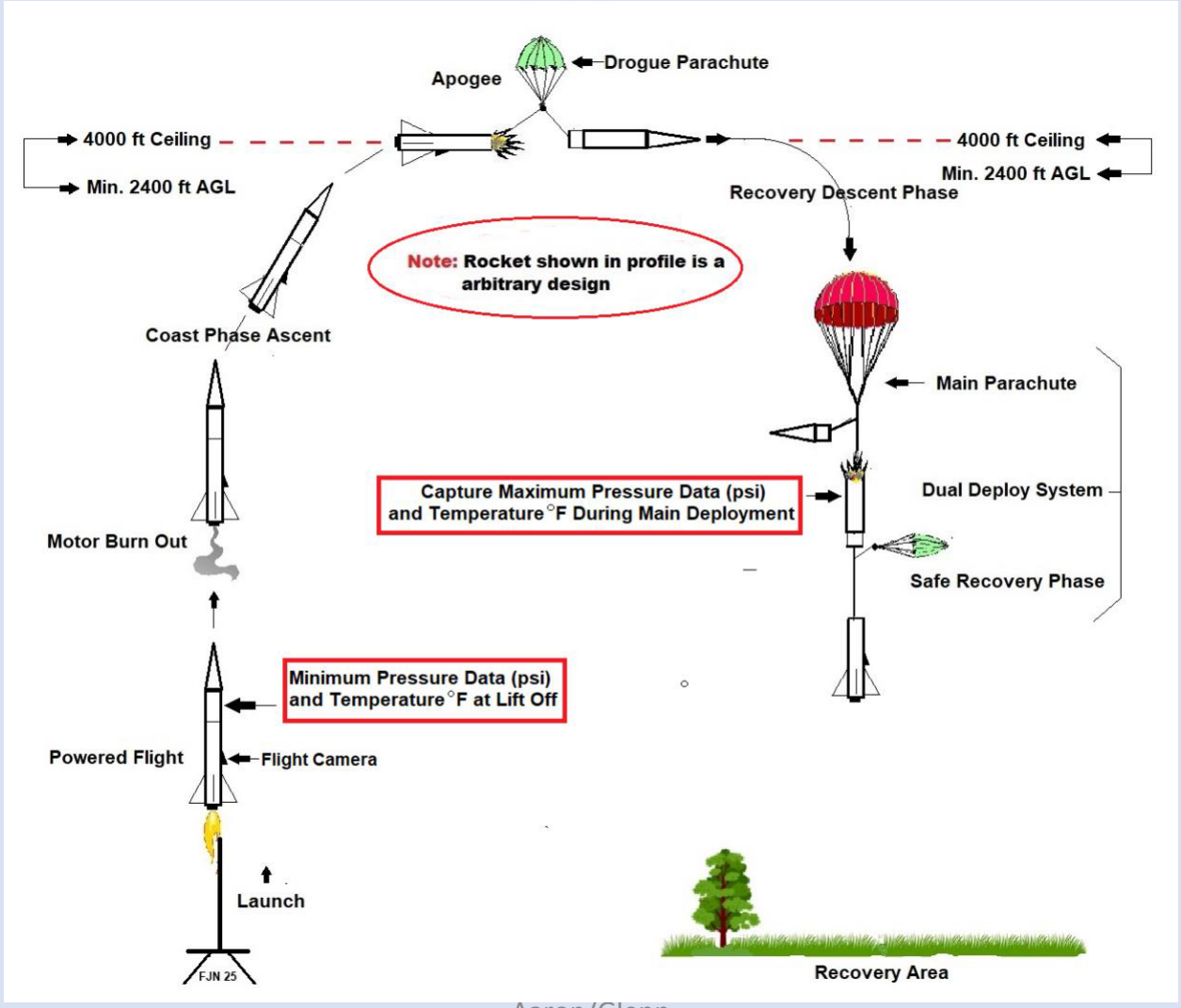


Figure 4-2: Dual Deploy Flight Profile

Rocketry 101 – CRL Competition Flight Profile



Rocketry 101 - Structures

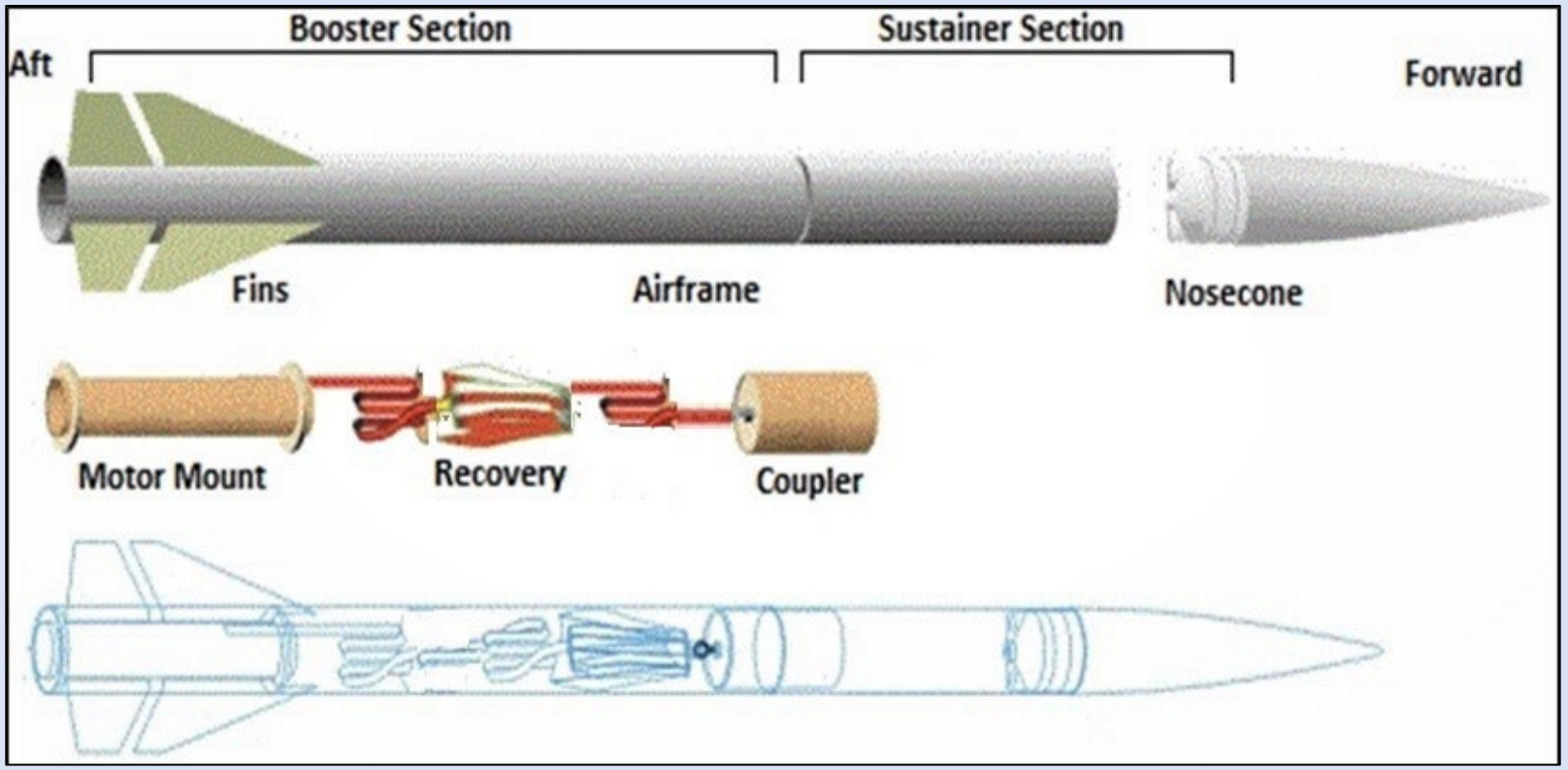


Figure 5-1: High-Power Rocket with Coupler

Rocketry 101 – RockSim Introduction

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

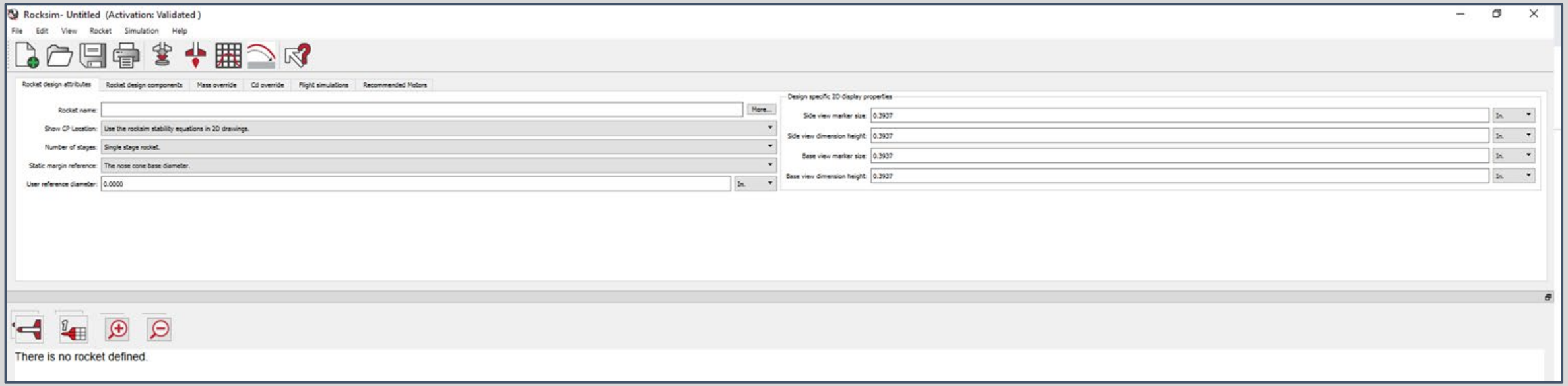


Figure 11-1: RockSim 10

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

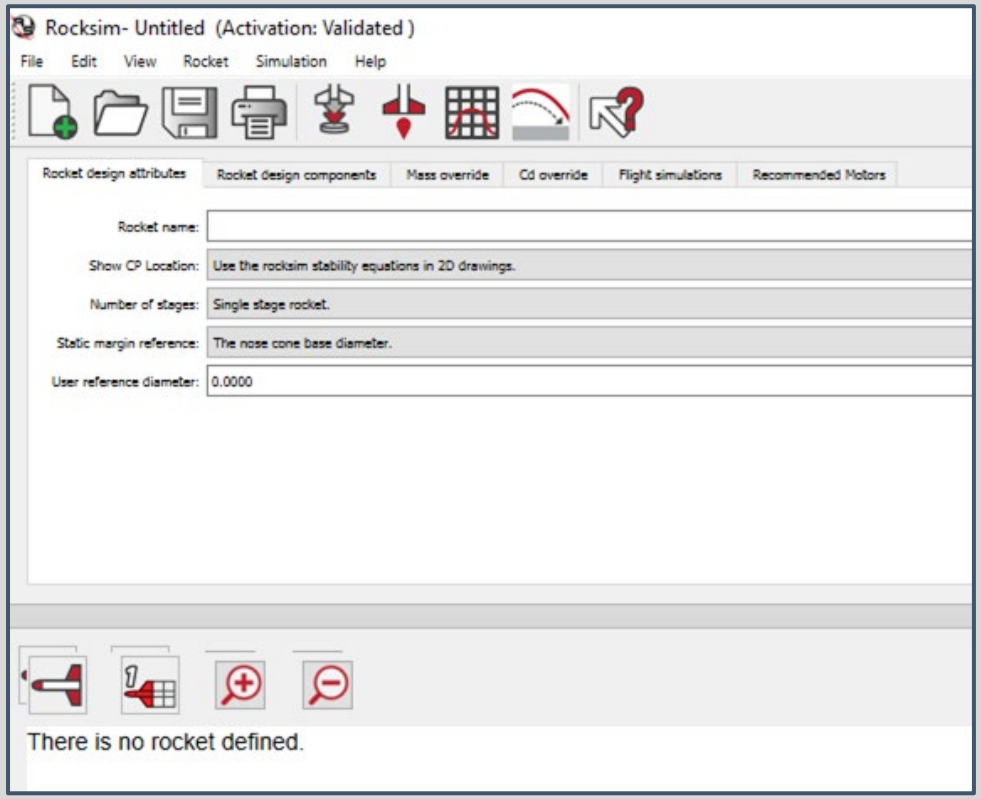
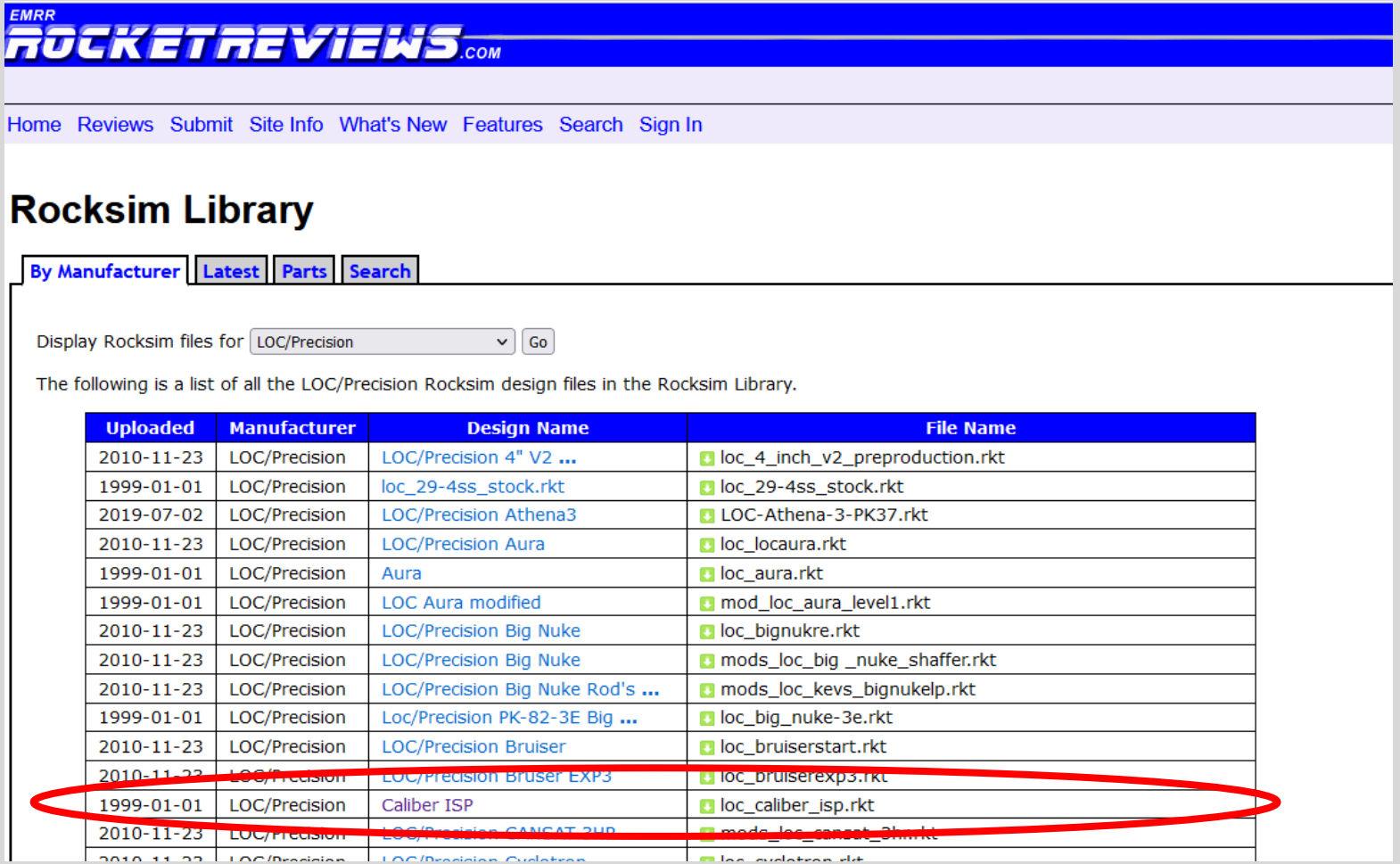


Figure 11-2: RockSim Folders

Rocketry 101 – RockSim Introduction

1. Download a pre-existing model of a LOC Precision-Caliber ISP kit
   a. https://www.rocketreviews.com/rocksim-library.html
   b. Sort by Manufacturer
   c. Display RockSim files for LOC/Precision
   d. Download Caliber ISP file



Uploaded	Manufacturer	Design Name	File Name
2010-11-23	LOC/Precision	LOC/Precision 4" V2 ...	loc_4_inch_v2_preproduction.rkt
1999-01-01	LOC/Precision	loc_29-4ss_stock.rkt	loc_29-4ss_stock.rkt
2019-07-02	LOC/Precision	LOC/Precision Athena3	LOC-Athena-3-PK37.rkt
2010-11-23	LOC/Precision	LOC/Precision Aura	loc_locaura.rkt
1999-01-01	LOC/Precision	Aura	loc_aura.rkt
1999-01-01	LOC/Precision	LOC Aura modified	mod_loc_aura_level1.rkt
2010-11-23	LOC/Precision	LOC/Precision Big Nuke	loc_bignukre.rkt
2010-11-23	LOC/Precision	LOC/Precision Big Nuke	mods_loc_big _nuke_shaffer.rkt
2010-11-23	LOC/Precision	LOC/Precision Big Nuke Rod's ...	mods_loc_kevs_bignukelp.rkt
1999-01-01	LOC/Precision	Loc/Precision PK-82-3E Big ...	loc_big_nuke-3e.rkt
2010-11-23	LOC/Precision	LOC/Precision Bruiser	loc_bruiserstart.rkt
2010-11-23	LOC/Precision	LOC/Precision Bruiser EXP3	loc_bruiserexp3.rkt
1999-01-01	LOC/Precision	Caliber ISP	loc_caliber_isp.rkt
2010-11-23	LOC/Precision	LOC/Precision CANSAT 2HP	mods_loc_cansat_2hp.rkt
2010-11-23	LOC/Precision	LOC/Precision Cyclotron	loc_cyclotron.rkt

Figure 11-3: Rocket Reviews RockSim Library, Caliber ISP

Rocketry 101 – RockSim Introduction

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

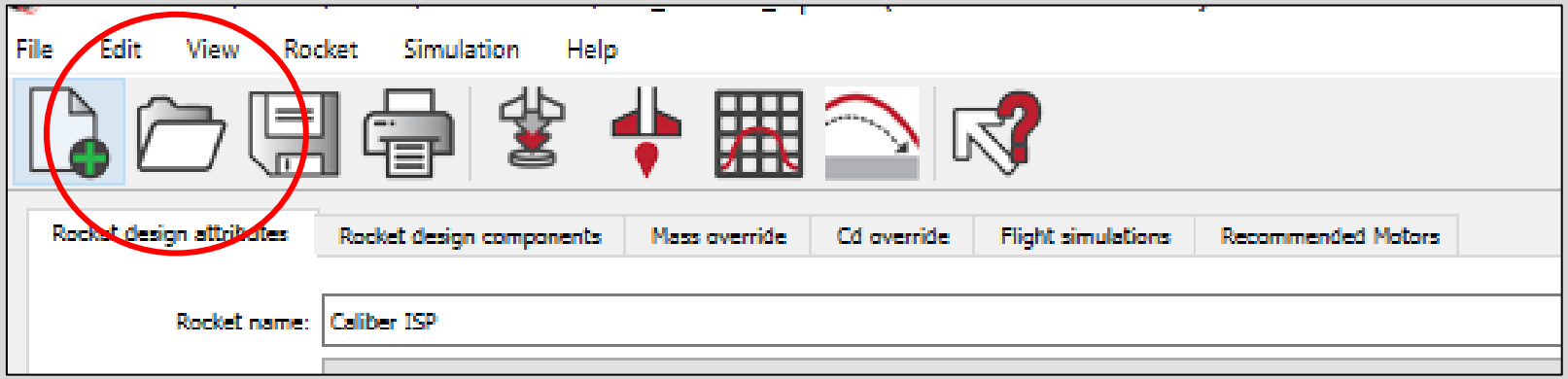


Figure 11-4: RockSim Import Folder

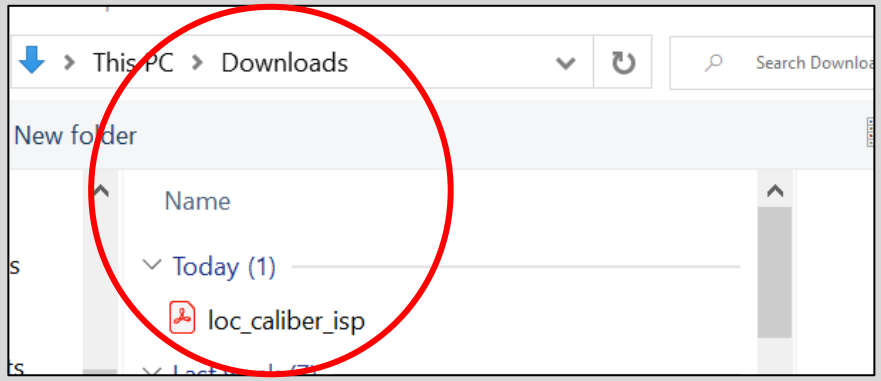


Figure 11-5: Select Rocket File from Download Folder on Computer

Rocketry 101 – RockSim Introduction

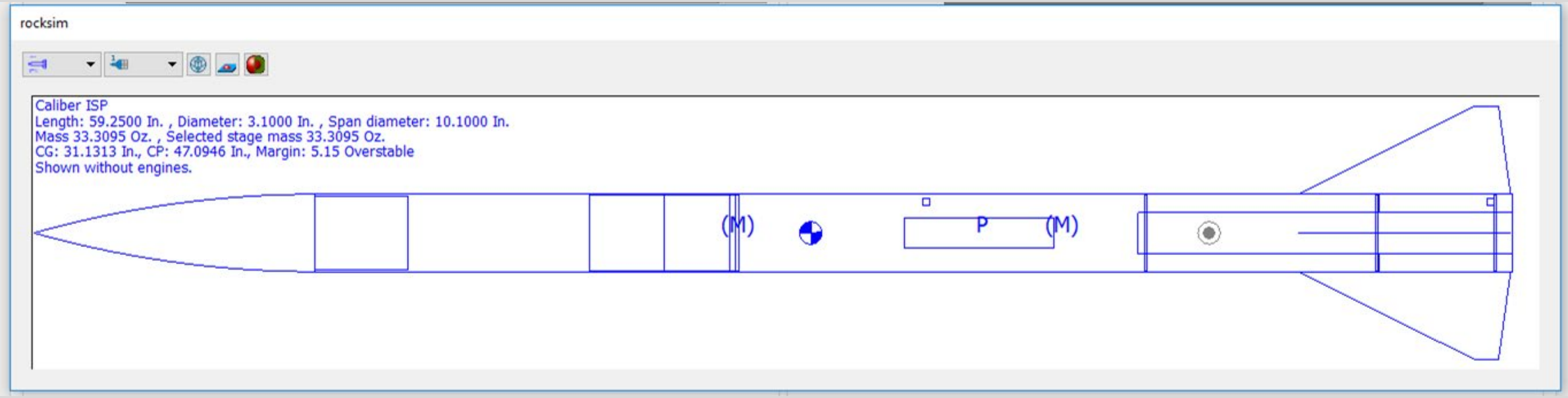


Figure 11-6: Caliber ISP Stock File

Rocket Build – Pre-Fit Check

Key to proper fit and adhesion is to **DRY-FIT** all rocket parts **BEFORE** applying any epoxy to parts.

Do not over-sand your parts, a snug fit is required.

Parts to dry-fit:

- Centering Rings
- Coupler and Bulkplate
- Motor Mount Tube (MMT)
- Airframe
- Fins
- Nosecone

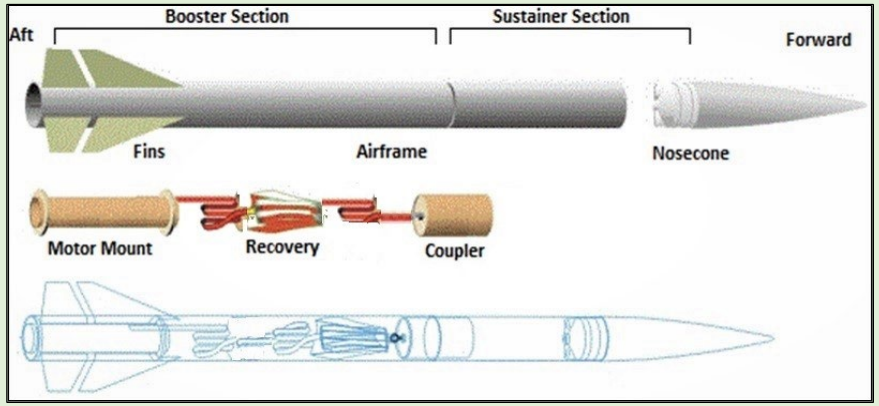


Figure 13-1: High-Power Rocket Diagram

Rocket Build – Pre-Fit Check
Centering Rings

1. Identify and label centering rings
    a. Add the word ‘forward’ to the ring with one (1) hole
    b. Add the word ‘mid’ to the ring with zero (0) holes
    c. Add the word ‘aft’ to the ring with two (2) holes
        - Add the word ‘out’ to one side of the Aft Centering Ring
        - Add the word ‘in’ to the other side of the Aft Centering Ring
2. Rough sand MMT just enough to remove glassine
3. Sand inside of centering rings so they fit into MMT
    a. May use a dremmel tool for sanding

Figure 13-2: Aligned Centering Rings

Rocket Build – Pre-Fit Check

Centering Rings

4. Install small eyebolt into the Forward centering ring
    a. Place one nut and small washer on the eyebolt side of the centering ring
    b. Place one small washer and one nut on the back end of the centering ring
    c. NOTE: (If you only have one washer, the washer should be placed on the back side of the bulkplate)

Figure 13-3: Forward Centering Ring with Eyebolt Installed

Rocket Build – Pre-Fit Check

Bulkplate

1. Install an eyebolt into the bulkplate
   a. Place one large washer and one nut on the eyebolt side of the centering ring
   b. Place one large washer and one nut on the back side of the bulkplate *(If you only have one washer, the washer should be placed on the back side of the bulkplate)*

Figure 13-5: Bulkplate and Eyebolt

Figure 13-6: Eyebolt Installed in Bulkplate

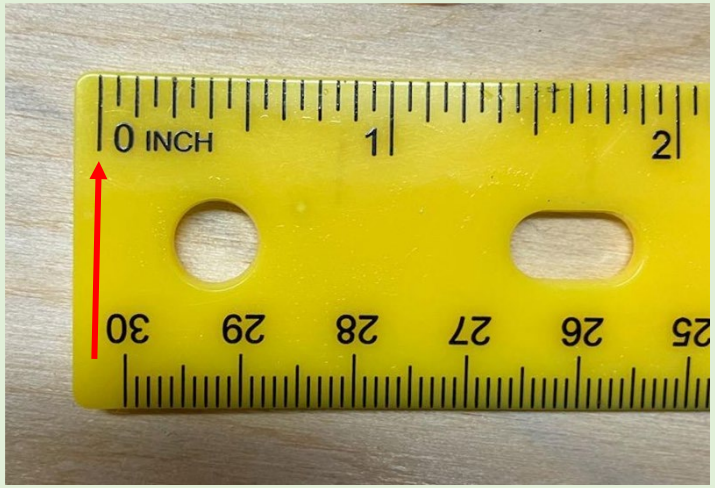
Rocket Build – Pre-Fit Check
Bulkplate

2. Dry-fit bulkplate into coupler tube (using eyebolt as handle)

3. Sand outside of bulkplate for proper fit

4. Place the **<u>Coupler Bulkplate</u>** 1/4” from end of the coupler
   - NOTE: When using a 12” ruler, make sure you start the measurement at 0” vs. the end of the ruler

Figure 13-7: Eyebolt installed in Bulkplate



Rocket Build – Pre-Fit Check

Centering Ring Alignment

5. Centering rings should fit on motor mount tube

6. Mark the forward end of motor mount tube at 1/8”-3/16” for forward centering ring placement

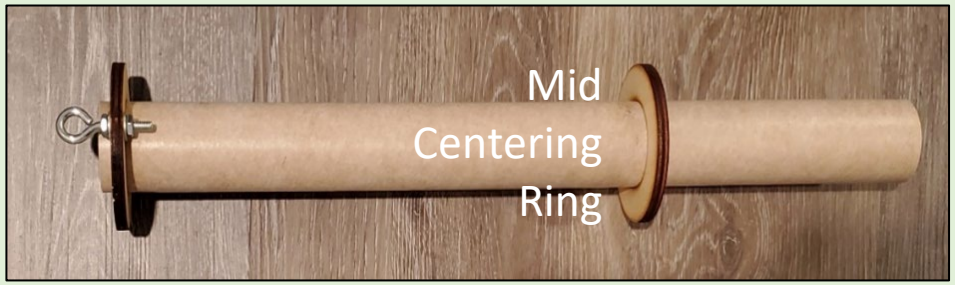


Figure 13-8: Centering Rings Fitted on Motor Mount Tube

Figure 13-9: Center Motor Mount Ring Distance from End of Motor Mount Tube

Rocket Build – Pre-Fit Check

Centering Ring Alignment

3. Measure distance from aft end of airframe to the forward fin slot for center motor mount ring placement

3. Draw line at same distance on motor mount tube for center motor mount ring placement. NOTE: Measure from aft end of motor mount tube

3. Mark the middle of motor mount tube at 5-1/4” from aft end for mid-centering ring placement

Figure 13-10: Center Motor Mount Ring Located above Fin Slot (Left); Measure the Length of the Fin Slot for Accuracy (Center); Draw a Line on the Motor Mount Tube around the Center Motor Mount Ring (Right)

Rocket Build – Pre-fit Check

Additional Steps: Airframe, Fins, Nose Cone

1. Rough sand around fin slots of airframe tube (for adhesion)

1. Fit fins into airframe tube slots – sand as needed to fit

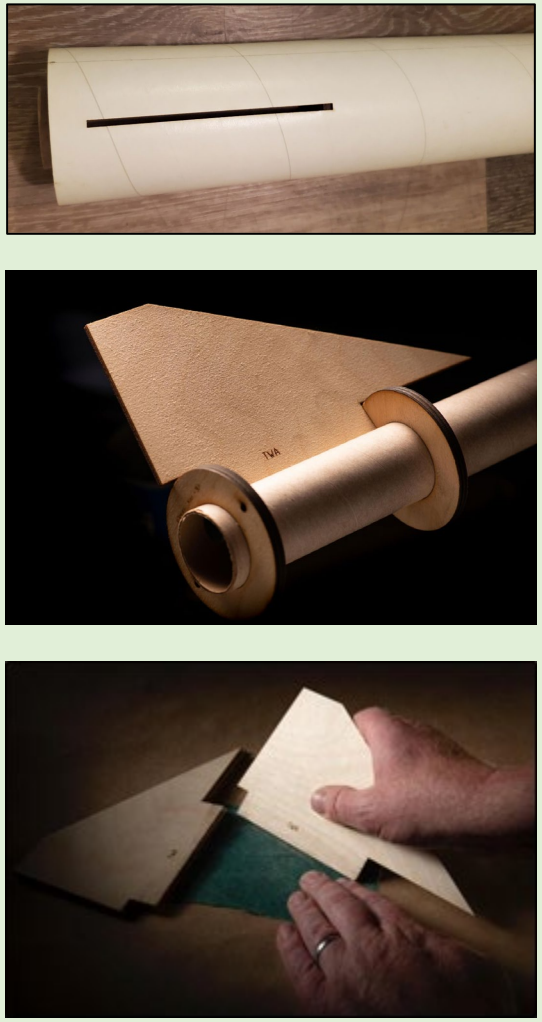


Figure 13-11: Fin Slot (Top); Relation to Motor Mount Tube and Mid/Aft Centering Rings (Center); Fin Sanding Technique (Bottom)

Rocket Build – Assembly

Epoxy Overview

- Normally a two-part chemical mixture
  - A resin
  - A hardener
  - Usually mixed in a 1:1 ratio
- Various Types Based on Material and Strength
  - Time, Strength
  - JB Weld – metallic bonding
  - Silica additive can be used for fin fillets
- Epoxy Usage
  - 5-minute epoxy sets quickly
  - Mix quarter-size amount of resin/hardener - no more

Figure 13-12: Epoxy Resin and Hardener

Rocket Build – Assembly

Epoxy Overview

- Epoxy Fillets
  - Creates a strong bond between two surfaces
  - Applied with a craft stick in single smooth line to create a valley between two surfaces
- Safety
  - Always wear gloves prior to mixing and applying epoxy
  - Work quickly and with small amounts of epoxy at each step
  - If you get epoxy on skin or unwanted surfaces, use rubbing alcohol to remove residue

Learn more about epoxy:
https://www.apogeerockets.com/education/downloads/Newsletter186.pdf

Or see the NASA Handbook for construction tips

Figure 13-13: Epoxy Application

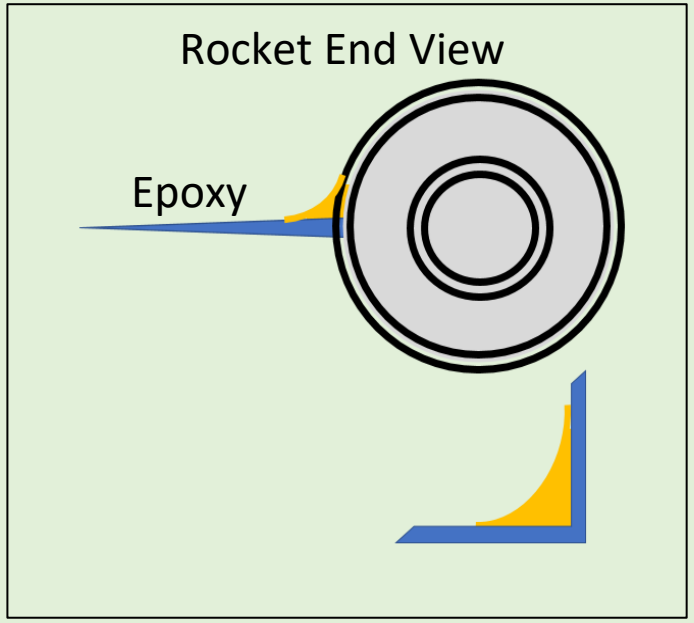


Figure 13-14: Epoxy Fillets

Rocket Build – Assembly

Motor Mount Assembly – Mid Centering Ring

1. Dry-fit Step: Fit the **mid-centering ring** at the measurement marked in previous steps

    a. Slide ring down below lines

    a. Put on gloves before preparing epoxy

    a. Prepare small amount of epoxy 1:1 ratio
        i. Open new bottles
        ii. Remove nozzle
        iii. Remove internal cap from the bottle
        iv. Replace the nozzle

    a. Apply epoxy to the motor tube on the lines drawn for mid-centering ring

    a. Slide the mid-centering ring just ahead of the forward fin slot on the marked line, using twisting motion

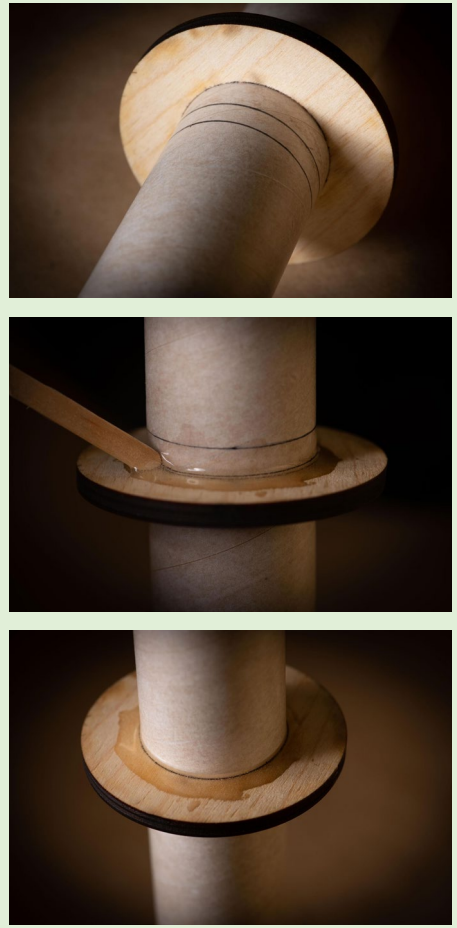


Figure 13-15: Motor Mount Placement with Line (Top); Applying Epoxy to the Mid-Centering Ring (Center); Completed Mid-Centering Ring (Bottom)

Rocket Build – Assembly

Motor Mount Assembly – Forward Centering Ring

2. Dry-fit Step: Fit the **forward centering ring** at the measurement marked in previous step

Figure 13-16: Motor Mount Assembly

   a. Slide ring down below lines

   a. Put on gloves before preparing epoxy

   a. Prepare small amount of epoxy 1:1 ratio

   a. Apply epoxy to the motor tube on the lines drawn for forward centering ring

   a. Slide the forward centering ring to the marked line(s), using twisting motion

Rocket Build – Assembly

Motor Mount Assembly

3. Apply fillet on **aft** side of **forward centering ring**

3. Apply small dabs of epoxy to eyebolt threads

    - Do not get epoxy on the outside of the motor mount tube

Figure 13-16: Epoxy Eyebolt Thread

3. Set motor mount assembly aside, allow epoxy to dry

Rocket Build – Assembly

Coupler Assembly

1. Dry-fit Step: Fit bulkplate inside coupler, ensuring level fit ~1/4” from the edge
1. Remove bulkplate after ensuring fit
1. Put on gloves before preparing epoxy
1. Prepare small amount of epoxy
1. Dab the threads and nut of eyebolt with epoxy

Figure 13-17: Bulkplate Installed in Coupler

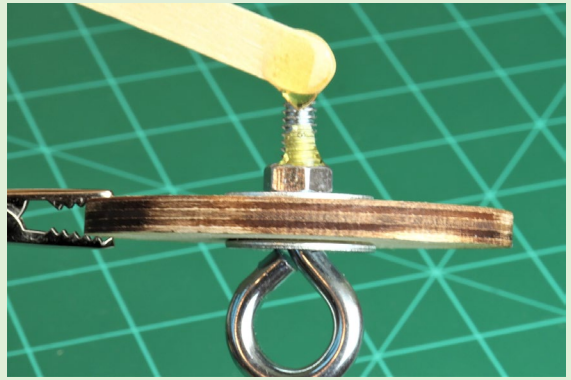


***Figure 13-17**: Dabbing epoxy on threads and nut of eyebolt*

Rocket Build – Assembly

Coupler Assembly

6. Apply epoxy around inside coupler ~ ¼” from the end
7. Twist the bulkplate into the coupler leaving ¼” gap from the edge of the coupler, brace the coupler to avoid bulkplate shifting
8. Hold in place few a few minutes to allow epoxy to start setting
9. Set coupler assembly aside, allow epoxy to dry
10. Add fillet of epoxy to edges of bulkplate

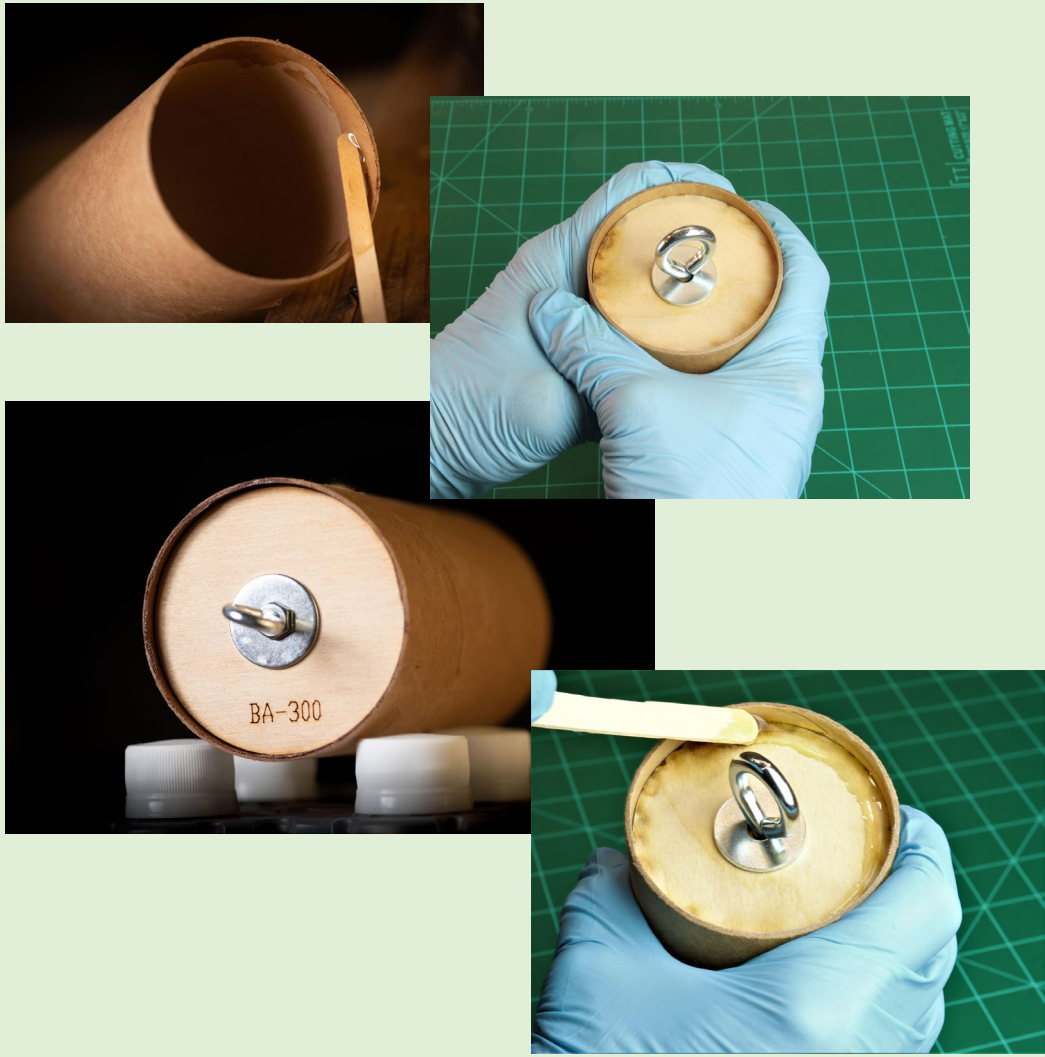


Figure 13-17: Applying Epoxy around Inside of Coupler (Top); Bulkplate Installed in Coupler (Bottom)

FRIDAY NIGHT BREAK

Remember…to be early is to be on time and to be on time is to be late. Saturday's presentation is being condensed by 3 hours. We will start exactly at 10:00 am CST.

We have lots to cover in a short period of time!

SATURDAY MORNING

Welcome Back!!!
Make sure your workstation is ready to go…table covered, handbook open, pen/pencil ready, gloves available, camera on, sound ready, water and snack nearby.

This session will be recorded

Workshop Day 1 - Morning Review

1. What are the two professional rocketry associations?
2. What are the two types of flight profiles?
3. Name the 6 phases of the single deploy flight profile.
4. What is the difference between single and dual deploy?
5. Who is the manufacturer of the kit?
6. Where is the mid centering located on the motor mount tube?
7. What is the purpose of sanding all of the rocket components?

Rocketry 101 - Propulsion Overview

Qualifying definitions for High Powered Rockets:

- A motor using an engine with more than 160 Newton-seconds of total impulse (and 'H' motor or larger) or motors that all together exceed 320 Newton-seconds; or
- Uses a motor with more than 80 Newtons average thrust (see rocket motor coding); or
- Exceeds 125 grams of propellant; or
- Weighs more than 1,500 grams including motor(s); or
- Includes any airframe parts of ductile metal

HPR motors cannot be purchased over the counter

- Must be certified either by NAR or TRA to the appropriate level to purchase motor
- FNL teams - Approved Rocketry Mentor can purchase motor for local launch
- CRL teams - Frank Nobile will purchase certification motors

Impulse Class		Category
H	160.01Ns to 320.01Ns	Level 1
I	320.01Ns to 640.00Ns	
J	640.01Ns to 1280.00Ns	Level 2
K	1280.01Ns to 2560.00Ns	
L	2560.01Ns to 5120.00Ns	
M	5120.01Ns to 10240.00Ns	Level 3
N	10240.01Ns to 20480.00Ns	
O	20480.00Ns to 40960.00Ns	

Table 6-1: HPR Motor Impulse Class and Category

Handbook Reference: *6a. Propulsion Systems – HPR Definition and Classifications, pg 22*

Rocketry 101 – Propulsion Overview

Figure 6-1: Motor Kit Example

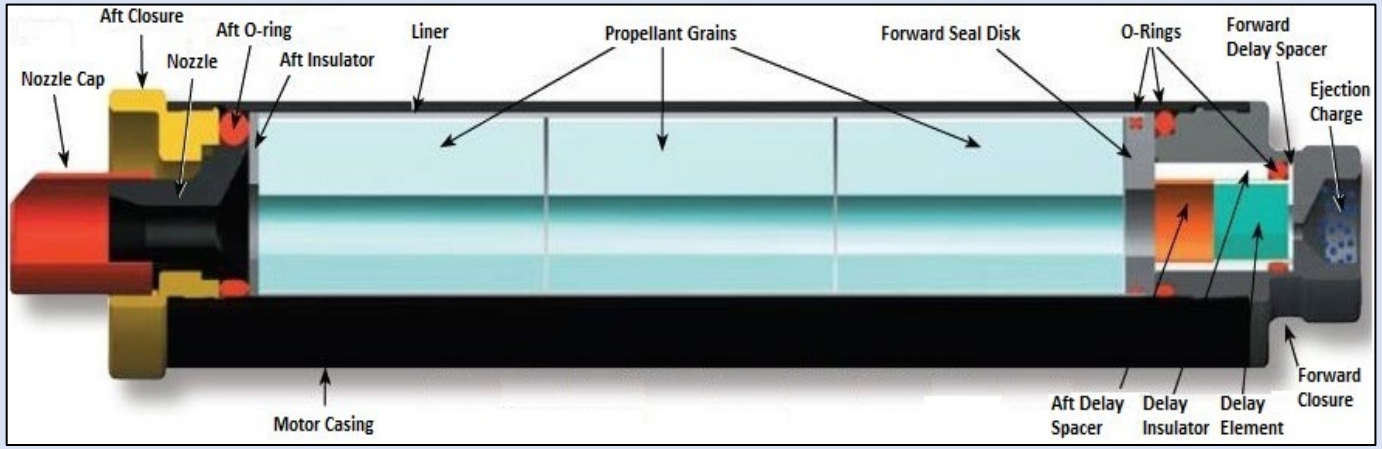


Figure 6-3: Cutaway Drawing of Typical Assembled RMS-Plus Motor

Figure 6-6: Motor assembly and example of burn

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

Handbook Reference: *6b-c. Commercial Motors/E-Matches/Motor Ignitor, pg 23-24*

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

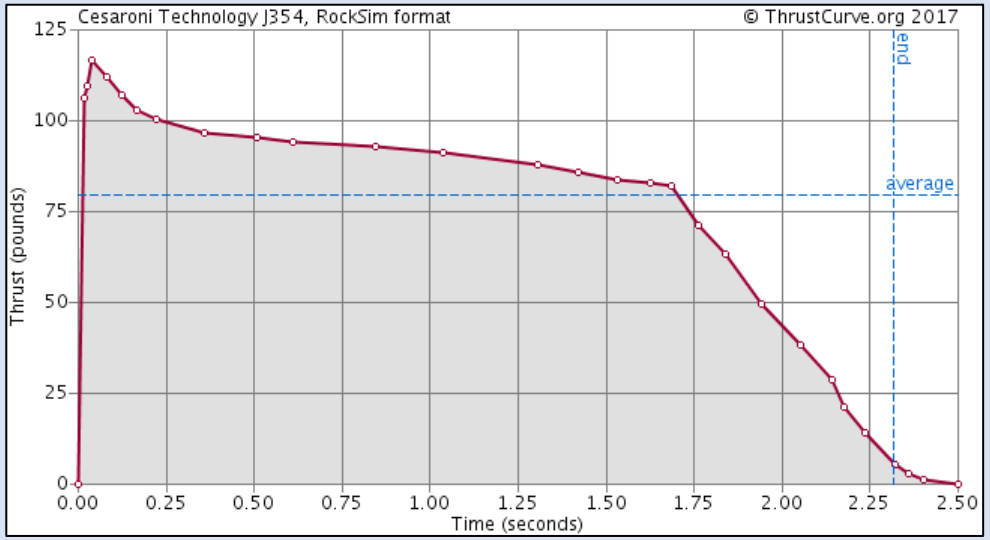


Figure 6-5: Thrust Curve Example

Rocket Build – Assembly

Coupler/Sustainer

1. Dry-fit coupler to upper airframe (sustainer)
2. Draw a line/mark around the center of the coupler
   - ~Approximately 3” on this kit
3. Put on gloves before preparing epoxy
4. Prepare small amount of epoxy

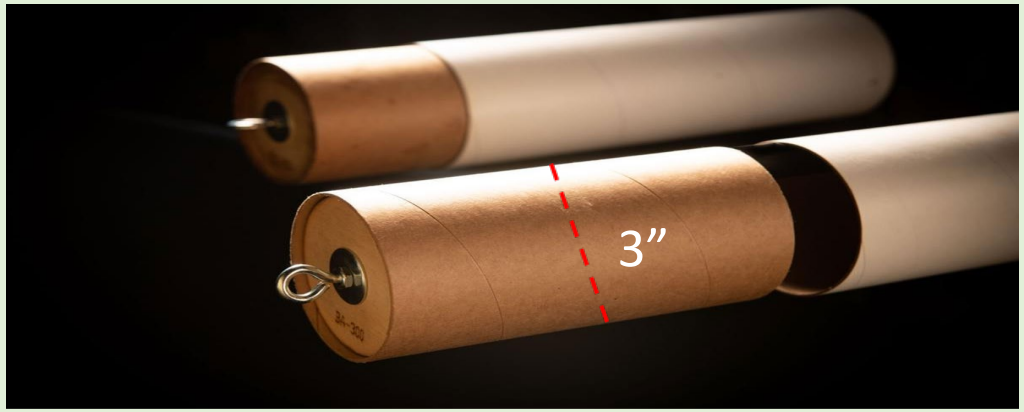


Figure 13-18: Example of Where to Draw Line on Coupler

Rocket Build – Assembly

Coupler/Sustainer

5. Apply epoxy around inside of the sustainer (about 1” from edge)
6. Place coupler into sustainer section aligning aft section of the sustainer with the center line drawn on the coupler
7. Use a twisting motion, to evenly distribute the epoxy
8. Clean off excess epoxy on exposed section of coupler
9. Set aside, let epoxy dry

Figure 13-18: Epoxy Application (Top));Coupler Placement (Bottom)

Rocket Build – Assembly

Motor Mount

1. Attach the shock cord to the forward centering ring eyebolt using a quicklink in the shock cord loop and the eyebolt
   a. A double slip square knot can be used if a loop is not on the shock cord OR if you do not have 2-3 quicklinks
      i. Attach shock cord by feeding the cord through the eyebolt
      ii. Feed the opposite end of the shock cord through the sewn loop
      iii. Pull shock cord tight

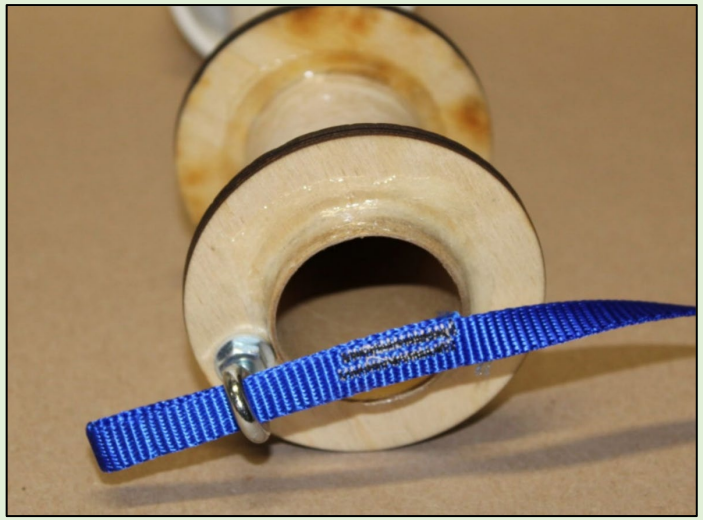
NOTE: Step by step information on how to do this knot can be found on the next slide

Figure 13-19: Shock Cord and Quicklink

Rocket Build – Assembly

Motor Mount Knot Overview – Shock Cord

[Slip Knots for Beginners!]



1. Attach shock cord by feeding the cord through the eyebolt

2. Feed the opposite end of the shock cord through the sewn loop

3. Pull shock cord tight

Rocket Build – Assembly

Motor Mount

2. Re-coil shock cord, securing with masking tape when done

3. Leave enough length on the eyebolt end of the shock cord such that it will come out the end of the forward opening on the air frame

Figure 13-20: Shock Cord Attached to Eyebolt

Rocket Build – Assembly

Motor Mount

4. Stuff the bundle of cord inside the motor mount tube

Figure 13-21: Shock Cord Installed Inside Motor Mount Tube Using Eyebolt (Left) and Quicklink and Eyebolt (Right)

Rocket Build – Assembly

Motor Mount

5. Dry-Fit Step: Make sure motor mount tube fits into air frame properly, sand outer edge of centering rings as needed

    a. Avoid making burrs on the inner edge of the airframe

    a. If a burr occurs, gently sand the inner edge of the airframe

6. Slide motor mount tube into air frame forward the mid-centering location

7. Remove MMT after ensuring proper fit

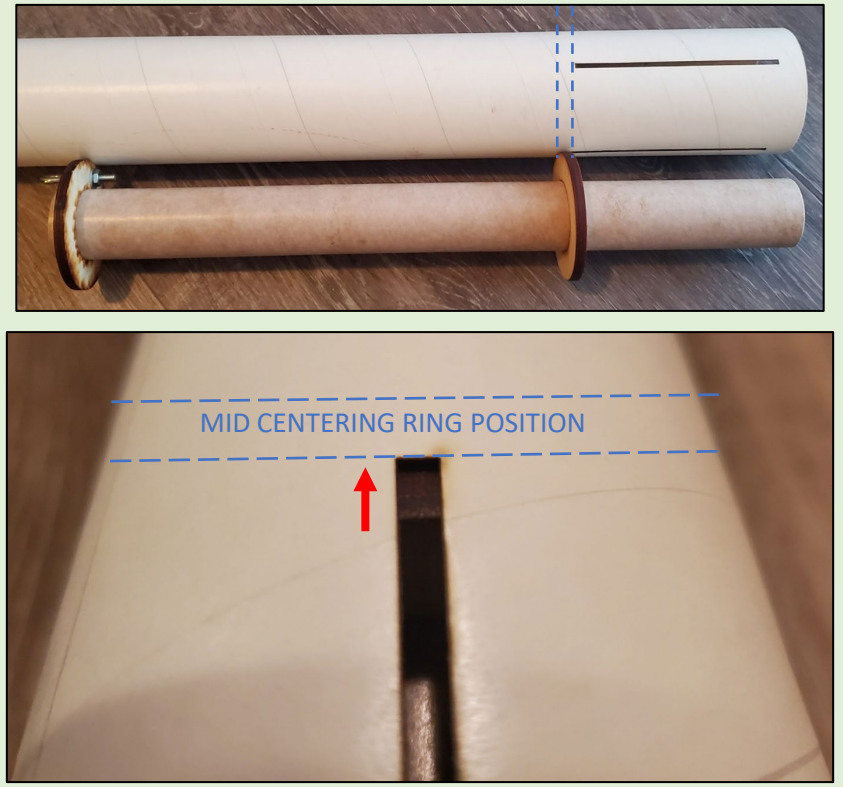


Figure 13-22: Relative Position of MMT Assembly Once Installed in Airframe (Top); Mid Centering Ring Should Sit Forward of Fin Slots (Bottom)

Rocket Build – Assembly

Motor Mount

8. Tape craft stick to the dowel rod - wrap 4-5 times minimum
9. Measure the distance from the top of the MMT to the forward centering ring using the craft stick/dowel rod
    - Make a mark on the dowel rod to indicate distance from aft end of the airframe to the forward centering ring
10. Put on gloves before preparing epoxy
11. Prepare small amount of epoxy

Rocket Build – Assembly

Motor Mount

12. Epoxy inside parameter of the aft air frame about a ¼” before the forward center ring location using craft stick taped onto dowel rod
13. Slide the motor mount tube into position
    - The Mid-Centering Ring must be just forward of the forward fin slot. If the mid-centering ring does not clear the slot, fins may not fit into the slots properly
    - The Motor Mount Tube should be flush with the aft side of the air frame
14. Stand airframe up with AFT down. Allow epoxy to dry

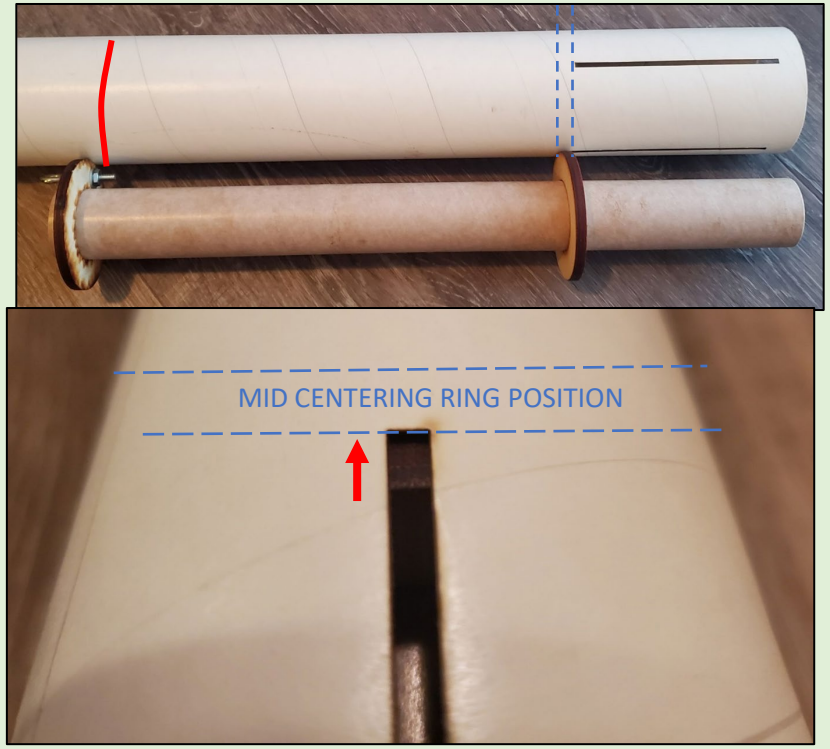


Figure 13-22: Relative Position of MMT Assembly Once Installed in Airframe (Top); Mid Centering Ring Should Sit Forward of Fin Slots (Bottom)

Rocketry 101 - RockSim Motors

Motor – Aerotech 38mm H219T - DMS/ H100W -DMS

- 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: *6d. Thrust to Weight Ratio, pg 24, 11b. Selecting an Engine, pg 47*

Rocketry 101 - RockSim Motors

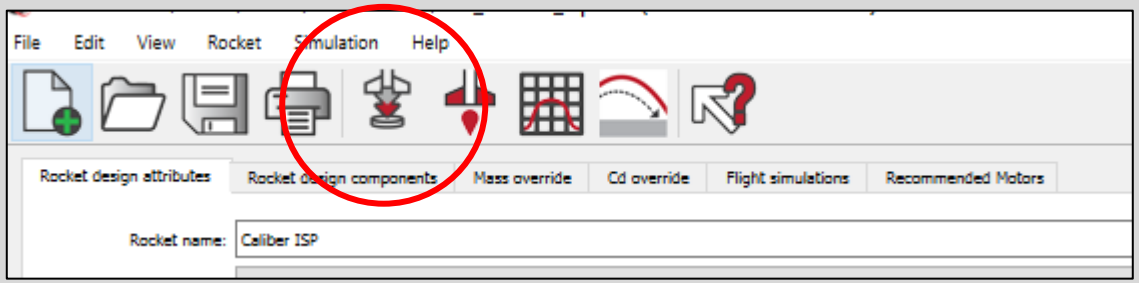


Figure 11-7: Prepare for Launch Icon

1. Select the ‘Prepare for Launch’ icon

1. Select the ‘Choose Engine’ tab

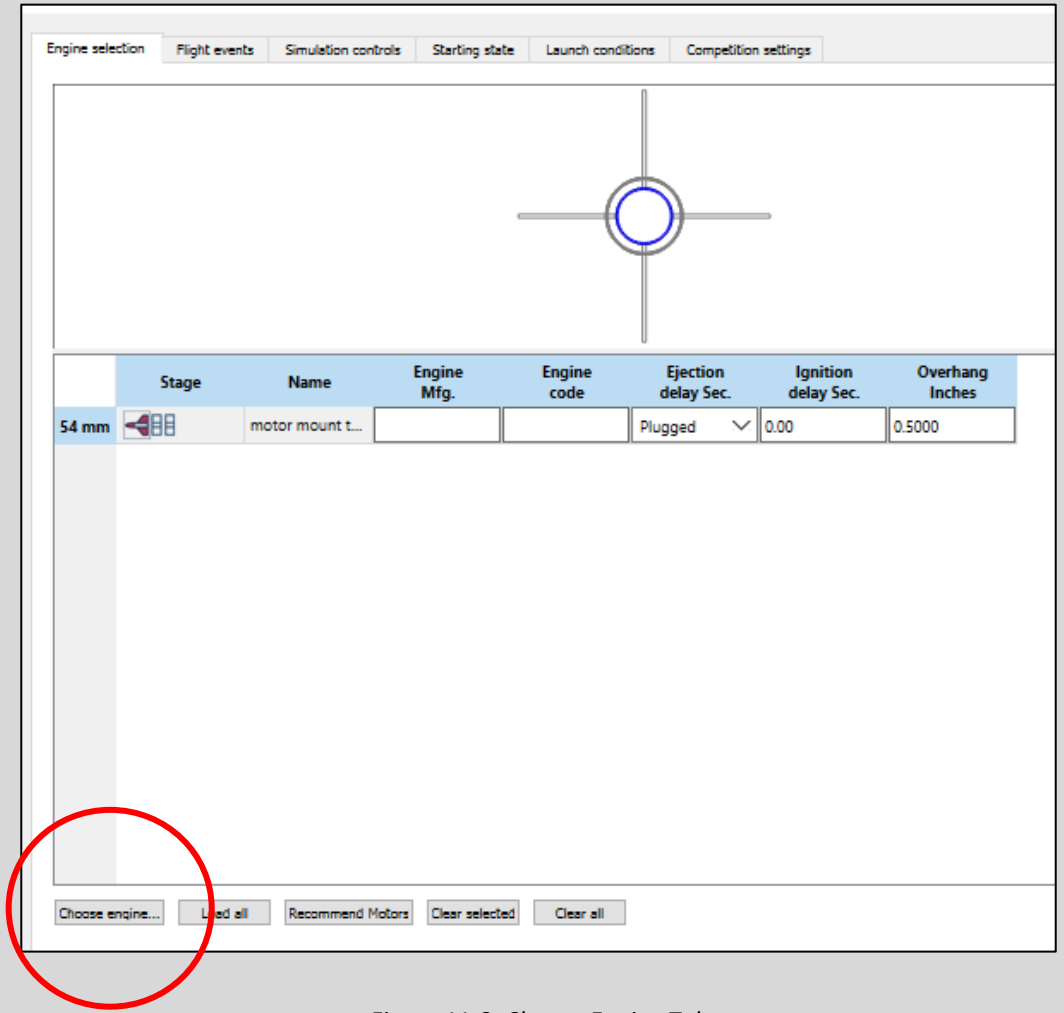


Figure 11-8: Choose Engine Tab

Rocketry 101 - RockSim Motors

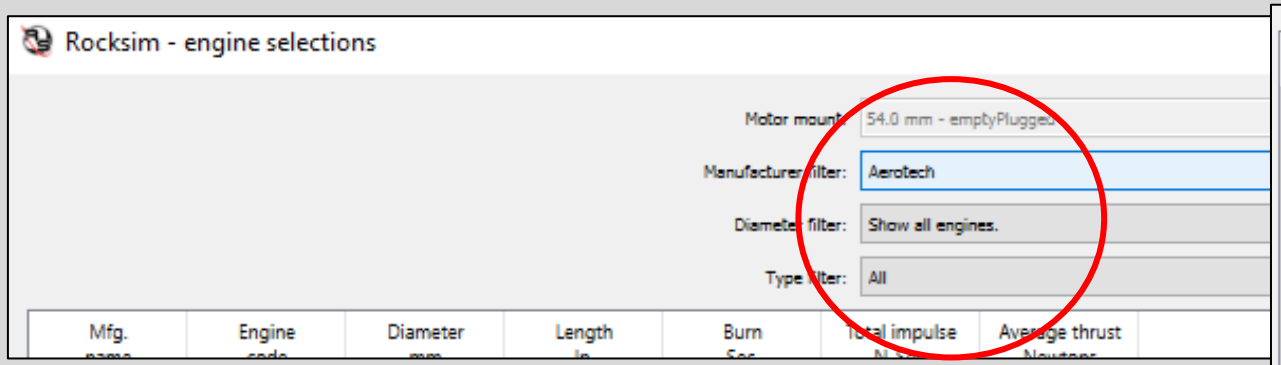


Figure 11-9: Manufacturer Field and Diameter Filter

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.	Average thrust Newtons
Aerotech	M1780NT	75.00	26.1811	3.04	5341.079	1759.828
Aerotech	M1800FJ	98.00	29.5669	4.95	8212.700	1658.461
Aerotech	M1845NT	98.00	23.5039	4.73	8093.458	1711.452
Aerotech	M4500ST	98.00	23.5039	1.69	7307.365	4321.328
AT	M6000ST	98.00	29.5669	1.74	9606.003	5533.412
Aerotech	N1000W	98.00	41.1811	16.14	14138.407	876.235
Aerotech	N2000W	98.00	41.1811	7.68	13263.435	1727.235
Aerotech	N3300R	98.00	41.7323	4.52	14035.152	3105.809
Aerotech	N4800T	98.00	47.2835	5.21	19273.861	3702.240
Aerotech	O5280X	98.00	59.0157	4.52	22223.946	4920.068
Aerotech	H283ST	38.00	6.1024	0.74	199.083	269.031
Aerotech	I175WS	38.00	8.4252	1.97	333.196	169.135
Aerotech	G80T	29.00	4.8819	1.50	116.252	77.501
Aerotech	D22W	24.00	3.4252	1.01	19.243	19.053
Aerotech	E26W	24.00	3.4646	1.22	27.619	22.583
Aerotech	F52C	29.00	4.3701	1.33	66.311	49.895
Aerotech	G125T	29.00	6.1417	12.60	145.847	11.574
Aerotech	H135T	29.00	8.3858	15.43	214.935	13.928
Aerotech	G83T	29.00	6.1417	19.96	129.868	6.505
Aerotech	K400C	54.00	14.1339	3.26	1307.257	401.122
Aerotech	H219T	38.00	6.1024	1.08	234.561	216.985
Aerotech	F52C	29.00	4.3701	1.33	66.311	49.895
Aerotech	I130-300CC0983	54.00	20.5118	4.00	477.075	119.269

Figure 11-10: Aerotech H219T Motor Selection

Rocketry 101 - RockSim Motors

The Aerotech H219T/H100W will automatically load into the RockSim software

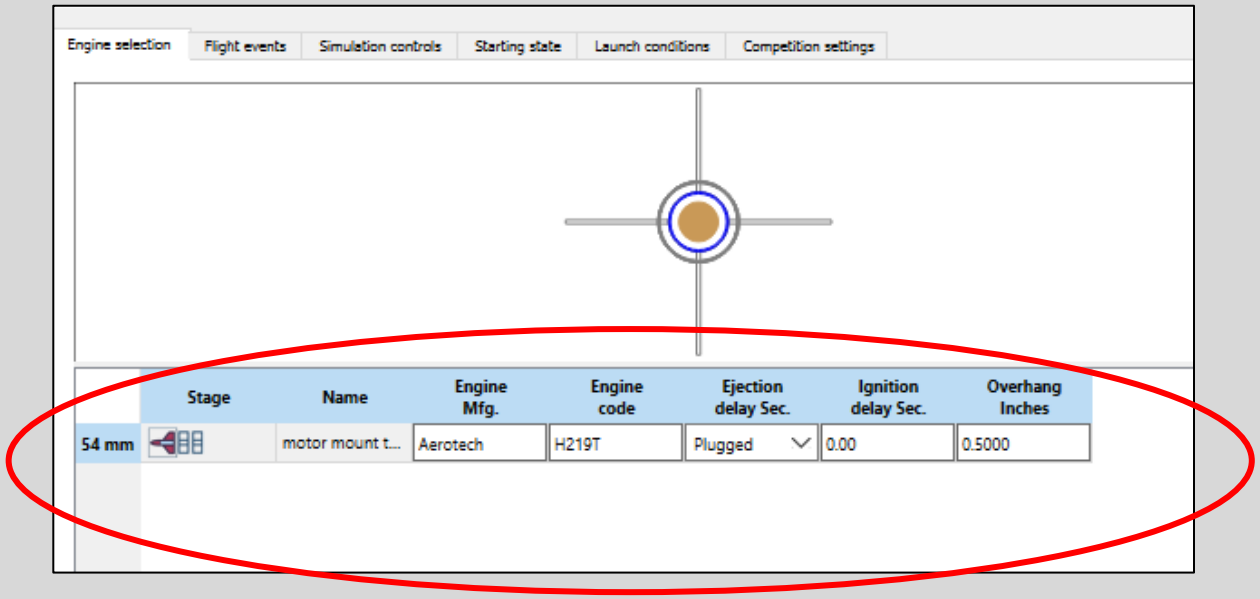


Figure 11-11: Motor Uploaded to RockSim

Rocket Build – Assembly

Nose Cone

1. Fit the nose cone to the sustainer
   a. Should not require sanding
2. Drill a single hole at location shown, through both airframe and nose cone with an awl or ⅛” drill bit
3. Attach the nose cone to the airframe with a #4 wood screw (pointed screw) to keep the nose cone from separating in flight (but allow for removal of nose cone)

Figure 13-23: Drilling the Airframe and Nose Cone (Left); Figure 13-24: Nose Cone Fitted on Sustainer, Red Dot Indicates Drill Mark

Rocket Build – Assembly

Rail Button Alignment

Rail Guide System

- 1010 rail guide (it's a 1.0" x 1.0" rail)
- 6' (or 72 inches) in length

Figure 5-6: Rail Guide

Handbook Reference: *5h. Rail Buttons p. 20, 13b.vii. Assembly – Rail Button Alignment, pg 19, 63*

Frank

Rocket Build – Assembly

Rail Button Alignment

1. Temporarily position a 4”- 5” length of tape between the fin slots. Place a mark on tape, just inside of both fin slots.
2. Remove the masking tape
3. Fold masking tape in half on non-stick side, matching the two fin slot reference marks
4. Make a crease at the middle location

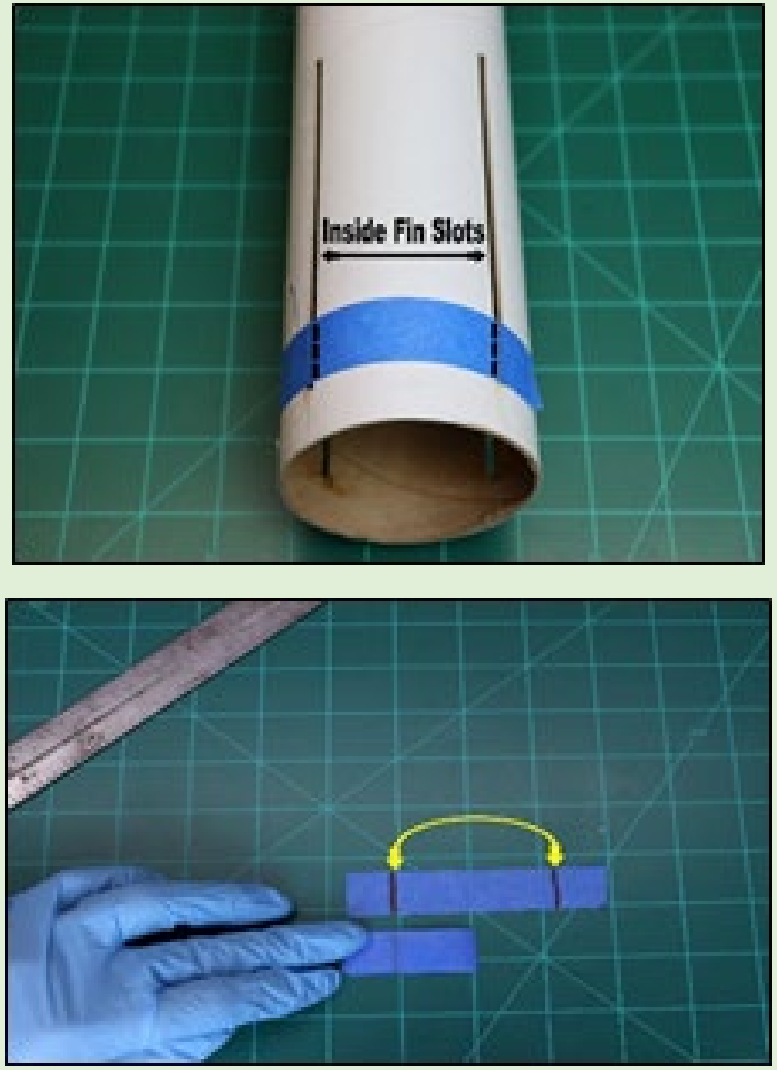


Figure 13-25: Measuring Fin Slots (Top); Measuring Half Way between Two Fin Slots (Bottom)

Rocket Build – Assembly

Rail Button Alignment

5. Place the strip of masking tape back on the airframe matching lines to the fin slots
6. Mark the center point at the crease line, making a line half way between the two fin slots on the aft portion of the booster section

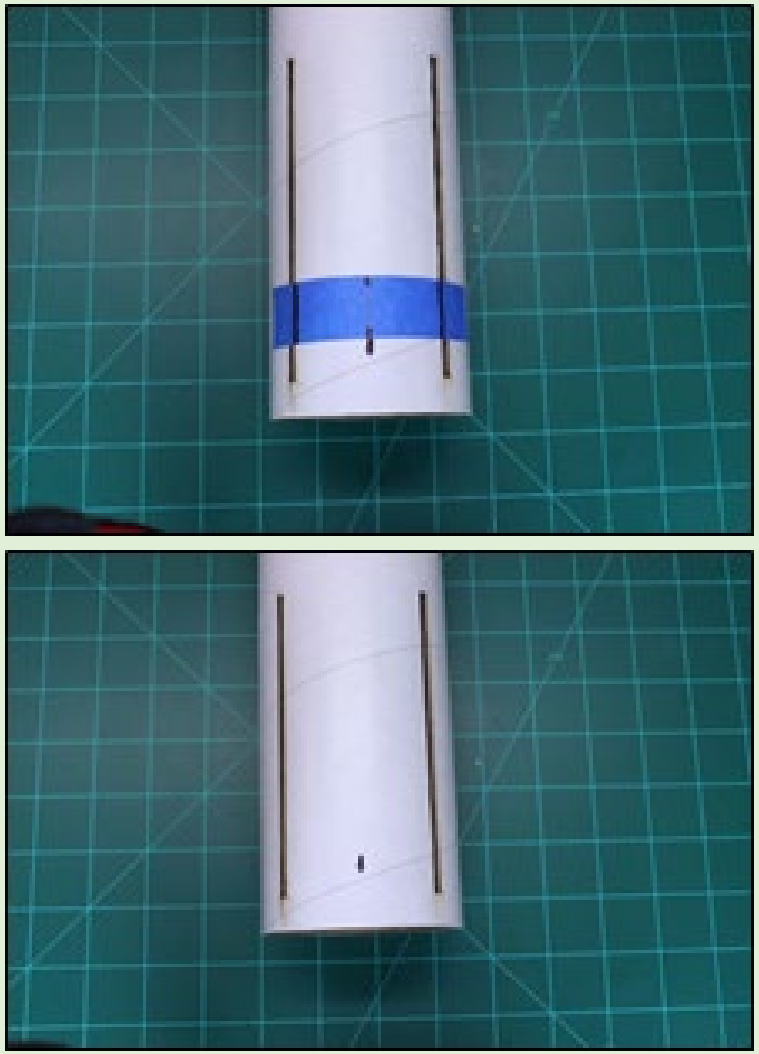


Figure 13-25: Drawing a Line at the Half Way Mark on Tape(Top); Drawing the Half Way Mark on the Air Frame (Bottom)

Rocket Build – Assembly

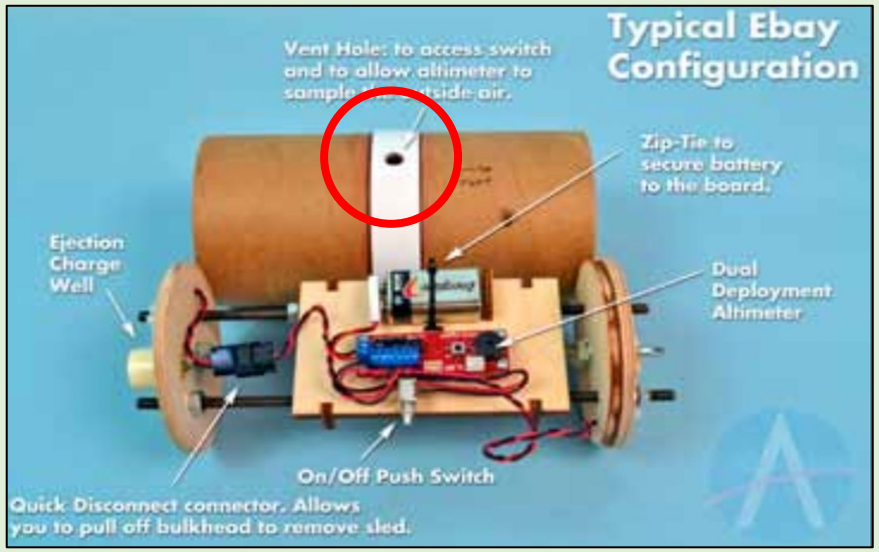
Rail Button Alignment

7. Draw a line halfway up the air frame
   a. Use door frame, window frame or table/counter edge to draw line
8. This is the line the rail buttons will be installed on after the fins have been installed

Figure 13-25: Markers to Indicate Rail Button Placement/Alignment (Bottom)

Rocket Build – Assembly
Vent Holes

- Vent (pressure relief) holes allow the pressure inside the rocket to equalize to the external atmosphere.
- Usually 1/8”-1/4” in diameter



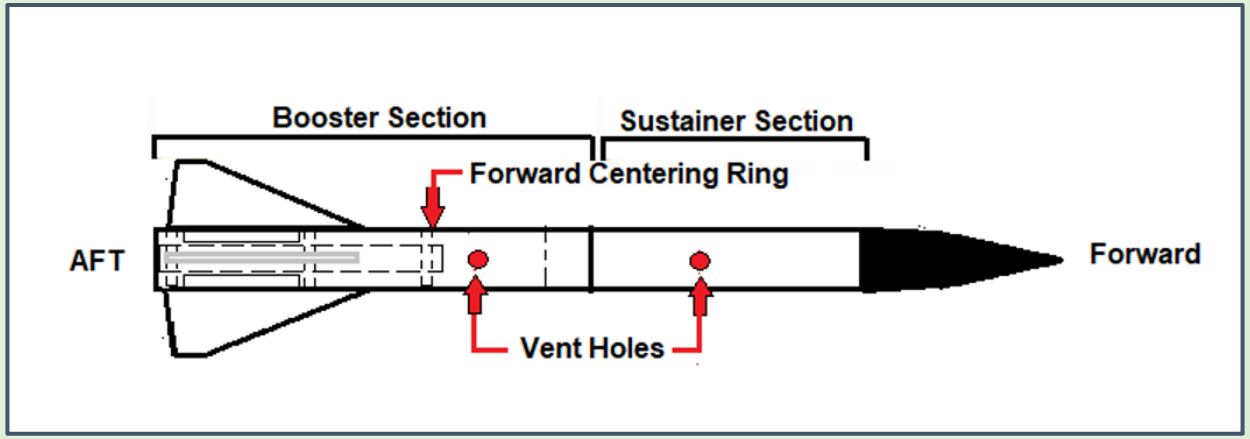


Figure 13-27: Vent Holes Indicated in Red on Rocket Airframe

Rocket Build – Assembly
Vent Holes

1. Drill first hole with an awl or ⅛” drill bit in the middle region of the sustainer

2. Drill second hole with an awl or ⅛” drill bit in the booster region above the motor mount tube/fins

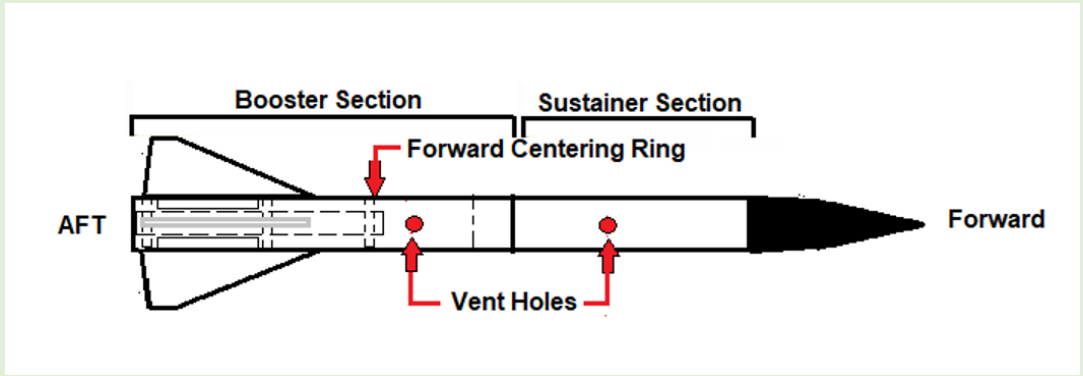


Figure 13-27: Vent Holes Indicated in Red on Rocket Airframe

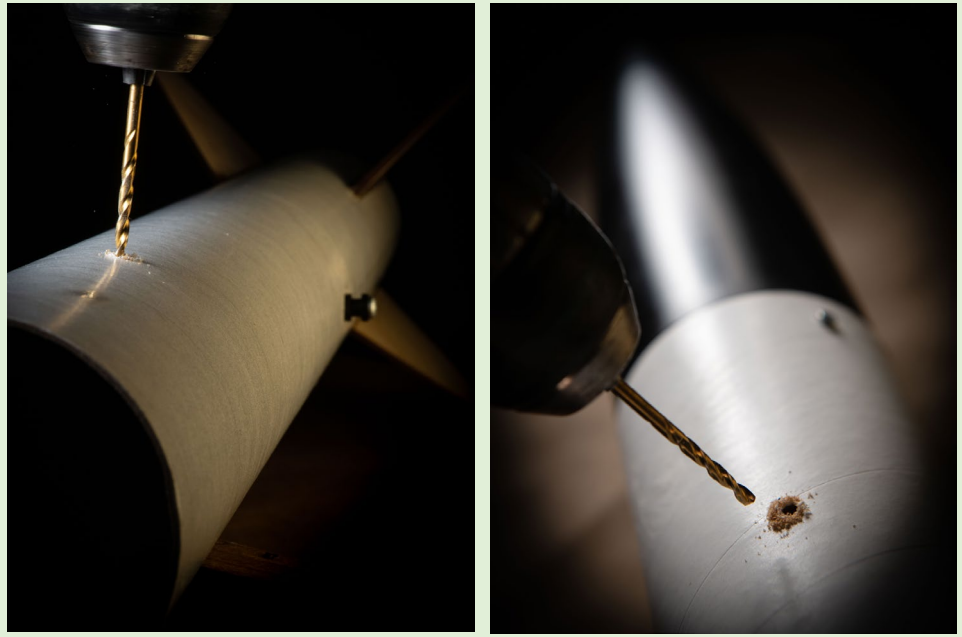


Figure 13-28: Drilling Vent Hole in Booster Section to Not Interfere with Rail Buttons Alignment (Left); Drilling Vent Hole in Sustainer Section (Right)

LUNCH BREAK

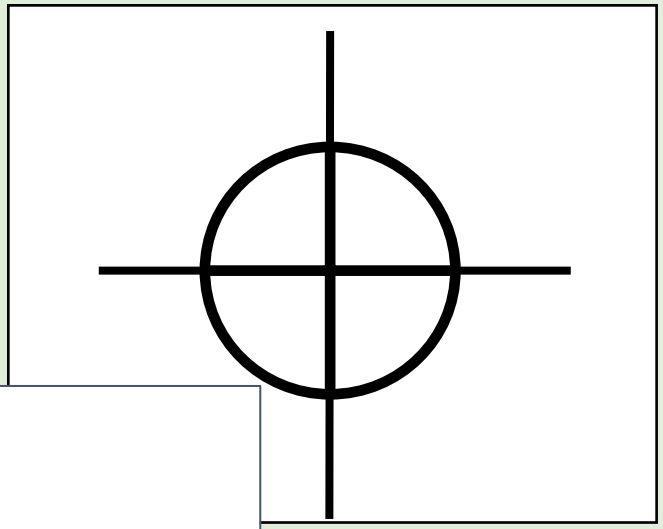
Remember…to be early is to be on time and to be on time is to be late. Saturday's presentation is being condensed by 3 hours. We have lots to cover in a short period of time!

Workshop Morning - Review

1. Name the parts of the rocket.
2. Where should the mid centering ring be installed inside the airframe?
3. What makes up the aft portion of the rocket?
4. What is the minimum thrust to weight ratio required?

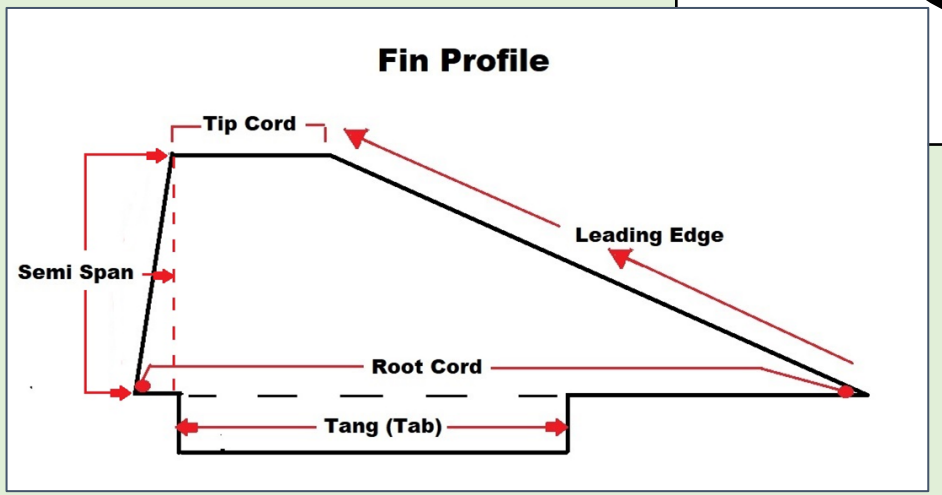
Rocket Build – Assembly

Fin Installation



Dry-fit and Tack

1. Dry-fit fins into slots
2. Retrieve fin installation guide from binder, and place guide on floor
3. Set air frame on the center circle on the guide
4. Align each fin to the crosshair lines
5. Remove fin and sand to ensure fin when inserted flush to motor mount
6. Remove fins before preparing epoxy



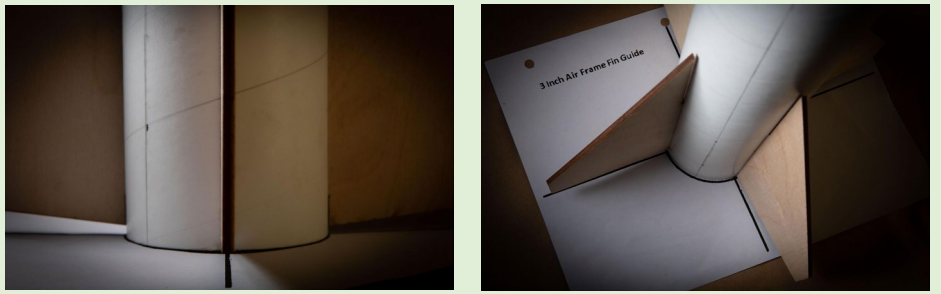
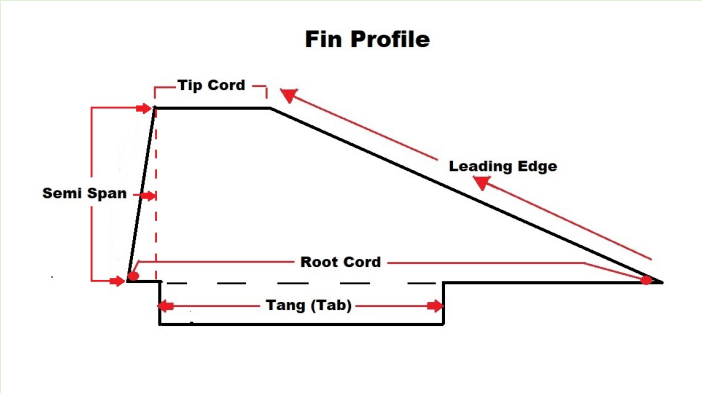


Figure 13-29: Align Each Fin to Crosshair Lines

Rocket Build – Assembly

Fin Installation



7. Put on gloves before preparing epoxy
8. Prepare small amount of epoxy
9. Apply epoxy to “Tang” side of fin #1 (light tack)
10. The span (b) is placed at the aft end of the airframe
11. Insert fin into fin slot – repeat for each fin
    a. Ensure the tang touches the motor mount tube

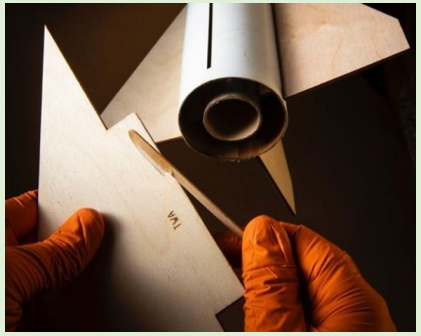


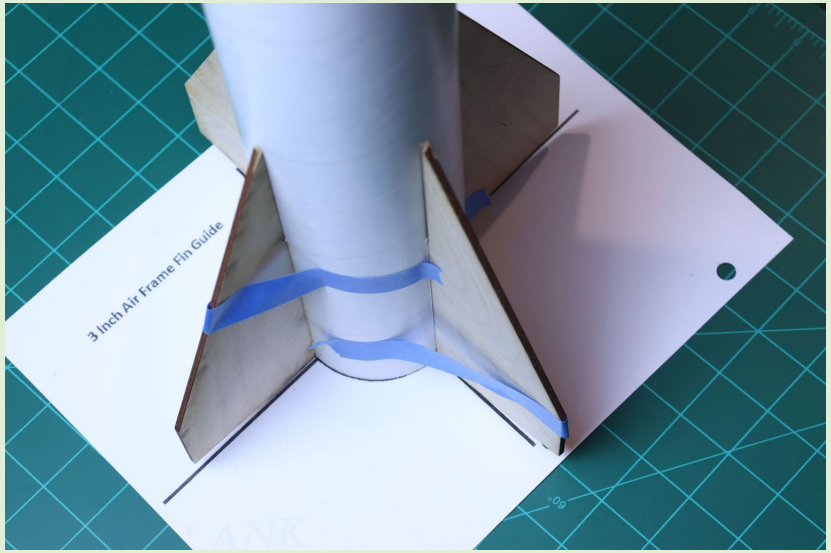
Figure 13-30: Tang Example (Top); Apply Epoxy to Tang (Center); Insert Tang in Fin Slot (Bottom)

Rocket Build – Assembly

Fin Installation

12. Place assembly on fin installation guide, and align fins - tape fins to the airframe as needed

13. **Do these steps quickly to get all fins tacked/aligned before the first fin cures - approximately 3-5 minutes from when epoxy mixed**



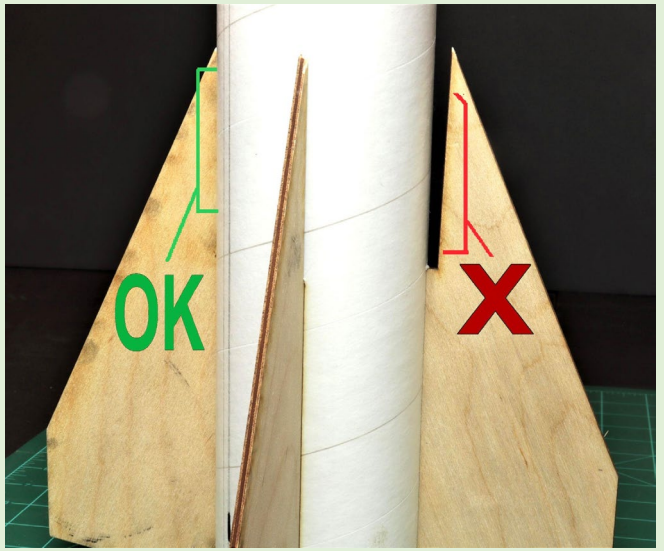


Figure 13-30: Figure 13-30: Tang Example (Top); Apply Epoxy to Tang (Center); Insert Tang in Fin Slot (Bottom)

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!)

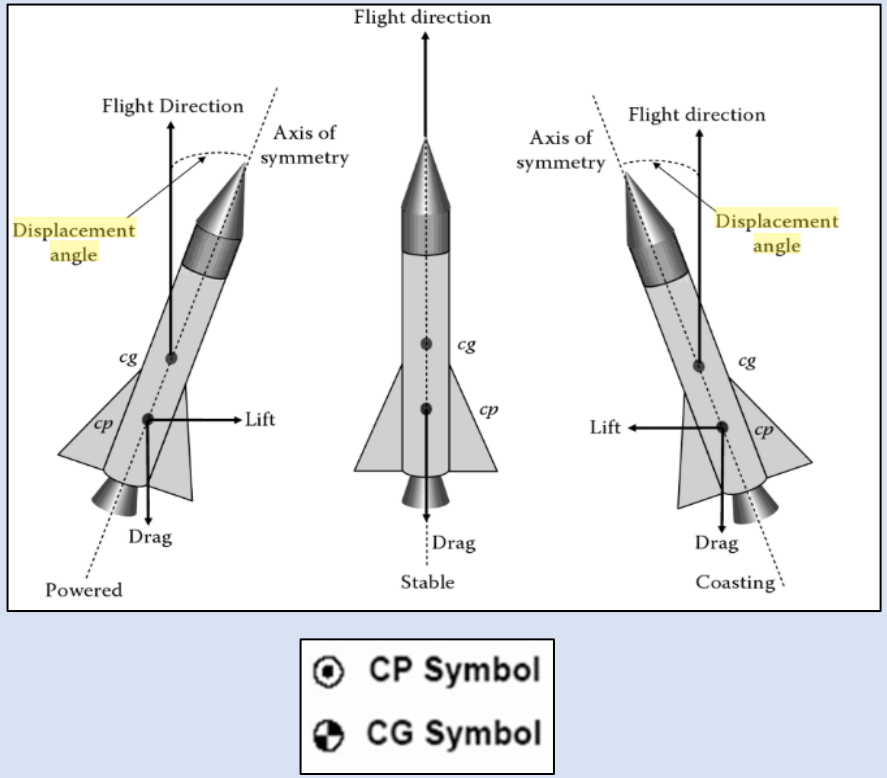


Figure 7-1: Rocket Stability Diagram

Rocket Build – Assembly

Fin Installation

Inner Fin Fillets

1. Preparation: Apply masking tape to outside diameter of motor mount tube and airframe (up to fin tab)
2. Put on gloves before preparing epoxy
3. Prepare small amount of epoxy
4. Apply epoxy fillet to seam between motor mount tube and “tang” side of the fin
5. Use long dowel to apply along full length
6. Apply quickly with large dollops
7. Apply a total of 8 fillets (on each side of 4 fins)
8. Allow epoxy to set, remove tape while wet (within 15 minutes)

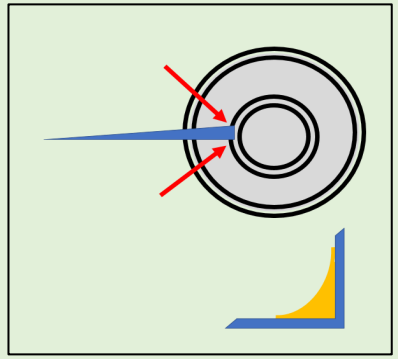


Figure 13-31: Epoxy Fillet to Seam Motor Mount and Tang

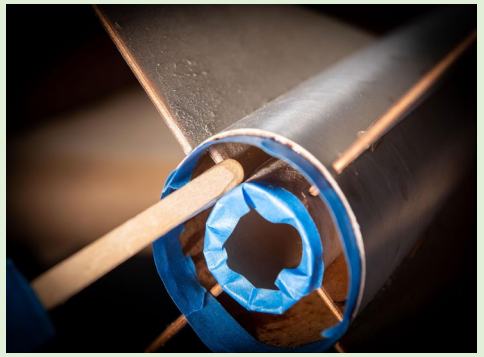


Figure 13-32: Use Craft Stick or Long Dowel to Apply Epoxy Fillet between Motor Mount and Fin

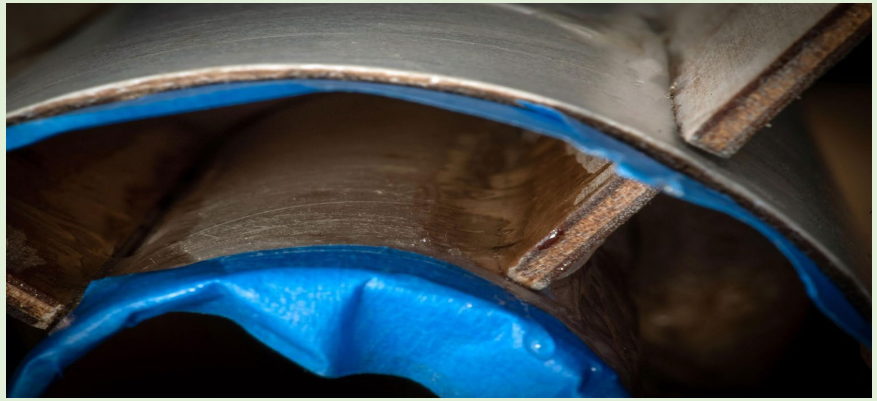
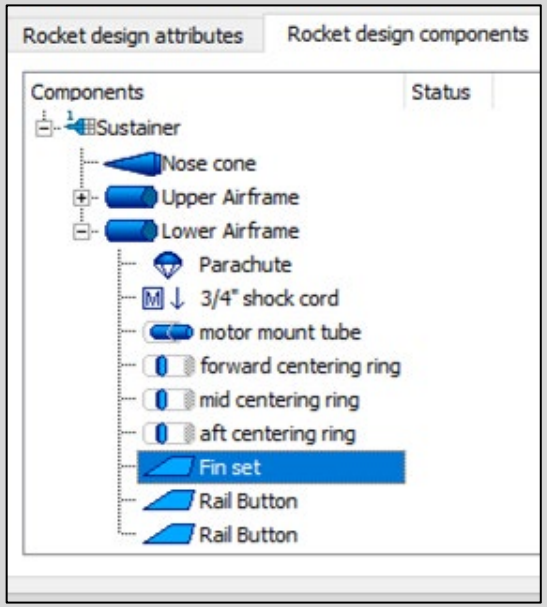
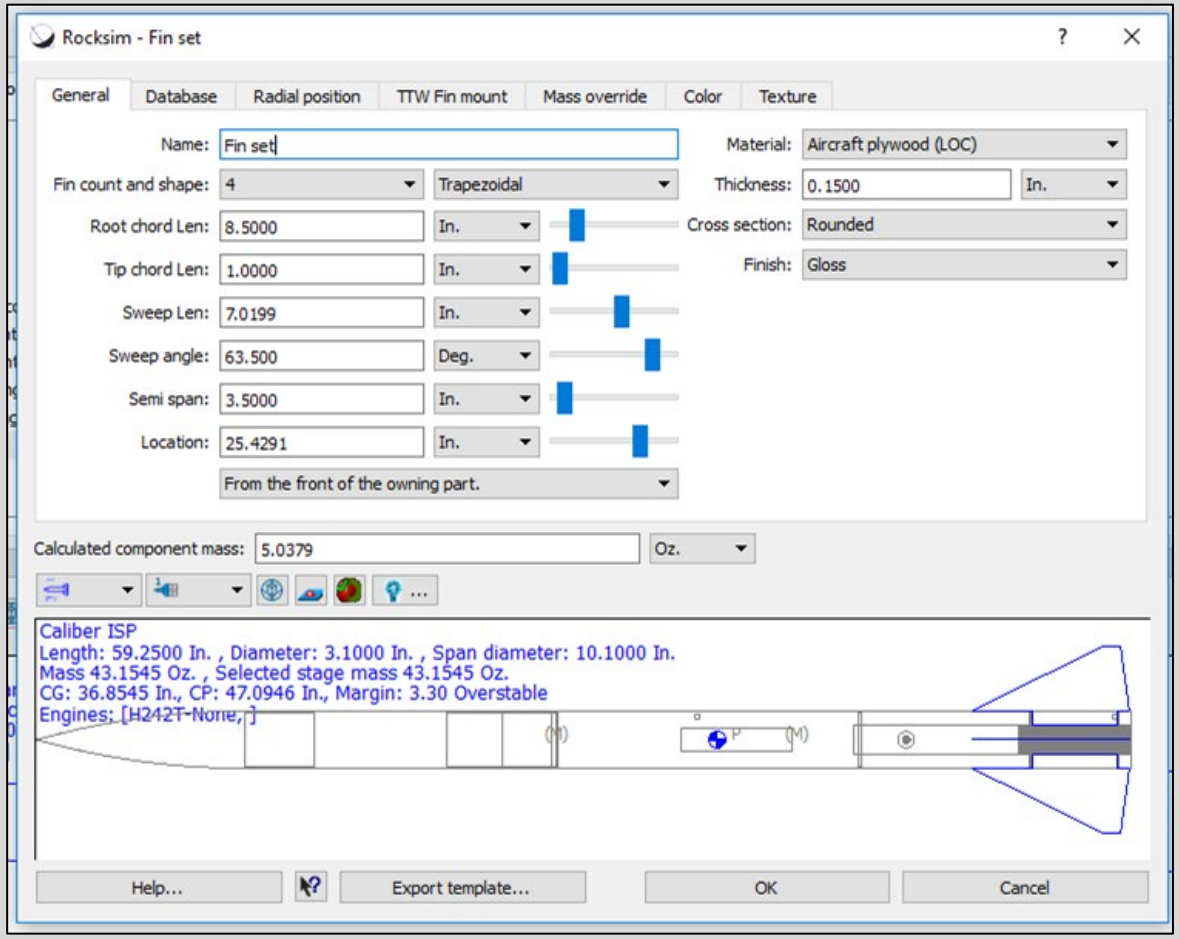


Figure 13-33: Fully Applied Epoxy Fillet between Motor Mount and Fin

Rocketry 101 - RockSim Update



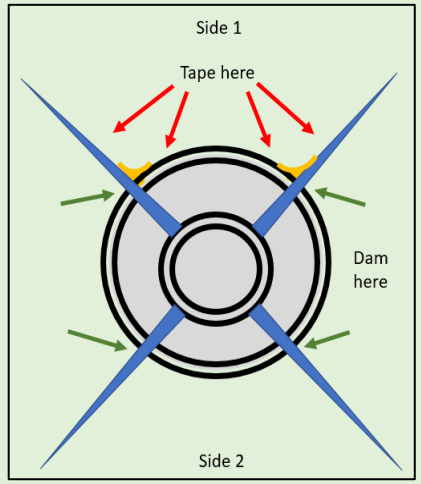


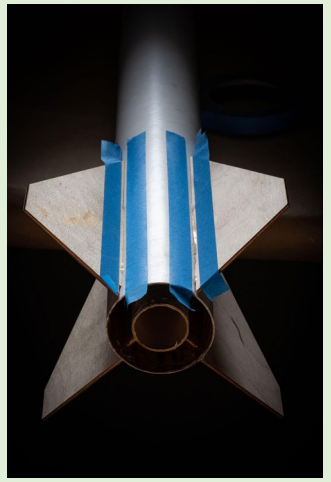
Rocket Build – Assembly

Fin Installation

Outer Fin Fillets (Prep)

1. Fillet tape must be installed parallel to fin, along the full length about 1/4” away from corner
   a. On both fin and tube (red arrows)
2. Repeat fillet tape for all four fins
   a. Will be 16 strips of tape for entire rocket for fillets
3. With the rocket positioned as shown, place 4 pieces of tape to create 4 dams to fill in the small gap between the fin and tube, on top of fillet tape
4. Place tape under fin long enough to cover gap
   a. Must be tight in corner, so epoxy does not leak through (green arrows)





Figures 13-34, 13-35: Tape and Dam Diagram; (Top Left); Tape Locations *for Epoxy Fillets (Top Right, Center); Dam Locations (Bottom Right)*

Rocket Build – Assembly

Fin Installation

Figure 13-35: Tape Locations for Epoxy Fillets (Left, Center); Dam Locations (Right)

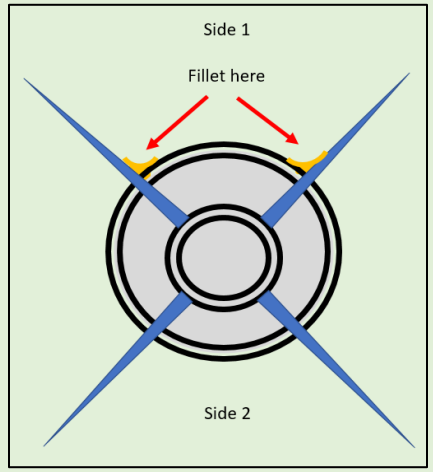
Rocket Build – Assembly

Fin Installation

Outer Fin Fillets (Epoxy)

5. For Side 1 (as shown):
    a. Put on gloves before preparing epoxy
    b. Prepare the right amount of epoxy (not a lot, you can mix more if needed)
    c. Fill in gap with epoxy (both fins) – let set few minutes, ensure epoxy is not leaking past dam on underside near the leading edge and AFT end near the semi span.
    d. Epoxy along entire length of fin root, create smooth fillets with craft stick (both fins)
    e. Remove dam tape from underside after 10 minutes
    f. Immediately remove both fillet tapes from Side 1 (tube and fins)
    g. Let set up for 10 – 12 minutes
6. Rotate rocket 180 degrees, and repeat for Side 2
7. Sides 3 and 4 do not require a dam step, fillet only

Fin failure (1:00)



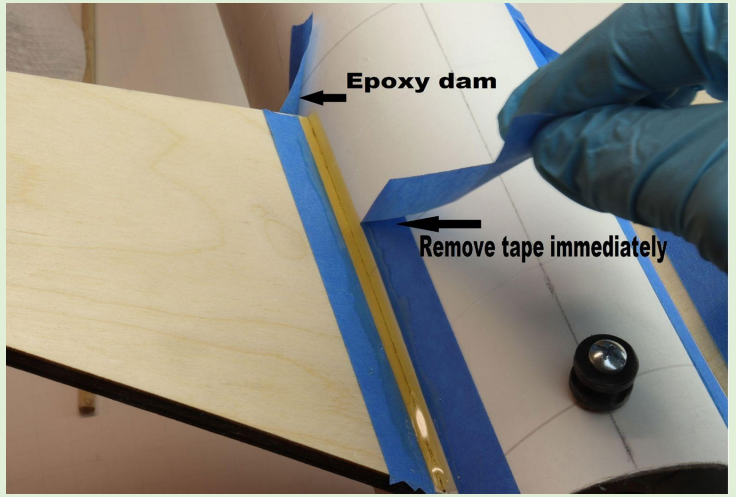


Figure 13-36: Fillet Diagram (Top); Fin Fillet Fill (Bottom)

AFTERNOON BREAK

Remember…to be early is to be on time and to be on time is to be late. Saturday's presentation is being condensed by 3 hours. We have lots to cover in a short period of time!

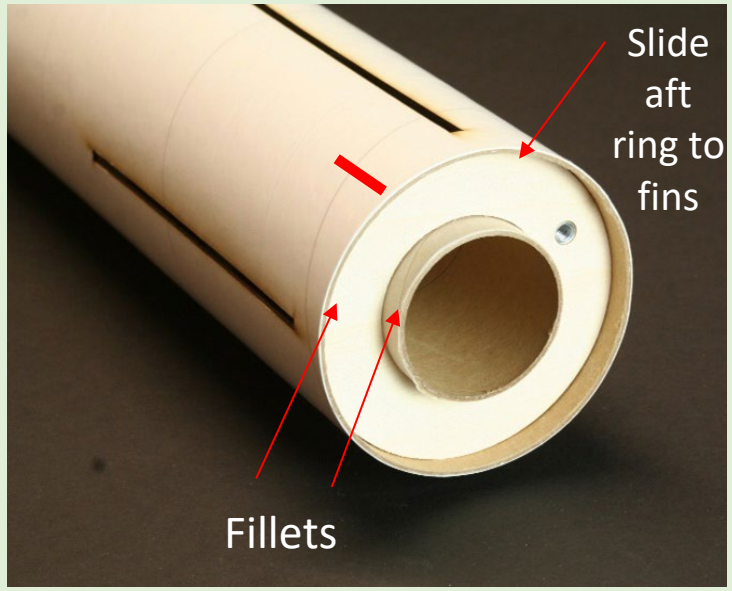
Workshop Afternoon - Review

1. What can result from improper fin installation?
2. Describe the rocket CG?
3. Describe the rocket CP?
4. What is the optimal stability margin/caliber?
5. What type of knot is used to connect the shock cord for the motor mount assembly?

Rocket Build – Assembly

Aft Centering Ring Installation

1. Install #8 wood screws halfway into Aft centering ring for use as handle. **Do not push down on these screws. Use them to pull out AFT ring only. Push down on ring only to install.**
   a. Dry-fit Step: Ensure the aft end of booster is free of epoxy, for ease of fit (sand or wipe with alcohol)
   b. Dry-fit Step: Ensure CR fits in tube, all the way until contact with fin tabs (will be an edge as shown) – sand as needed
   c. Remove aft CR after dry-fit
2. Put on gloves before preparing epoxy
3. Prepare a small amount of epoxy
4. Apply a band of epoxy around outside of MMT and inside of airframe



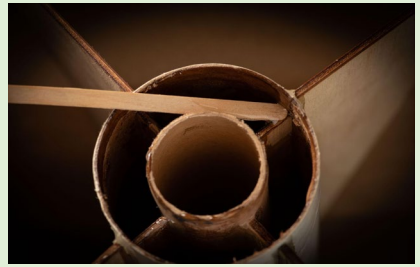


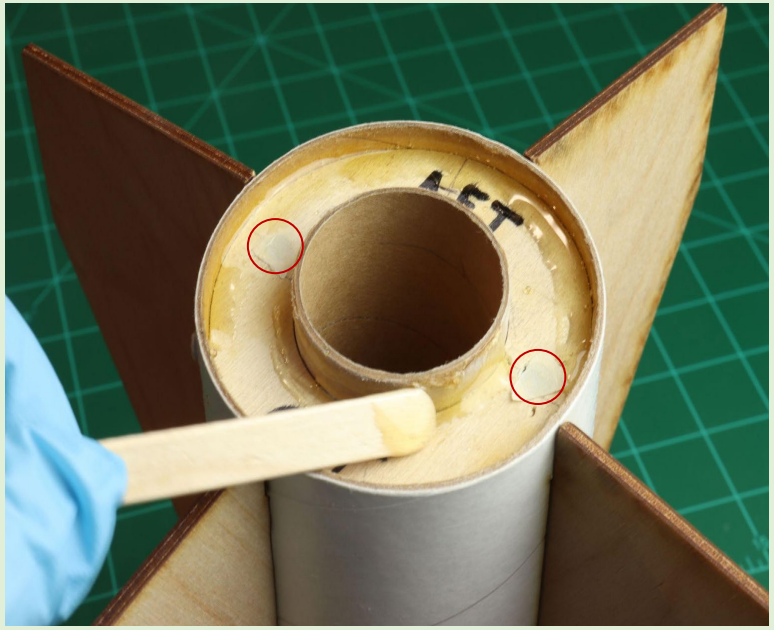
Figure 13-37: Slide Aft Ring to Fins (Top); Epoxy Outside of MMT (Left Middle); Epoxy Inside of Airframe (Right Middle)

Handbook Reference: *13b.x. Assembly – Aft Centering Ring Installation, pg 69*

Rocket Build – Assembly

Aft Centering Ring Installation

5. Twist centering ring into place, pushing in all the way until it stops against fin tabs
6. **Ensure wood screw is offset from rail button mark and fin tangs**
7. Apply fillet on aft end of aft CR
   a. Avoid getting epoxy in MMT and in pre-drilled motor retainer holes
   b. (Optional) Tape MMT to avoid getting epoxy in MMT
   c. (Optional) Add screw into hole



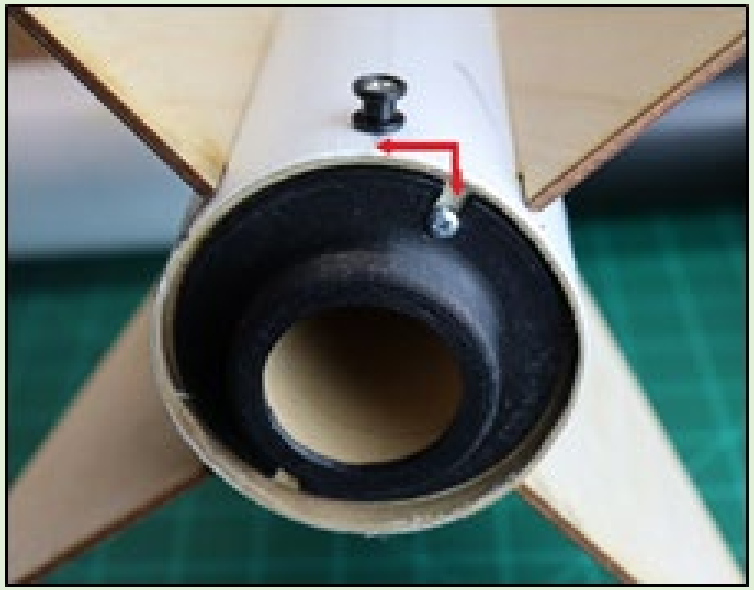


Figure 13-37: Rail Button and MMT Cap Installed (Top); Offset between Motor Retainer Screws and Rail Button (Bottom)

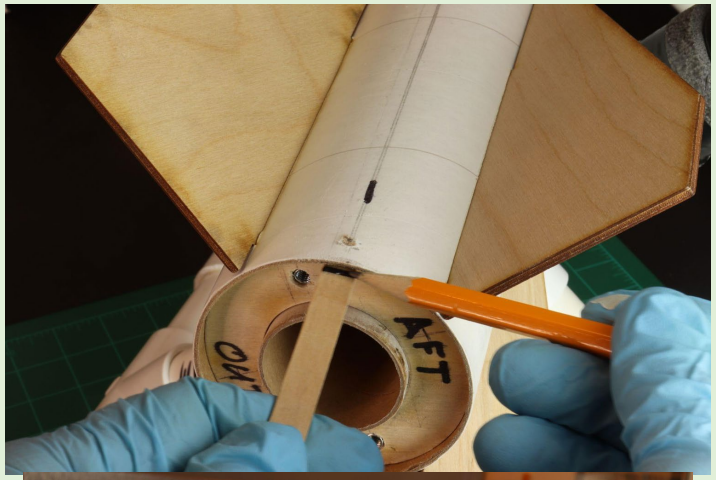
Rocket Build – Assembly

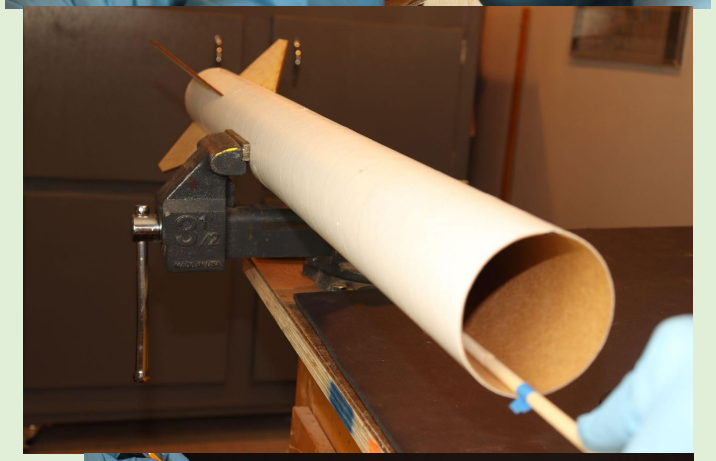
Rail Button Installation

Rail Buttons are installed so that your rocket can be fit to a standard launch rail. <u>Tape a craft stick to the end of your 18" dowel.</u>

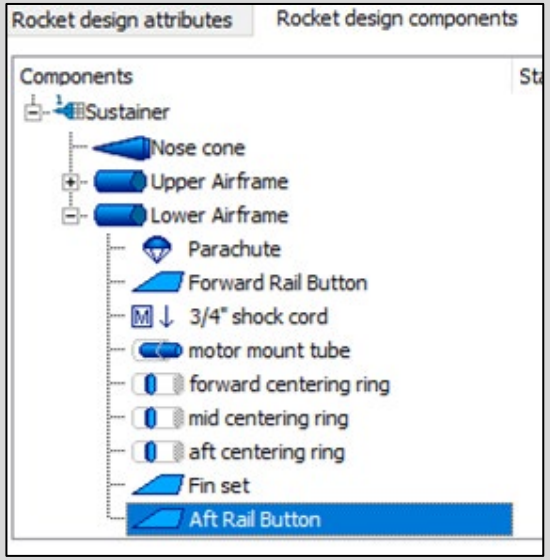
The bottom rail button will be installed into the aft centering ring, while the top rail button will be installed into the airframe (with backing nut – or into forward centering ring)

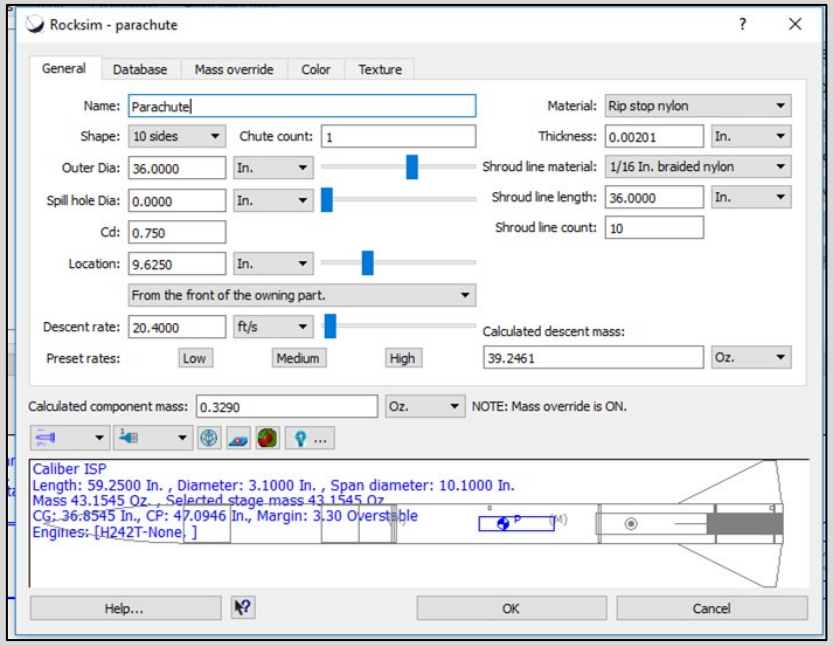
1. Mark an 'X' on the vertical line where it intersects the aft CR
   a. Use a craft stick to gauge the depth of the aft CR. (add ⅛")
1. Mark an 'X' on the vertical line near the forward CR
   a. Insert into forward end of airframe until it touches the forward CR. Beware dowel must be in contact with CR not the eyebolt.
   b. Mark line on dowel indicating end of airframe, remove and place on top of airframe to use as "measuring gauge" (add ⅛")
2. Drill holes using a 1/8" drill bit – ensure hole is perpendicular to surface
3. Dab epoxy in hole
4. Attach rail buttons and pointed wood screws into place

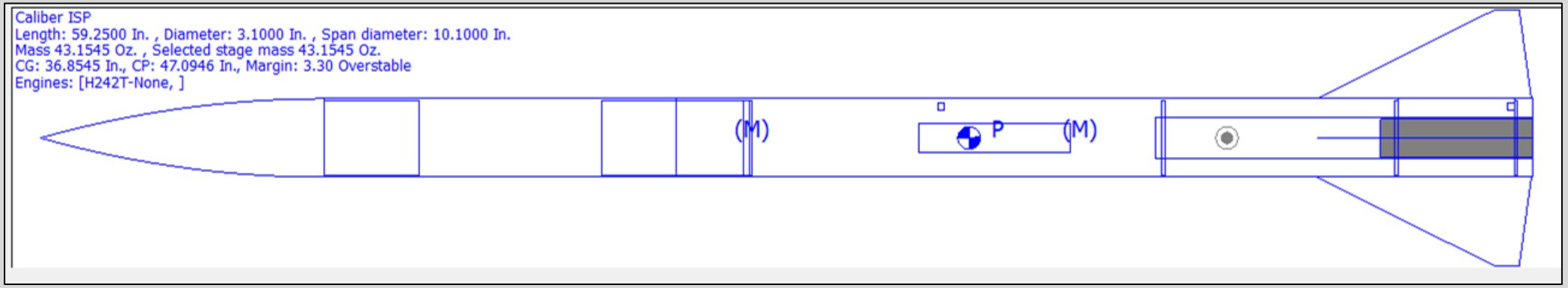




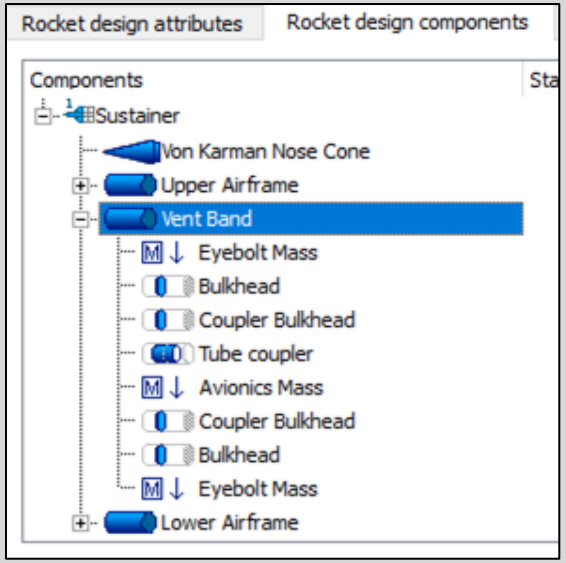
Rocketry 101 - RockSim Update

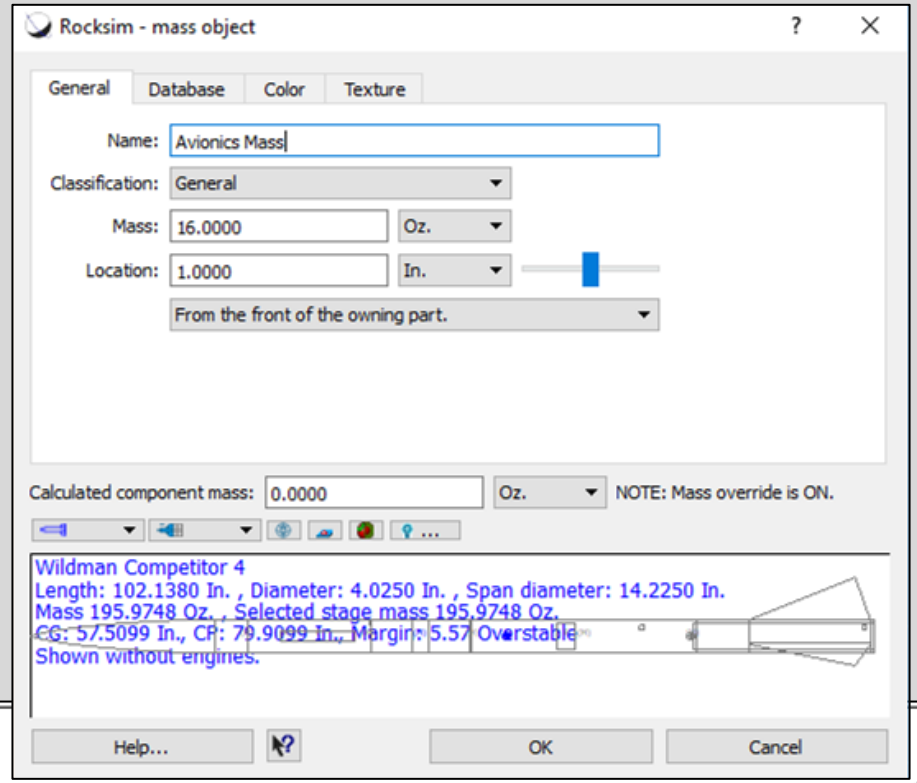


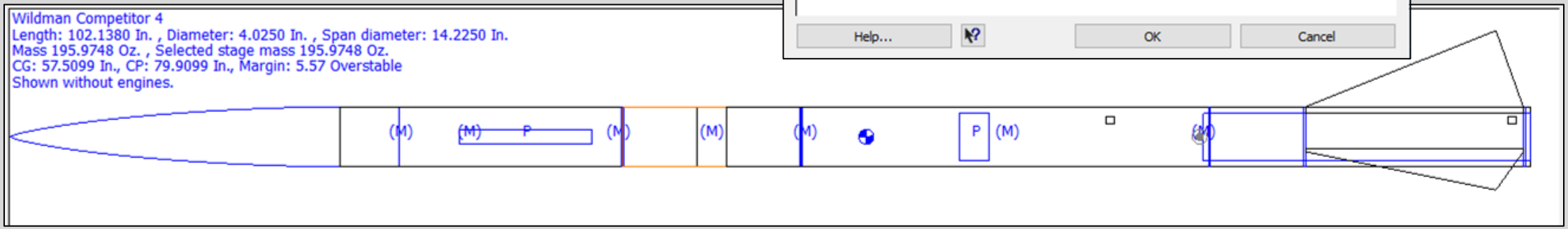




Rocketry 101 - RockSim Update







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
- NOTE: TRA recently changed the descent rate to 30 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

Rocket Build – Assembly

Recovery Installation

Figure 13-38: Recovery Supplies

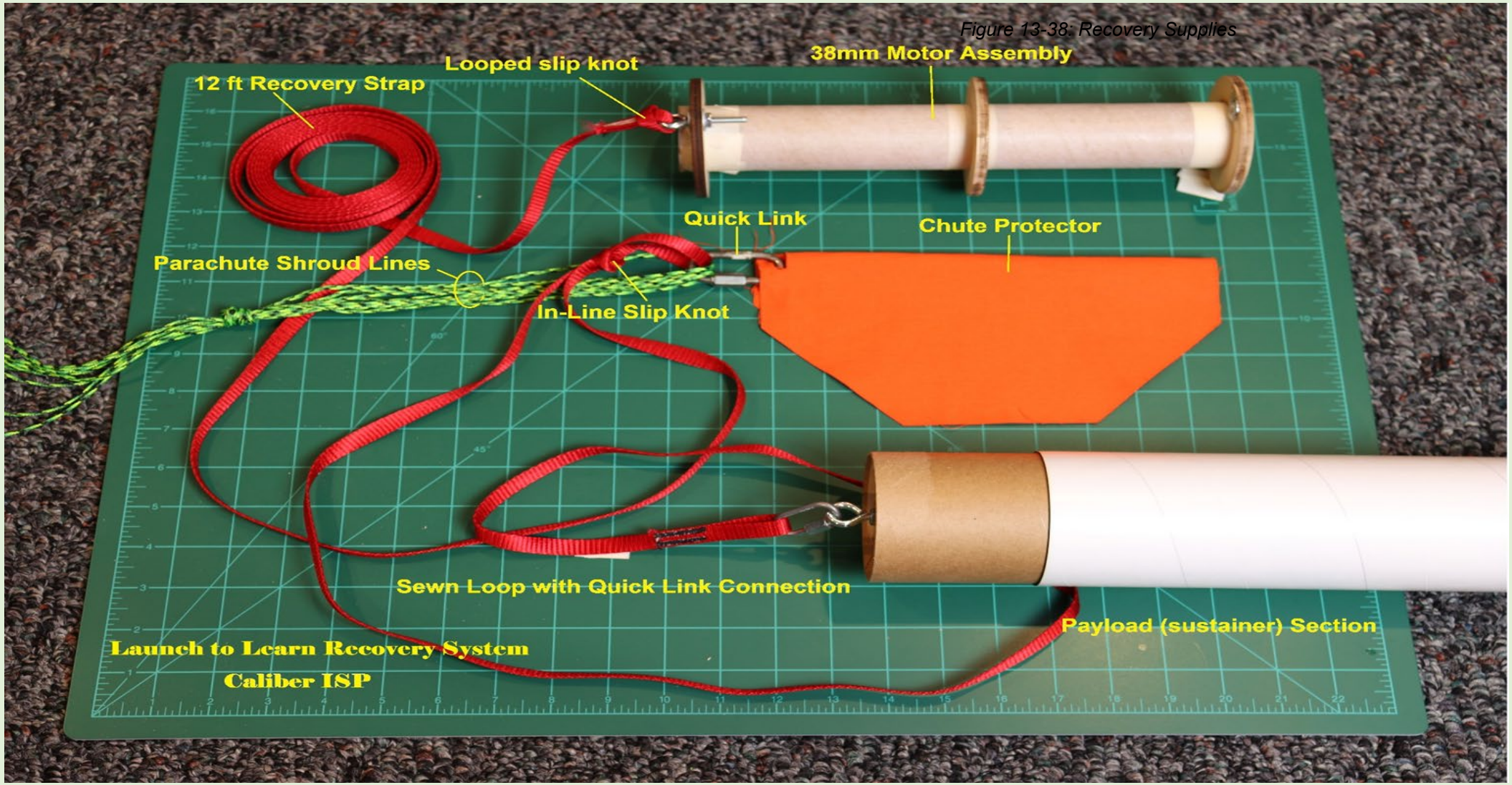


Figure 13-39: Recovery Supplies

Rocket Build – Assembly

Recovery Installation

[Failed parachute deployment]

1. Push shock cord out through forward end of airframe, remove masking tape
2. Tie a knot in the shock cord (at 1/3 total distance from end)
   - A quick-link may be used at this step as an alternate method
3. Untangle parachute shroud lines
4. Place arm through the shroud lines

Figure 13-40: Masking Tape and Shock Cord (Top); Knot Location on Shock Cord (Bottom)

Rocket Build – Assembly

Knot Overview - Parachute

5. Attach the parachute to the parachute protector with a knot (step-by-step procedure next slide)

a. Feed shroud lines through sewn loop in shock cord end

b. Pass parachute through shroud lines

c. Pull parachute tight

Rocket Build – Assembly

Parachute Preparation

1. Make sure the parachute shroud lines are untangled, then lay it flat on the table
2. Position one shroud line nearest you, then start folding the parachute gores into angular sections by bringing each consecutive shroud line over the first and evening out the fold up to the tip

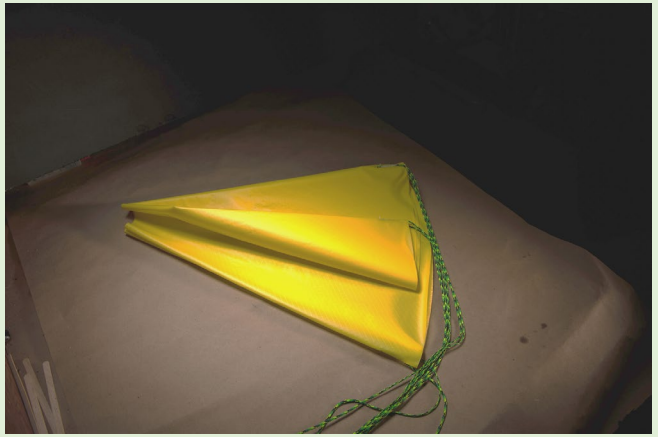


Figure 13-44: Step 1 of Parachute Prep

Figure 13-45: Step 2 of Parachute Prep

Rocket Build – Assembly

Parachute Preparation

3. Once all gores are folded with all shroud lines together, it should appear like this
4. Fold the parachute like a zig-zag

Figure 13-46: Step 3 of Parachute Prep

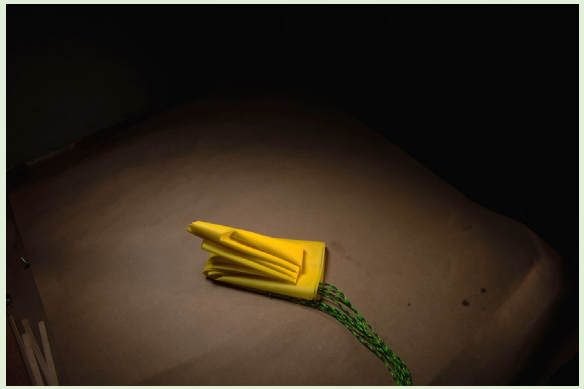


Figure 13-47: Step 4 of Parachute Prep

Rocket Build – Assembly

Parachute Preparation

5. Tightly roll the parachute into a cylinder. Ensure all shroud likes are still untangled and together.

6. Neatly bring the shroud lines together in a zig-zag fashion and place them next to the parachute at one corner of the parachute protector or Nomex cloth

    a. Watch demo of alternate method with small Nomex cloth

Figure 13-48: Step 5 of Parachute Prep

Figure 13-49 Step 6 of Parachute Prep

Rocket Build – Assembly

Parachute Preparation

7. Start rolling the Nomex over the parachute and shroud lines. Keep it snug. Then place the shock cord onto the Nomex using the same method as the shroud lines.

Figure 13-50: Step 7 of Parachute Prep

8. Fold the left and right corners of the Nomex inward, then continue rolling the bundle tightly, keeping all of the shroud line inside the Nomex cloth

Figure 13-51: Step 8 of Parachute Prep

Rocket Build – Assembly

Parachute Preparation

9. Place the newly-wrapped parachute bundle into the booster section of the rocket

Figure 13-52: Step 9 of Parachute Prep

Certification Launch Requirements

Safety Overview - Key Personnel

Tripoli Safety Code, NFPA 1127, etc.

HPR Launch Operations Overview

1. Range Safety Officer (RSO)
    a. The goal of the RSO is to minimize the risks to personnel and property involved in the handling, preparation, and launch operations of model and high-power rocket launches.
2. Launchpad Safety Officer (LSO)
    a. The LSO is responsible for determining the status of range operations: site, airspace, and weather.
3. Launch Pad Manager
    a. The Launch Pad Manager will assist you with the launch prep
4. Rocketry Mentor
    a. TRA/NAR certified at a level equal to or above the motor you will use to certify
    b. May guide, direct, and assist you as you prepare your rocket and go to the launch pad

Launch Failure

Launch Preparation

Launch Preparation Overview

Launch Site Materials & Supplies

- Drill
- Screwdriver
- Dog Barf
- Epoxy
- Masking Tape
- Screw
- Washer
- Nut
- Etc.

Figure 14:1 Launch Site Preparation Area

Certification Launch Overview

Certification Launch Requirements

1. When arriving at the launch site, you are expected to abide by the presiding organizations safety procedures
2. Requirements at the certification launch
    a. Review pre-launch checklist
    b. Complete launch card and submit to TRA/NAR
    c. After rocket recovery, return to HPR Launch Operations area
    d. Properly dispose motor
    e. Sign and submit TRA Membership Application to Frank Nobile (Wisconsin only)
    f. Pack rocket for return home

Certification Launch Overview

Certification Launch Requirements

3. Fees associated with certification launch
   a. FNL reimbursable by WSGC using reimbursement form or coordinated with local TRA/NAR
      i. Flight/Ground Transportation/Meals
         - $45 maximum meal allowance per day
         - Ground transportation: When personal vehicles are utilized, either gas or miles can be reimbursed, but not both
      ii. Original receipts with names of individuals on each receipt
   b. CRL certification launches will take place during launch competition weekend
      i. Special arrangements may be made to conduct certification launch on a regularly scheduled launch event through Frank Nobile maxq3@aol.com
   c. Complete and submit a reimbursement request to wsgc.accounts@carthage.edu no later than 30 days after certification launch

Certification Pre-Flight

Pre-Flight Overview

When you arrive at the launch site on launch day, you will need to:

1. Obtain a launch card from the club organizer table - each site
2. Prepare your rocket for flight
3. Ensure all of your bonds / fillets are intact
    a. Ensure all your parts fit - no excess epoxy
4. Prepare your parachute as instructed in the workshop

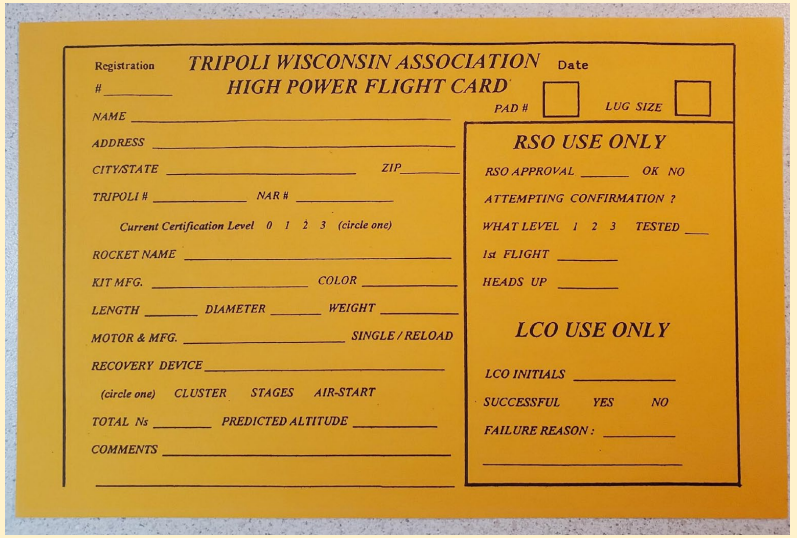

Registration # _____
TRIPOLI WISCONSIN ASSOCIATION
HIGH POWER FLIGHT CARD
Date
PAD #
LUG SIZE
NAME
ADDRESS
CITY/STATE
ZIP
TRIPOLI #
NAR #
Current Certification Level 0 1 2 3 (circle one)
ROCKET NAME
KIT MFG.
COLOR
LENGTH
DIAMETER
WEIGHT
MOTOR & MFG.
SINGLE / RELOAD
RECOVERY DEVICE
(circle one) CLUSTER STAGES AIR-START
TOTAL Ns
PREDICTED ALTITUDE
COMMENTS
RSO USE ONLY
RSO APPROVAL _____ OK NO
ATTEMPTING CONFIRMATION ?
WHAT LEVEL 1 2 3 TESTED ___
1st FLIGHT
HEADS UP
LCO USE ONLY
LCO INITIALS
SUCCESSFUL YES NO
FAILURE REASON :

Figure 15-1: Tripoli Wisconsin Launch Card

Certification Pre-Flight

Pre-Flight Overview

5. Ensure your nose cone is attached
   a. You may fly a ‘payload’ if you wish
6. Ensure you have a piece of tape with you (for friction fit & igniter)
7. Prepare you motor (see the RSO/Mentor for motors)
8. Ensure you have your motor retainer with you and tools to tighten it

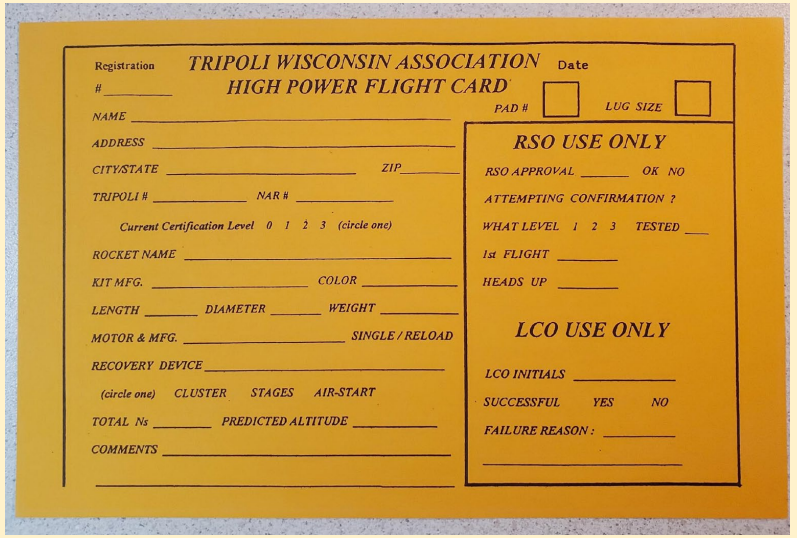

Registration # _____
TRIPOLI WISCONSIN ASSOCIATION
HIGH POWER FLIGHT CARD
Date
PAD #
LUG SIZE
NAME
ADDRESS
CITY/STATE
ZIP
TRIPOLI #
NAR #
Current Certification Level 0 1 2 3 (circle one)
ROCKET NAME
KIT MFG.
COLOR
LENGTH
DIAMETER
WEIGHT
MOTOR & MFG.
SINGLE / RELOAD
RECOVERY DEVICE
(circle one) CLUSTER STAGES AIR-START
TOTAL Ns
PREDICTED ALTITUDE
COMMENTS
RSO USE ONLY
RSO APPROVAL _____ OK NO
ATTEMPTING CONFIRMATION ?
WHAT LEVEL 1 2 3 TESTED ___
1st FLIGHT
HEADS UP
LCO USE ONLY
LCO INITIALS
SUCCESSFUL YES NO
FAILURE REASON :

Figure 15-1: Tripoli Wisconsin Launch Card

Certification Pre-Flight

Pre-Flight Overview

9. Fill out / turn in your launch card to the LCO when you are ready to fly.
   a. LCO will assign you a launch pad (numbered)
10. Proceed to launch pad when range is open
    a. Usually, a Launch Pad manager (or mentor) will assist you with launch prep
11. Return to pit area to watch your launch!
12. Observe and recover your rocket
13. Return rocket to RSO for inspection and sign off

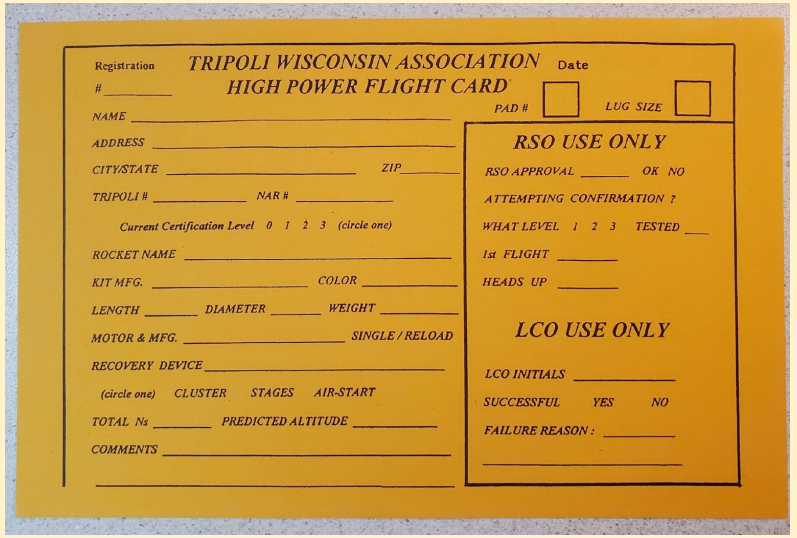

Registration # _____
TRIPOLI WISCONSIN ASSOCIATION
HIGH POWER FLIGHT CARD
Date
PAD #
LUG SIZE
NAME
ADDRESS
CITY/STATE
ZIP
TRIPOLI #
NAR #
Current Certification Level 0 1 2 3 (circle one)
ROCKET NAME
KIT MFG.
COLOR
LENGTH
DIAMETER
WEIGHT
MOTOR & MFG.
SINGLE / RELOAD
RECOVERY DEVICE
(circle one) CLUSTER STAGES AIR-START
TOTAL Ns
PREDICTED ALTITUDE
COMMENTS
RSO USE ONLY
RSO APPROVAL _____ OK NO
ATTEMPTING CONFIRMATION ?
WHAT LEVEL 1 2 3 TESTED ___
1st FLIGHT
HEADS UP
LCO USE ONLY
LCO INITIALS
SUCCESSFUL YES NO
FAILURE REASON :

Figure 15-1: Tripoli Wisconsin Launch Card

Certification Pre-Flight

Pre-Flight Inspection

Prepare the following information for the LCO:

1. TRA/NAR Membership #
2. Kit Manufacturer
3. Center of Gravity (CG) and Center of Pressure (CP) – Mark the CG and CP on the rocket
4. Motor Type and Manufacturer
5. Type of Recovery Device
6. Length, Diameter, and Weight of Rocket
7. Predicted Altitude (Remember to conduct a simulation in RockSim)

Registration # _____

TRIPOLI WISCONSIN ASSOCIATION
HIGH POWER FLIGHT CARD

Date

PAD # ☐ LUG SIZE ☐

NAME _____

ADDRESS _____

CITY/STATE _____ ZIP _____

TRIPOLI # _____ NAR # _____

Current Certification Level 0 1 2 3 (circle one)

ROCKET NAME _____

KIT MFG. _____ COLOR _____

LENGTH _____ DIAMETER _____ WEIGHT _____

MOTOR & MFG. _____ SINGLE / RELOAD

RECOVERY DEVICE _____

(circle one) CLUSTER STAGES AIR-START

TOTAL Ns _____ PREDICTED ALTITUDE _____

COMMENTS _____

RSO USE ONLY

RSO APPROVAL _____ OK NO

ATTEMPTING CONFIRMATION ?

WHAT LEVEL 1 2 3 TESTED ___

1st FLIGHT _____

HEADS UP _____

LCO USE ONLY

LCO INITIALS _____

SUCCESSFUL YES NO

FAILURE REASON : _____

Figure 15-1: Tripoli Wisconsin Launch Card

Certification Rocket Overview
Pre-Launch Rocket Preparation

1. Airframe
    a. Must be built by flyer
    b. Display Center of Pressure
2. Recovery
    a. Standard parachute recovery is required.
3. Motor
    a. Single certified H or I motor (tested total impulse between 160.01 and 640.00 n-sec)
        i. Local Certification Launch
            1. Coordinate Motor Purchase with TRA/NAR Mentor (Reimbursable cost)
            2. Contact TRA/NAR Launch organizer(s) to have a motor available if a vendor is on site (Reimbursable cost)
            3. Order motor through Wildman Rocketry (most reliable, but an additional hazmat fee (~$50) charged) WSGC billed
        ii. Richard Bong Recreational Park Certification Launch
            1. Motor available competition weekend through WSGC
    b. Flyer shall be observed by certifying member during assembly and preparation of motor
4. Electronics
    a. Not required

Certification Launch Preparation

Motor Preparation

1. Obtain your motor from the RSO
   a. WSGC provides one certification motor
2. Perform your own motor prep
   a. Remove certification motor from protective cardboard tube
   b. Delay Adjustment
   c. Black Powder
   d. Motor Installation
3. RSO will observe your motor prep
   a. It is not a test, it is a hands-on learning experience
   b. If you don't understand something, ask questions
4. Insert your motor in rocket and install motor retainer
5. Suggest you tape the ignitor to the outside of the rocket for later

Figure 14-2 Certification Motor and Packaging

Handbook Reference: *14d. - Motor Preparation, pg 76*

Aaron/Trent

Certification Launch Preparation

Motor Preparation

The certification motor will come in a protective cardboard tube when shipped. The motor may be sealed in a plastic bag.

Remove contents from carton and plastic bag. The motor will have a parts contained within:

1. Motor
2. Ignitor Leads
3. Pyrogen
4. Vial of Black Powder
5. Red Forward Plug
6. Baffle Washer

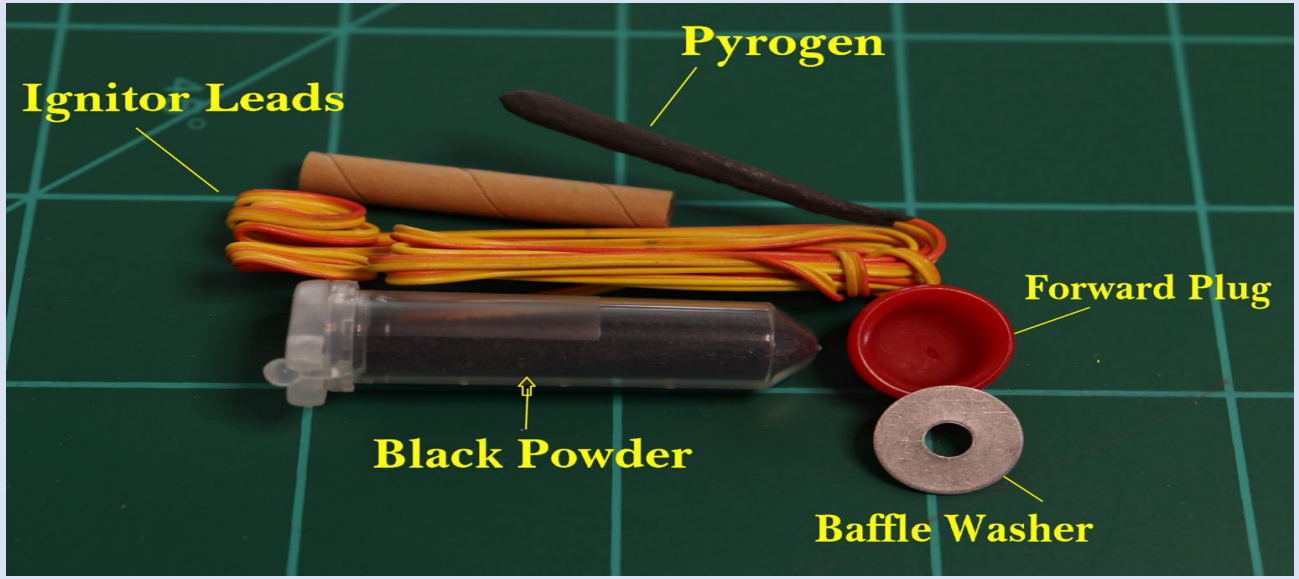


Figure 14-3: Certification Motor Parts

Handbook Reference: *14d. - Remover from Container, pg 76*

Aaron/Trent

Certification Launch Preparation

Motor Preparation

1. Adjust the motor ejection charge delay
    a. Use the delay adjust tool to remove seconds from delay
        i. Adjust the tool for proper amount
        ii. Screw the tool into the end
    a. Shake flakes out – discard
    a. Install Baffle Washer

Figure 14-4: Delay Tool

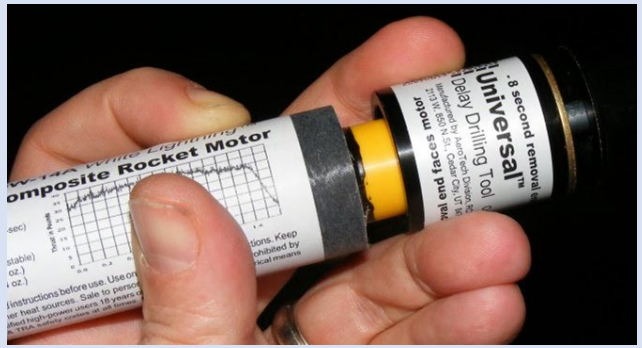


Figure 14-5 Removing seconds from delay

Figure 14-6: Install Baffle Washer

Certification Launch Preparation

Motor Preparation

d. Pour black powder into end

d. Place plug cap on end

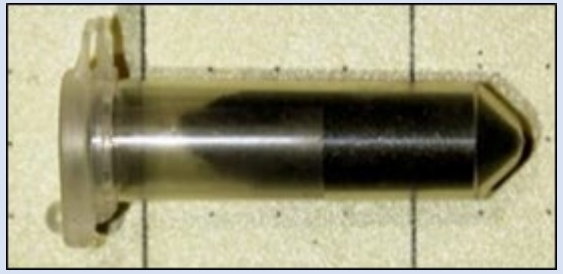


Figure 14-7: Black Powder Vial

Figure 14-8: Pour Black Powder into Deployment Well

Figure 14-9: Pour Black Powder into Deployment Well

Certification Launch Preparation

Motor Preparation

1. Insert your motor into your rocket (narrow end first – red cap inside)

1. If motor is difficult to insert
   a. May need to clean epoxy from inside of MMT

1. Attach motor retention to keep motor in place

1. Secure ignitor with tape to exterior of rocket for later

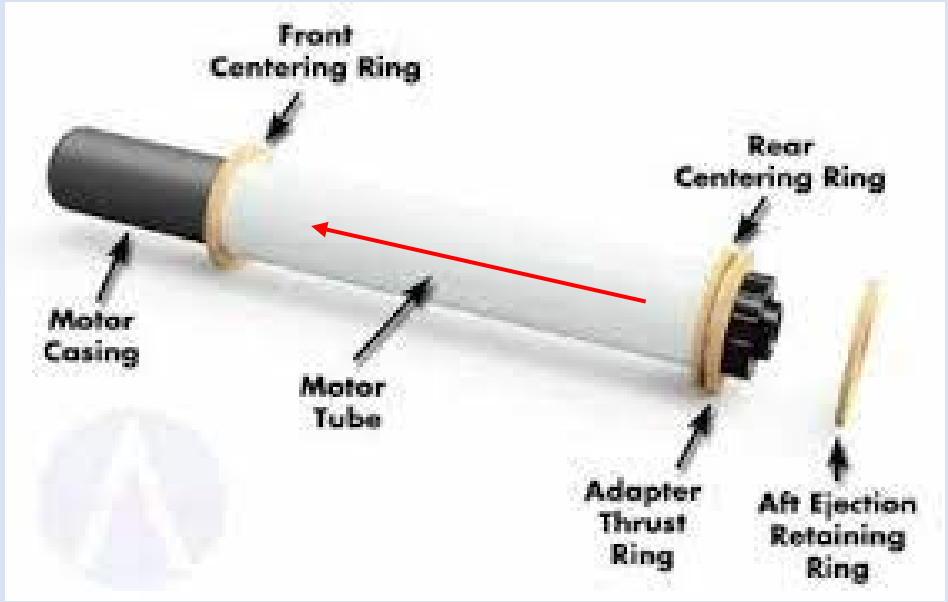
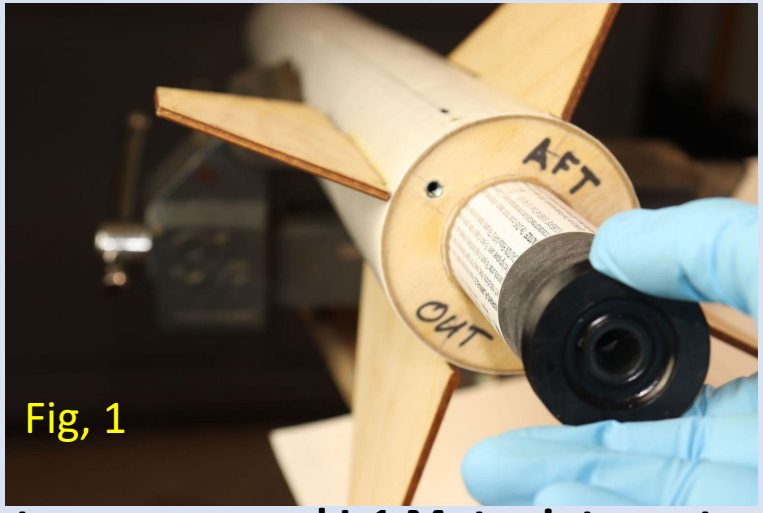


Figure 14-10: Motor Installation

Motor Retention Installation

Motor Retention cap



Fig, 1

Insert your prepared L 1 Motor into motor tube until it stops

Fig. 2

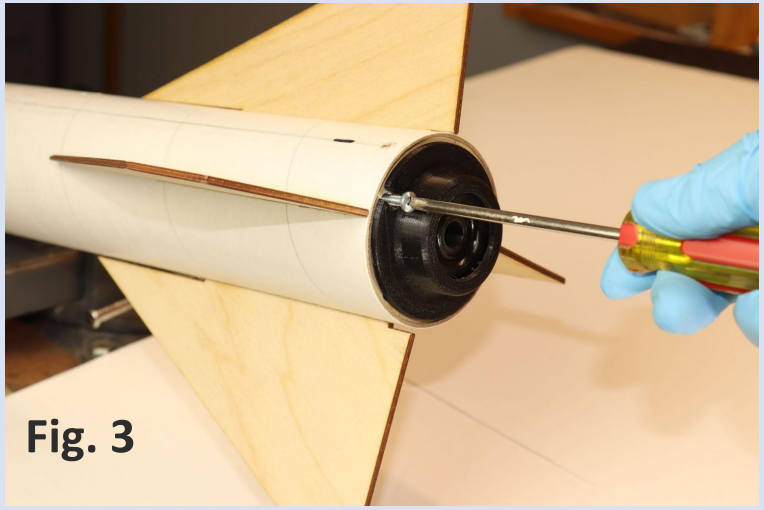


Fig. 3

Install 2 machine screws to secure retention system do not over tighten

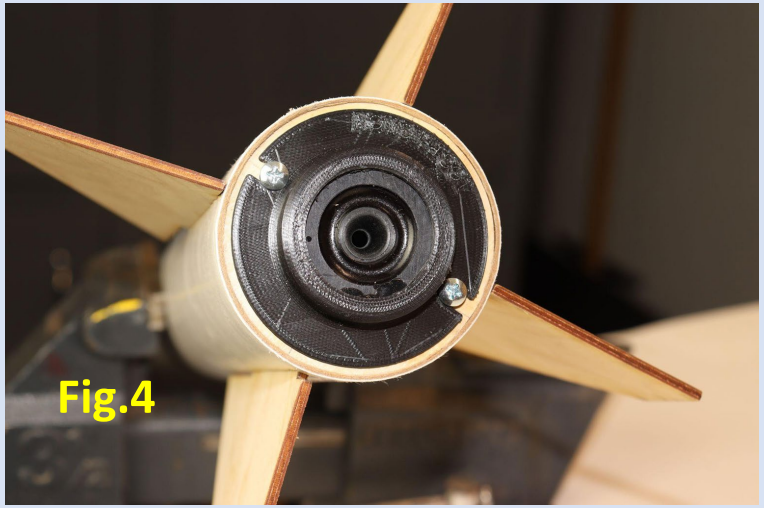


Fig.4

Certification Launch Preparation

Recovery

1. Know how to fold / install your parachute into your rocket (as previous demo)
   a. Ensure parachute and protectors are **attached** inside of quick-links
   b. Ensure your quick-links are attached to rocket and **closed**
   c. Ensure to use parachute protectors and/or ‘dog barf’ to protect your nylon parachute from the hot ejection charge gases
      i. Ensure parachute protection is on bottom (where ejection charge is) and parachute on top

Figure 14:11: Parachute and Protectors Attached Inside of Quicklinks (Top); Quicklink Attached to Rocket and Closed (Bottom)

Certification Launch Preparation

Recovery

2. If your certification flight occurs in adverse conditions
   a. Consider using a smaller parachute than the stock parachute provided, to prevent drift
      i. Your Rocketry Mentor may be able to assist you
   b. You may ‘reef’ your shroud lines using tape (or by tying a knot part way up the shroud lines)
      i. This will decrease the parachute open diameter
      ii. This will increase descent rate (decrease drift)
   c. Ensure your mentor or RSO is aware of any adjustments you have made prior to flight

Figure 14-12: “Reef” the Shroud Lines Using Tape

Certification Launch Preparation
Recovery

3. At Tripoli Wisconsin (only) - additional recovery techniques are used for certification flights (when flying in adverse conditions)
   a. Jolly Logic Parachute Release
      i. This device will be loaned to flyers
      ii. This device will not open the parachute until a much lower altitude
         1. AKA streamer (or tumble) recovery from apogee
   b. RF Tracker and Antenna
      i. This device will be loaned to flyers
      ii. This device will emit an RF signal that allows you to track on ground
         1. It can be flown in your sustainer section or taped to shock cord

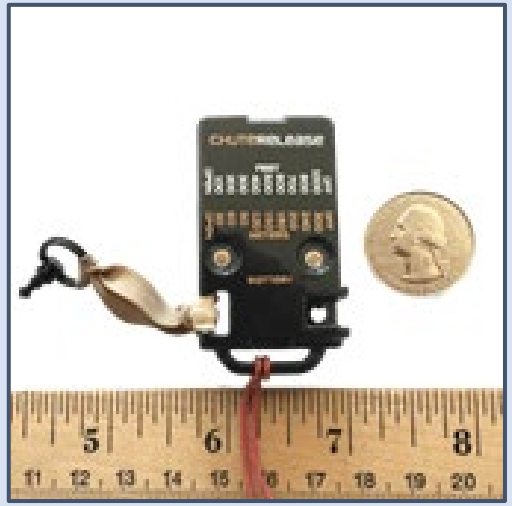


Figure 14-13: Jolly Logic Parachute Release

Figure 14-14: RF Tracking Device (Left); Yagi Antenna (Right)

Certification Launch Preparation
Recovery

4. These devices ARE NOT REQUIRED for certification flight
    a. If you plan to use a device be familiar with its operation prior to flight
    b. Ensure your mentor or RSO is aware of any devices used in flight

https://jollylogic.com/products/chuterelease/

https://www.com-spec.com/rcplane/index.html

Certification Launch Preparation

Launch Pad Preparation

Once you are prepared your rocket for the certification launch and have completed the pre-launch checklist:

1. Check in with the LCO for your pad assignment
2. Turn in the launch card
3. Proceed to the Launch pad when the “Range is Open.”

Handbook Reference: *14f. Launch Pad Preparation, pg 80*

Frank

Certification Launch Preparation

Launch Pad Preparation

The Launch Pad Manager (or Mentor) will assist you with the launch prep. This is a time for learning not for quizzing:

1. The rail is tilted over for loading
    a. Slide your rocket on rail, aligning your rail buttons in the grooves in the rail
2. Your rocket should be on top – your rail buttons down
    a. Slide all the way down until it hits the stops

Handbook Reference: Handbook Reference: *14f. Launch Pad Preparation, pg 80*

Frank

Certification Launch Preparation

Rocket Retrieval

1. Carefully observe the descent of your rocket for retrieval
2. Use the landmarks (trees / field / roads / water) to remember where you last saw it
3. You may want to go out in pairs and assist each other
    a. This is for safety as well – look for one, then the other
4. Do not enter a hazardous situation to retrieve your rocket
    a. Do not enter water
    b. Do not climb trees
5. Check-in if you have been searching for awhile

Launch Preparation

Rocket Retrieval

1. Note the Hazards

1. Note the Landmarks

1. Note the Distances

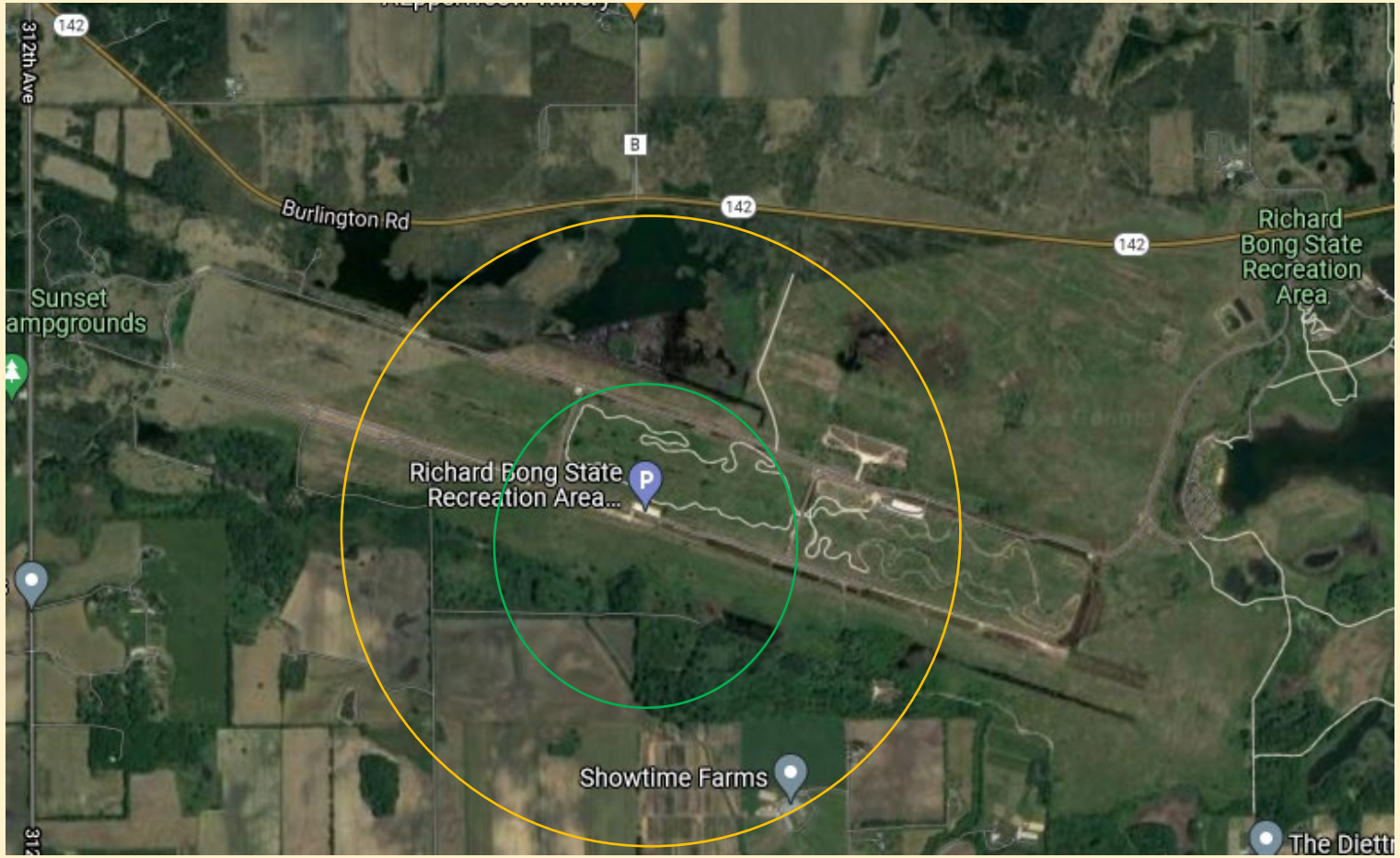


Figure 14-16: Richard Bong State Recreation Area Aerial Map

Handbook Reference: *14g; Rocket Retrieval, pg 82*

Frank

Certification Launch Requirements

Certificaton Post-Flight

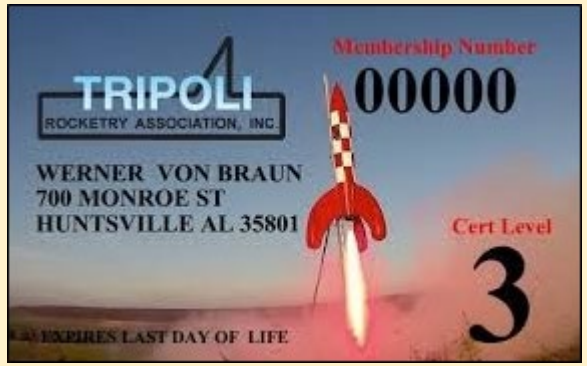


Figure 15-2: Tripoli Membership Card Example

Upon a successful flight and retrieval of your rocket, the following steps will take place:

1. The RSO will inspect your certification rocket
2. The RSO will sign your certification form
   a. WSGC will reimburse L2L participants for the first year of TRA or NAR membership
3. WSGC will pay L2L participants TRA or NAR membership for Certification flights conducted at Richard Bong Recreation Area
4. Tripoli Membership cards will be mailed to participants address provided on form
   a. Membership is valid for one year
   b. Membership must be renewed by participant annually
   c. TRA Certification is valid at NAR launches
   d. Level II Certification may be obtained by participants, however, WSGC does not cover the cost of certification.

Certification Flight

Post-Flight Inspection - Non-Certification

Any of the following will result in non-certification for a certification flight:

1. Motor CATO (Catastrophic Take Off)
2. Excessive damage
3. No recovery system deployment or tangled recovery system deployment
4. Rocket drifting outside the specified launch range
5. Components coming down not attached to the recovery system.
6. Any other violation of TRA safety code associated with this particular flight.
7. Any other legitimate reason the certifying member deems merits non-certification

Certification Launch Requirements

Rocket Transport

When preparing to bring your certification rocket home, you will need to take the necessary steps to clean your rocket and prepare for the transport.

1. Cleaning and packaging rocket for transport
    a. Remove / dispose of the motor
    b. Wipe out any black powder residue
    c. Disassemble any components
2. Transporting rocket from Kenosha, WI
    a. Checked bag for airline flights
    b. Ship from hotel (confirm this option with the hotel)
        i. Boxes, bubble wrap and labels will be available for shipping for certification launches conducted at Richard Bong Recreation Area. If you ship your rocket to the hotel during competition weekend, keep original packaging material for return shipment.
1. Shipping costs may be submitted with Launch 2 Learn travel expenses

Certification Launch Requirements

Tripoli Requirements/WSGC Information

NAR Level 1 Certification at Richard Bong Recreational Area

https://www.youtube.com/watch?v=EFm5sG7qdmo

Workshop Closing - Review

1. Where can rocket supply equipment files be downloaded from?
2. What checkbox is critical to check or uncheck in RockSim?
3. What is the “Key Enemy” of your rocket build?
4. What does an altimeter do?
5. What is a reasonable rocket descent rate?
6. What must you do to become level one certified?
7. Who are the key personnel at the rocket launch?

Workshop Objectives Review

- Introduce design, build, fly stages of high-power rocketry
  - Remember this is only an introductory workshop, there is not enough time to cover all aspects in greater detail
- Build a Level 1 high-power rocket
  - We will build the LOC Precision Caliber-ISP kit
- Develop basic understanding of RockSim
  - Import the Caliber kit rocket into RockSim and analyze a flight
- Understand Tripoli Level 1 certification

SURVEY TIME

Help us hit a home run with our program. Tell us what is good (80%) and tell us ways to get better (20%)

This is what I LOVED about your workshop!!!

If you make “this change,” you’ll be hitting a home run

Please fill out the workshop evaluation questionnaire here:

https://forms.gle/HfyoLWQUru2uq85c6

QUESTIONS?