Launch 2 Learn

Introductory Rocket Workshop

First Nations Launch - January 20-21, 2023

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

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?

Rocket Build – Assembly

Coupler Assembly

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

Figure 13-17: Bulkplate Installed in Coupler

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

8. Apply fillet on forward side of bulkplate

9. Set coupler assembly aside, allow epoxy to dry

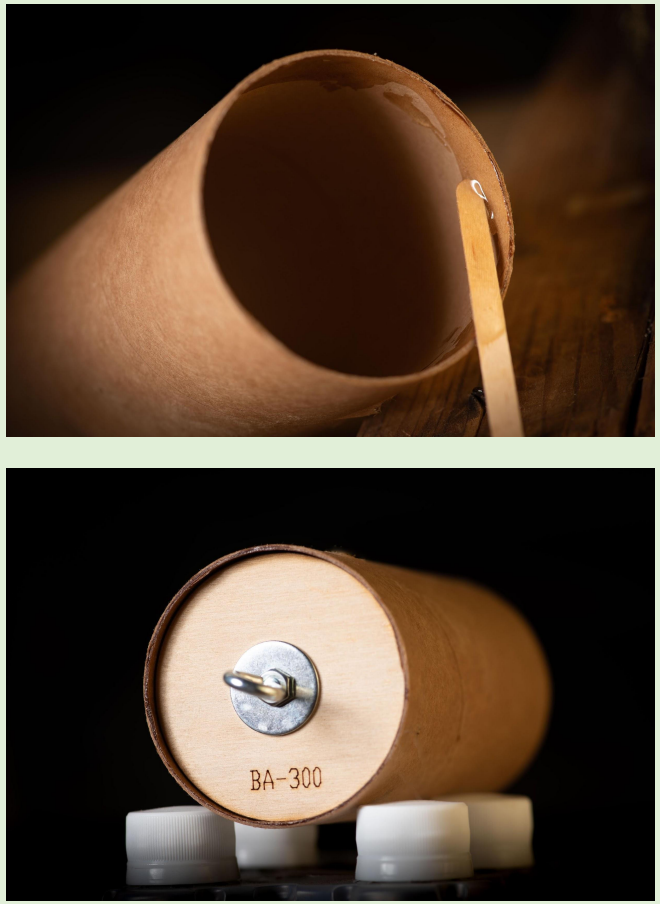


Figure 13-17: Applying Epoxy around Inside of Coupler (Top); Bulkplate Installed in Coupler (Bottom)

Rocket Build – Assembly

Coupler/Sustainer

1. Dry-fit coupler to upper airframe (sustainer)

2. Draw a line/mark around the center of the coupler

3. Put on gloves before preparing epoxy

4. Prepare small amount of epoxy

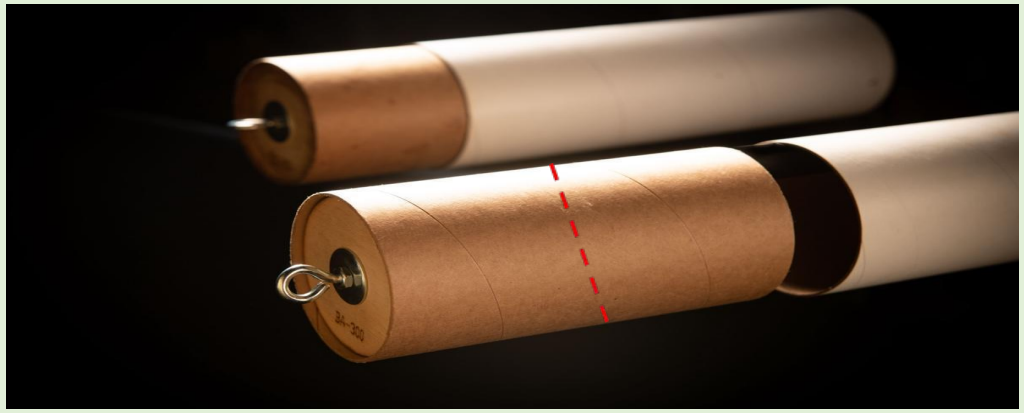


Figure 13-18: Example of Where to Draw Line on Coupler

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. 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

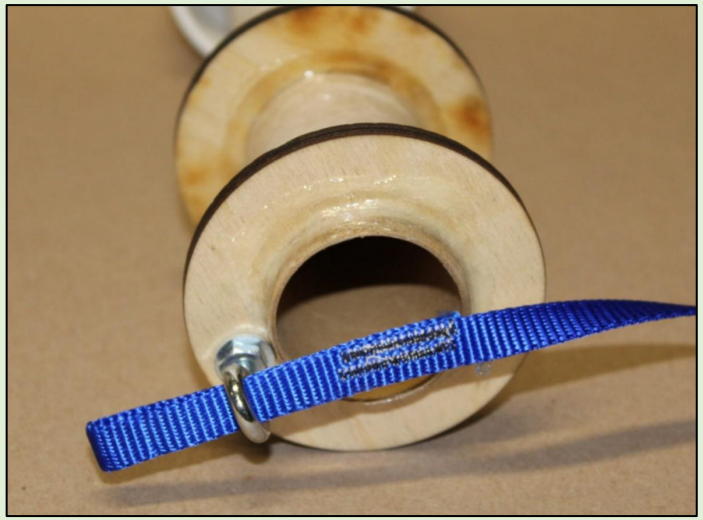
NOTE: Step by step information on how to do this knot can be found on the next slide

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 in ~8 - 10” in length, 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

    b. 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

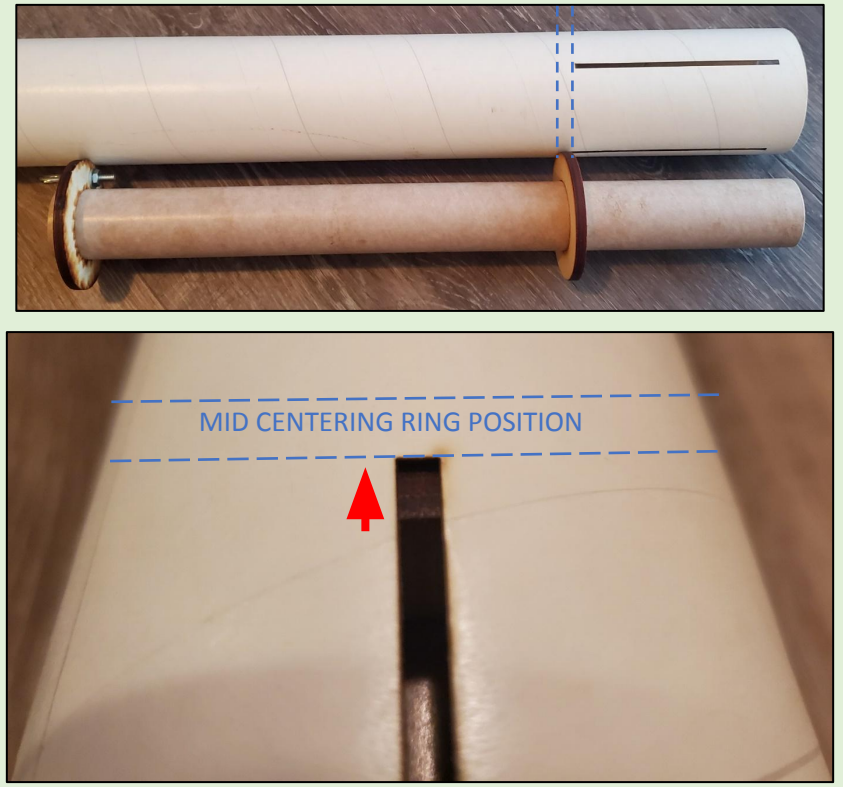


Figure 13-22: Relative Position of MMT Assembly Once Installed in Airframe (Top); Mid Centering Ring Should Sit Forward of Fin Slots (Bottom)

Rocket Build – Assembly

Motor Mount

8. Put on gloves before preparing epoxy
9. Prepare small amount of epoxy
10. Epoxy inside parameter of the aft air frame just in front of the forward center ring location using craft stick taped onto dowel rod
11. Slide the motor mount tube into position
    a. 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
    b. The **Motor Mount Tube** should be flush with the aft side of the air frame
12. Allow epoxy to dry

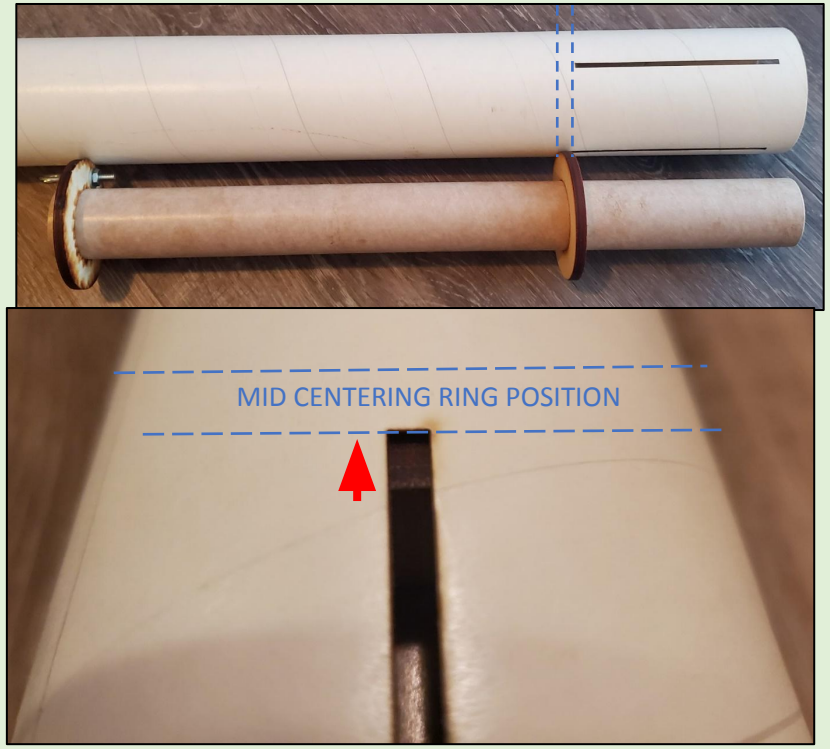


Figure 13-22: Relative Position of MMT Assembly Once Installed in Airframe (Top); Mid Centering Ring Should Sit Forward of Fin Slots (Bottom)

Rocketry 101 - 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

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

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

Rocketry 101 – Propulsion Overview

Figure 6-1: Motor Kit Example

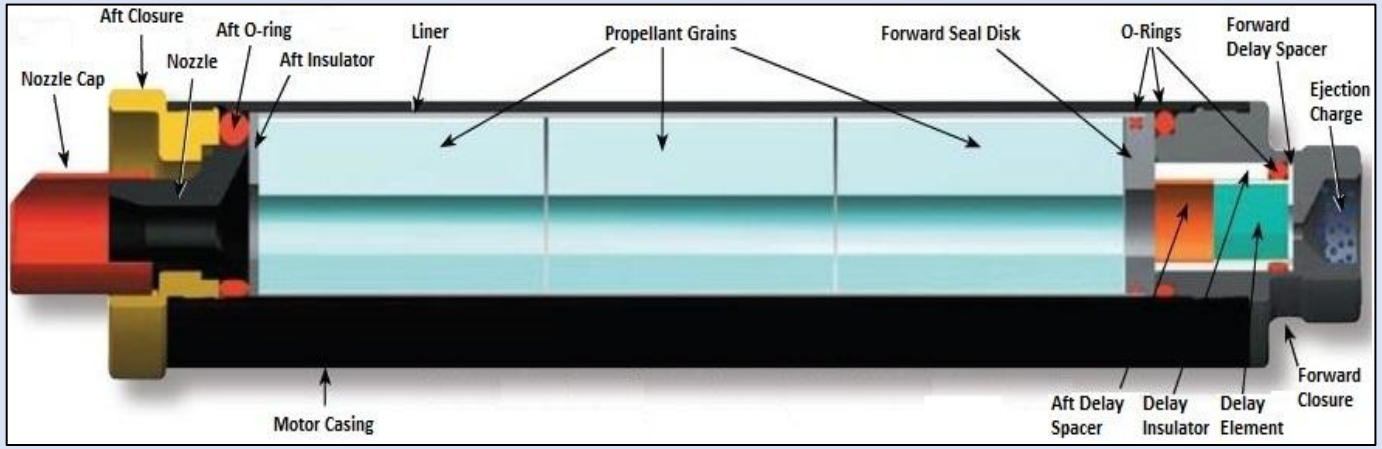


Figure 6-3: Cutaway Drawing of Typical Assembled RMS-Plus Motor

Figure 6-2: Cesaroni Motors

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

Handbook Reference: *6b-c. 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

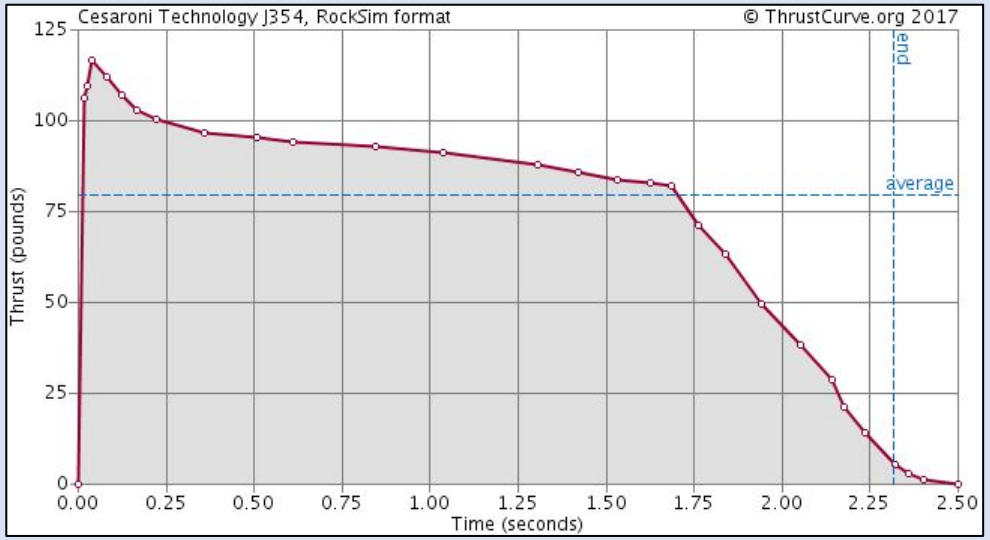


Figure 6-5: Thrust Curve Example

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

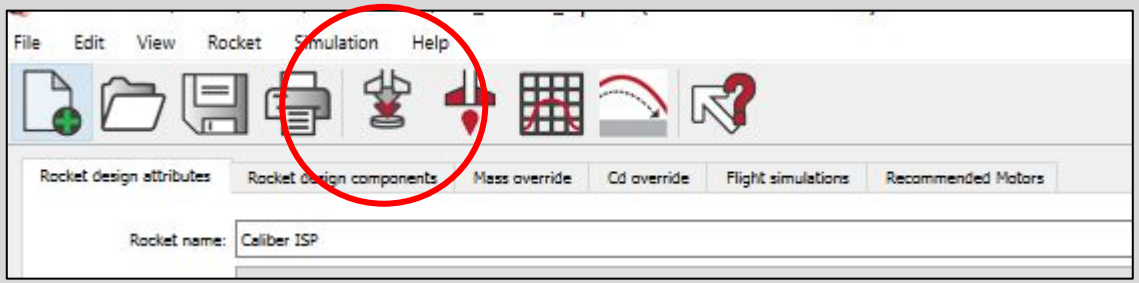


Figure 11-7: Prepare for Launch Icon

1. Select the ‘Prepare for Launch’ icon

2. Select the ‘Choose Engine’ tab

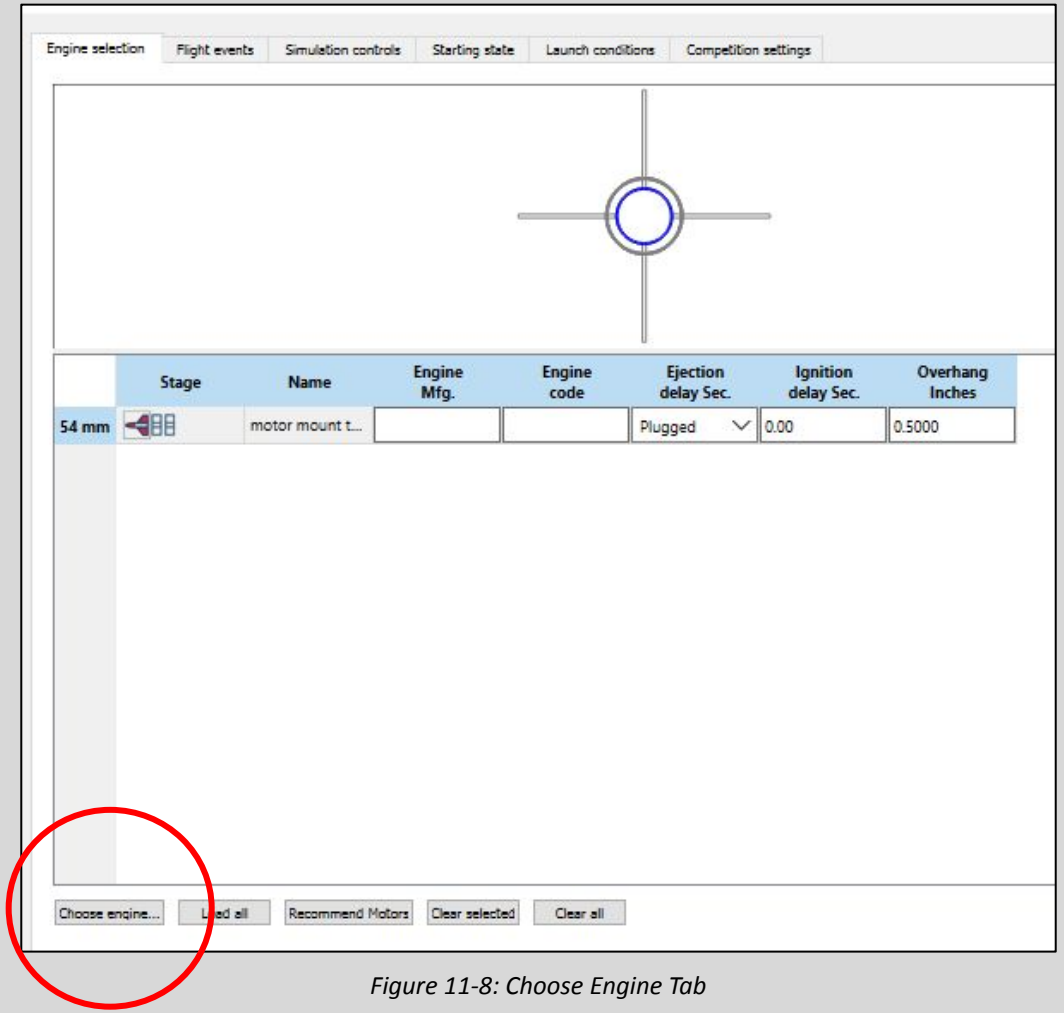


Figure 11-8: Choose Engine Tab

Rocketry 101 - RockSim Motors

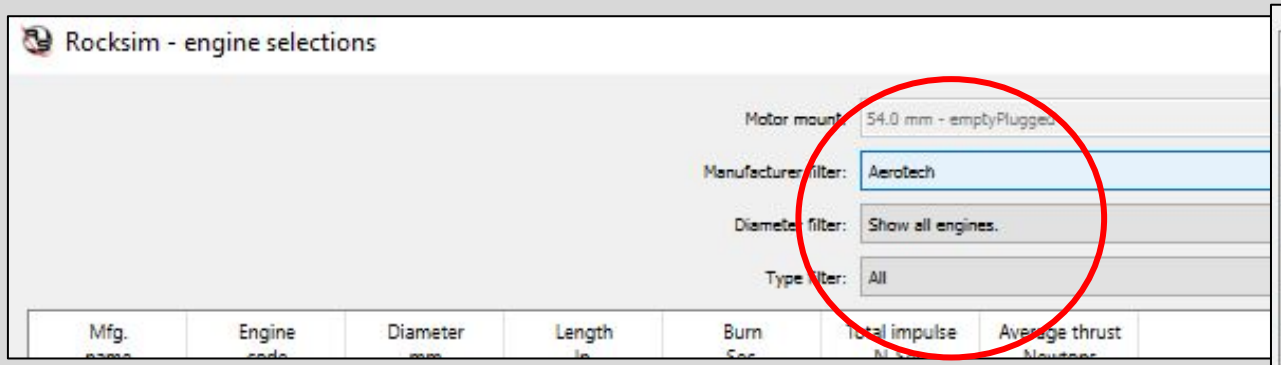


Figure 11-9: Manufacturer Field and Diameter Filter

3. Select 'Aerotech' in the Manufacturer Filter field

4. Select the 'Show all engines' in the Type Filter field

5. 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

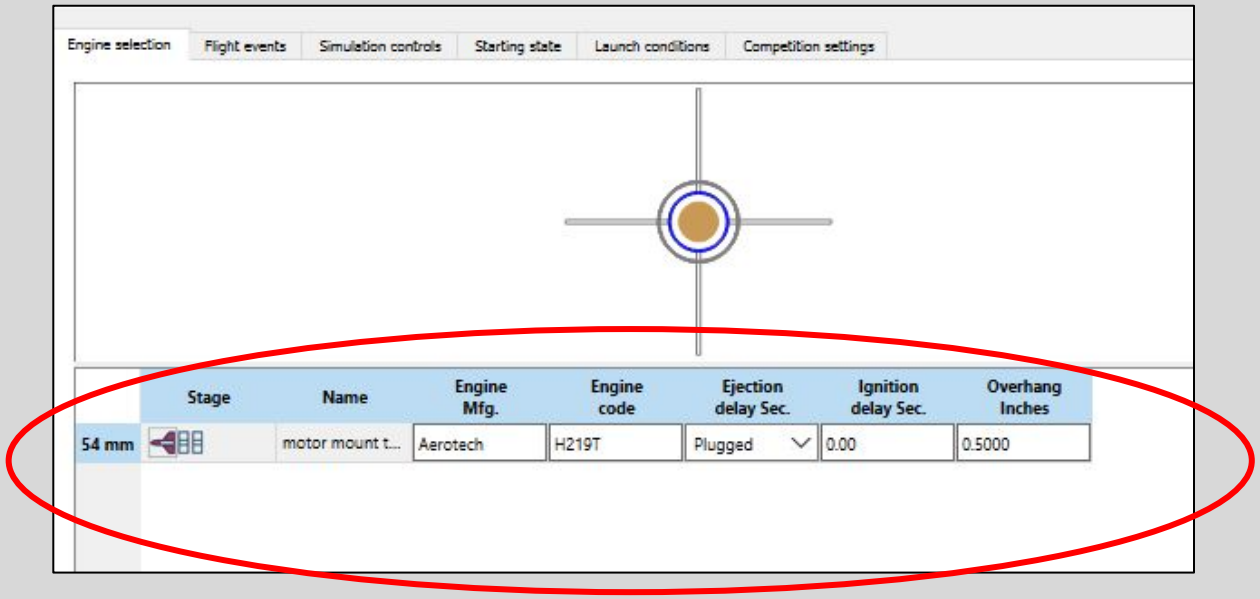


Figure 11-11: Motor Uploaded to RockSim

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 #8 ½” wood screw (longer pointed screw) to keep the nose cone from separating in flight (but allow for removal of nose cone)

4. Seam along nose cone (flash) may be sanded with fine grain sandpaper (at least 200 grit) (while waiting for fin epoxy to set)

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*

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

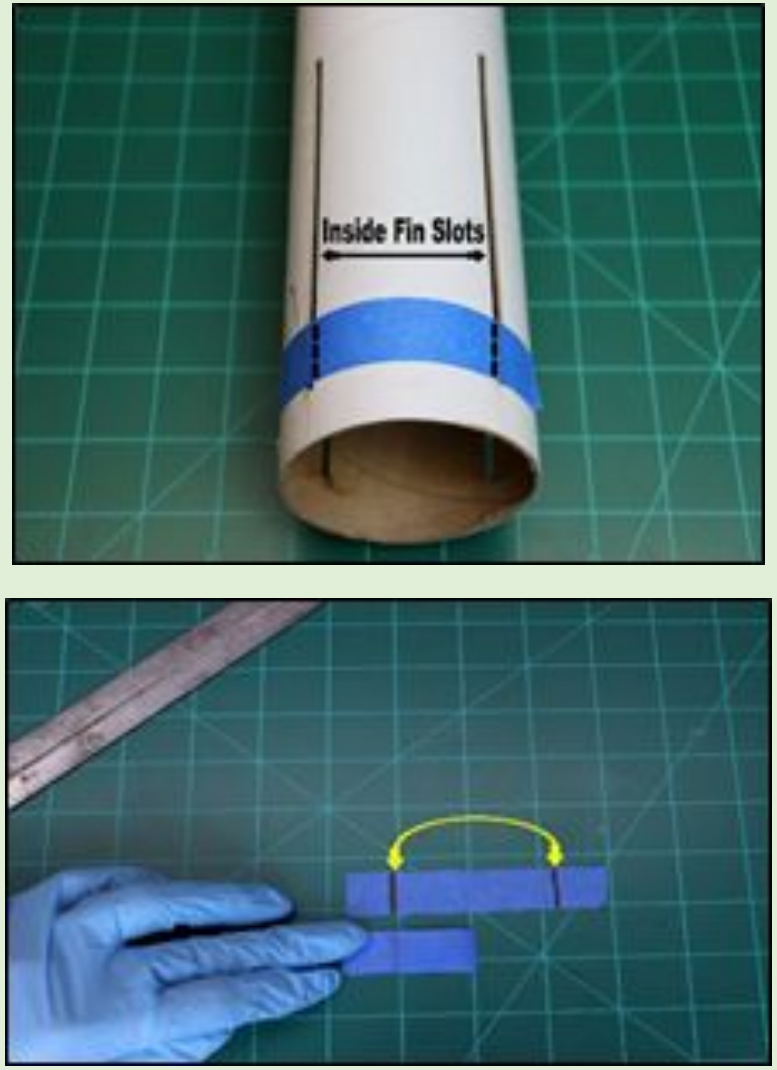


Figure 13-25: Measuring Fin Slots (Top); Measuring Half Way between Two Fin Slots (Bottom)

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

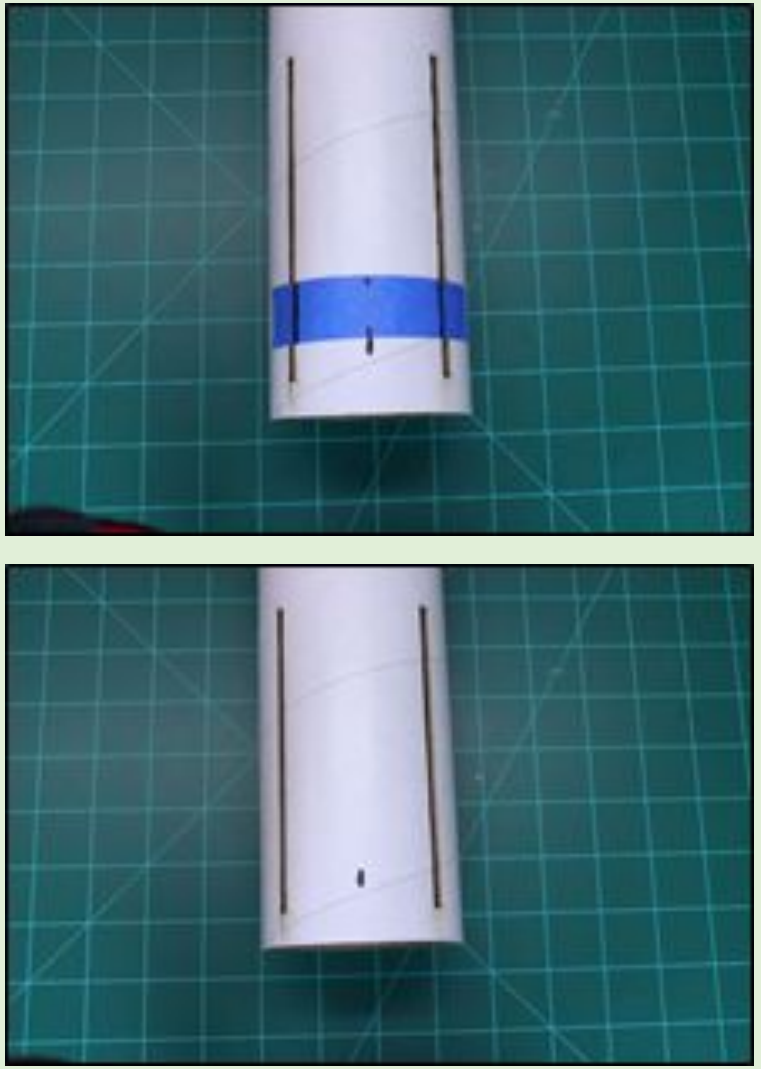


Figure 13-25: Drawing a Line at the Half Way Mark on Tape(Top); Drawing the Half Way Mark on the Air Frame (Bottom)

Rocket Build – Assembly

Rail Button Alignment

8. Draw a line halfway up the air frame

9. This is the line the rail buttons will be installed on after the fins have been installed

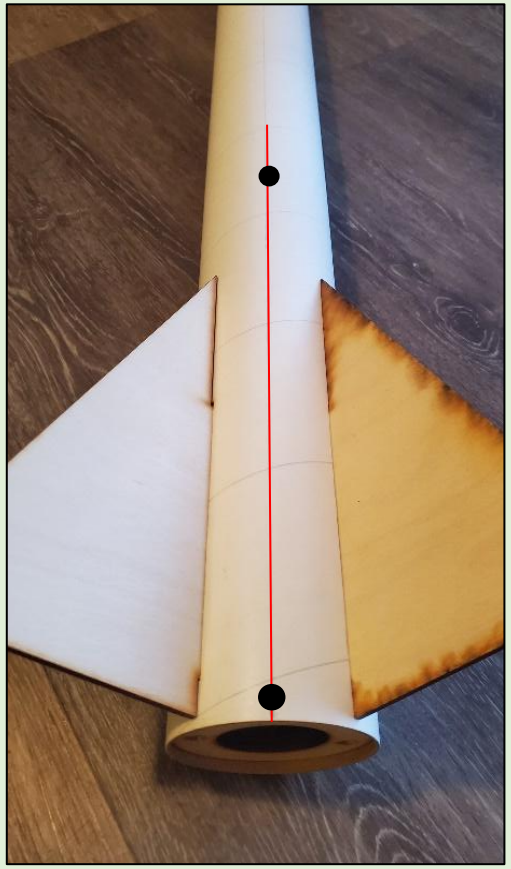


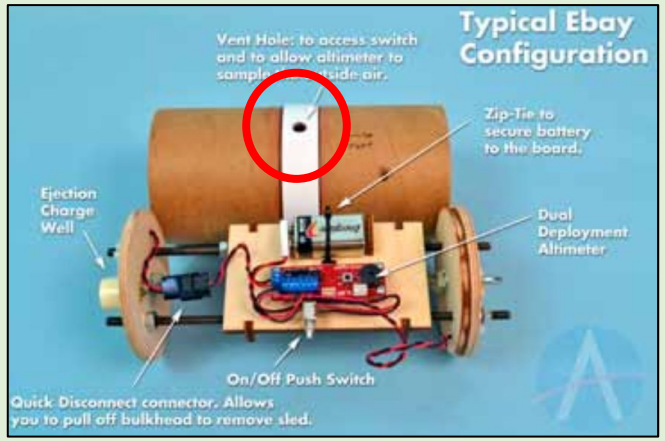
Figure 13-25: Markers to Indicate Rail Button Placement/Alignment (Bottom)

Figure 13-26: Rail Buttons are Drilled into the Mid-Centering Ring (Top) and Aft-Centering Ring (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



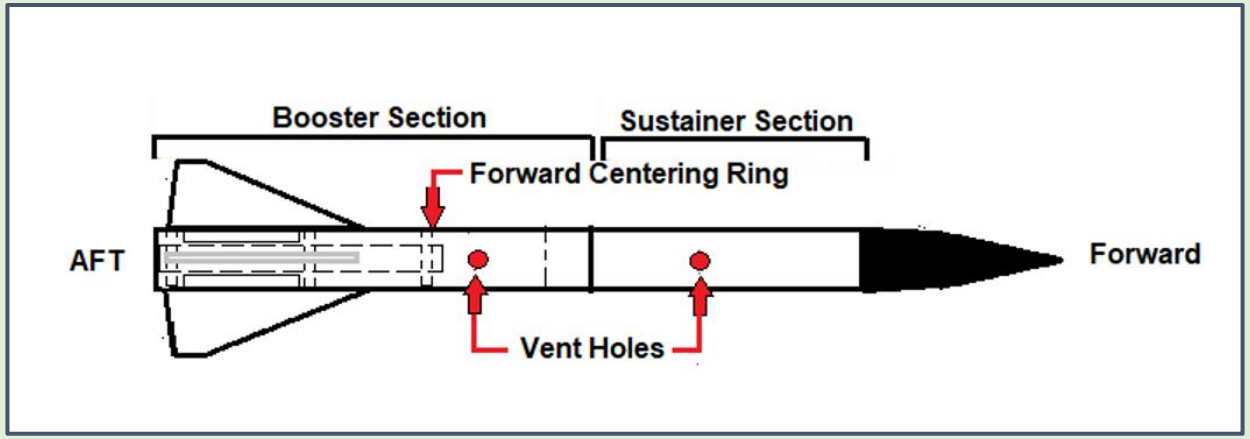


Figure 13-27: Vent Holes Indicated in Red on Rocket Airframe

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

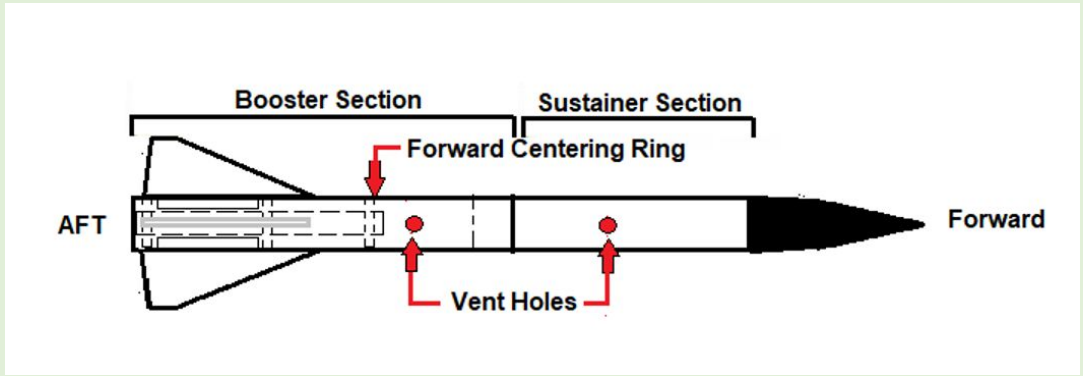


Figure 13-27: Vent Holes Indicated in Red on Rocket Airframe

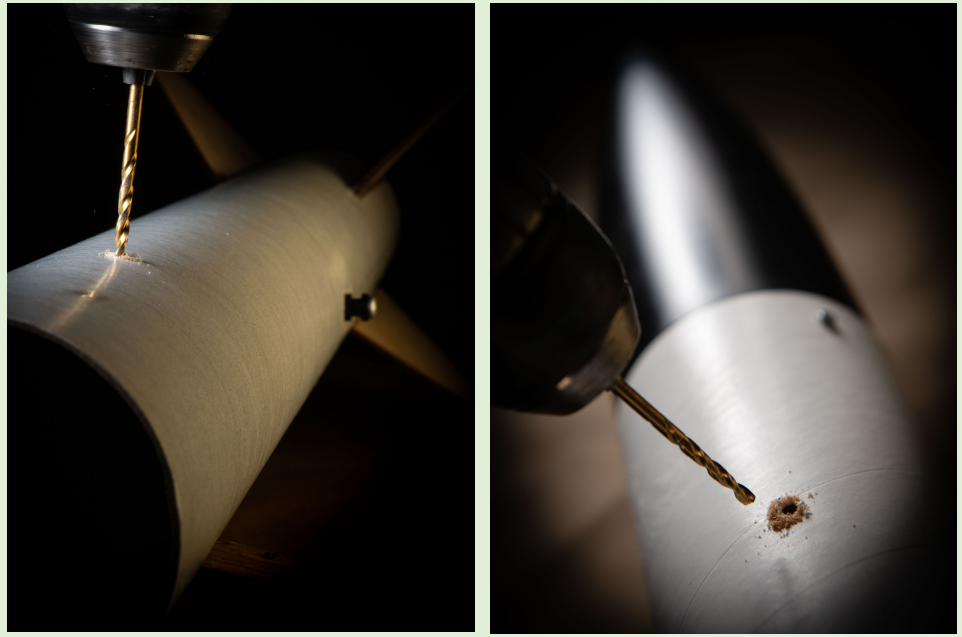


Figure 13-28: Drilling Vent Hole in Booster Section to Not Interfere with Rail Buttons Alignment (Left); Drilling Vent Hole in Sustainer Section (Right)

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

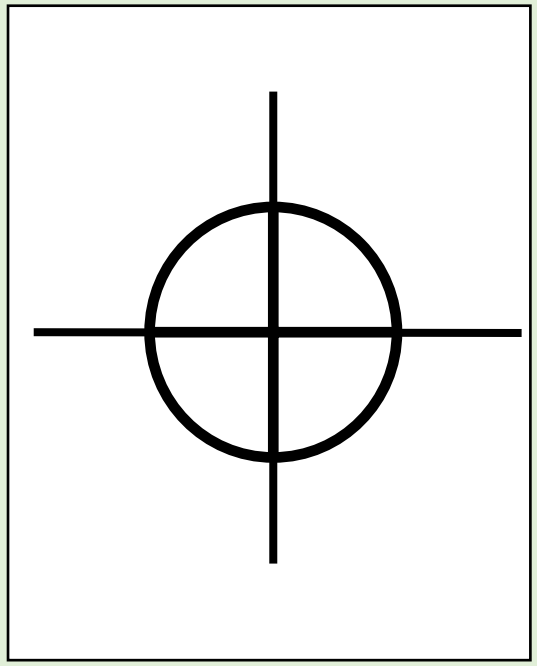


Figure 13-29: Align Each Fin to Crosshair Lines

<u>Dry-fit and Tack</u>

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. Put on gloves before preparing epoxy
6. Prepare small amount of epoxy

Rocket Build – Assembly

Fin Installation

7. Apply epoxy to “Tang” side of fin #1 (light tack)

8. The span (b) is placed at the aft end of the airframe

9. Insert fin into fin slot – repeat for each fin
   a. Ensure the tang touches the motor mount tube

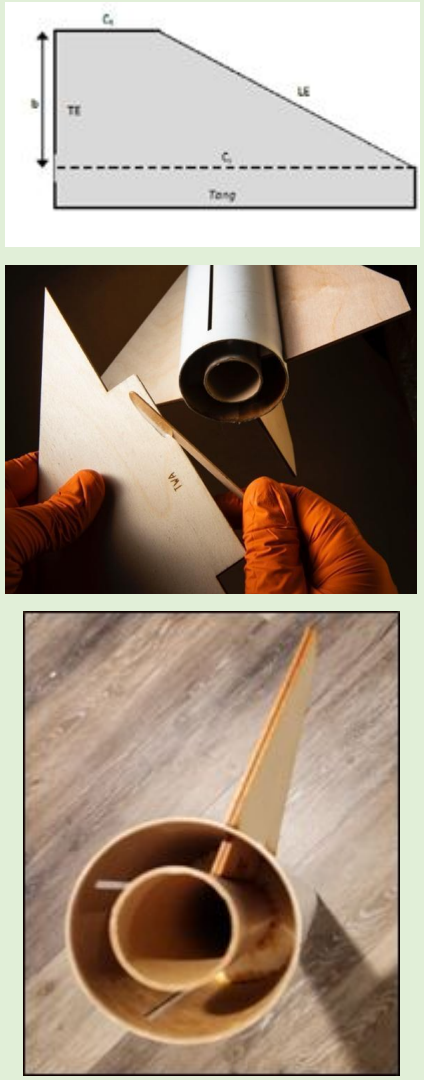


Figure 13-30: Tang Example (Top); Apply Epoxy to Tang (Center); Insert Tang in Fin Slot (Bottom)

Rocket Build – Assembly

Fin Installation

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

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

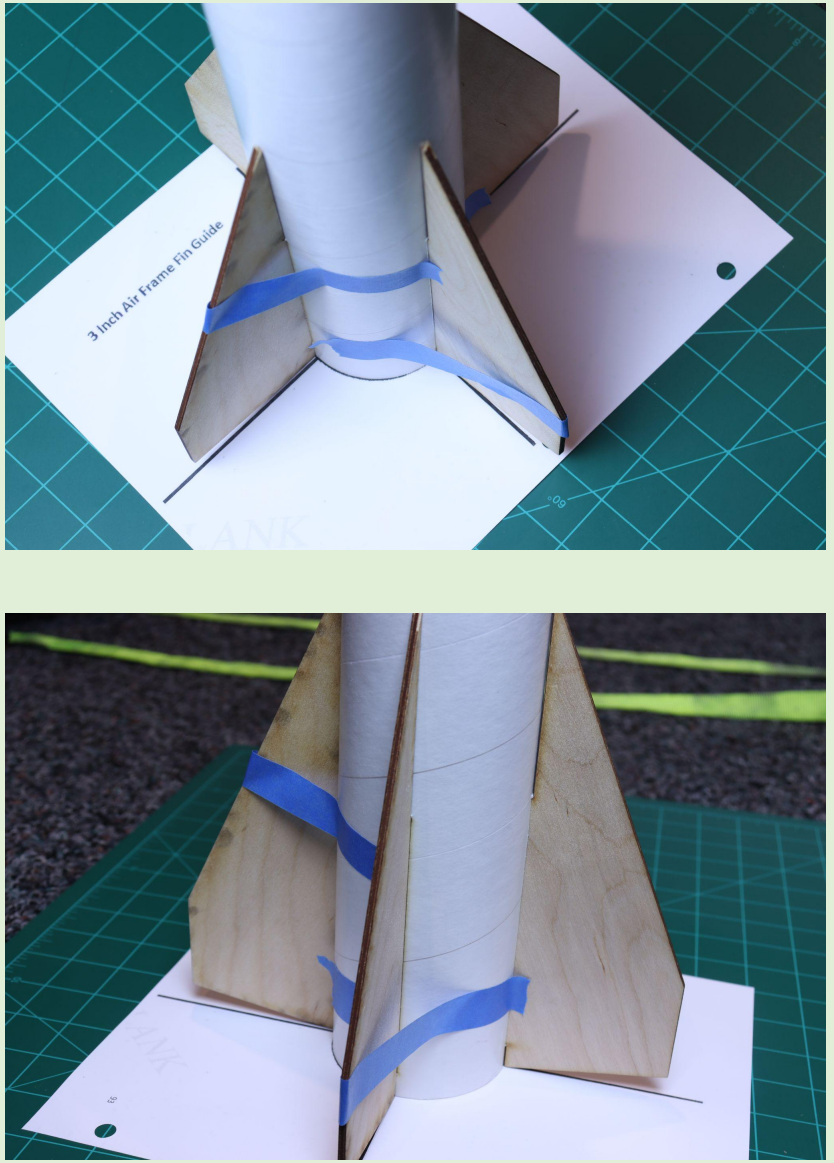


Figure 13-30: Figure 13-30: Tang Example (Top); Apply Epoxy to Tang (Center); Insert Tang in Fin Slot (Bottom)

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!)

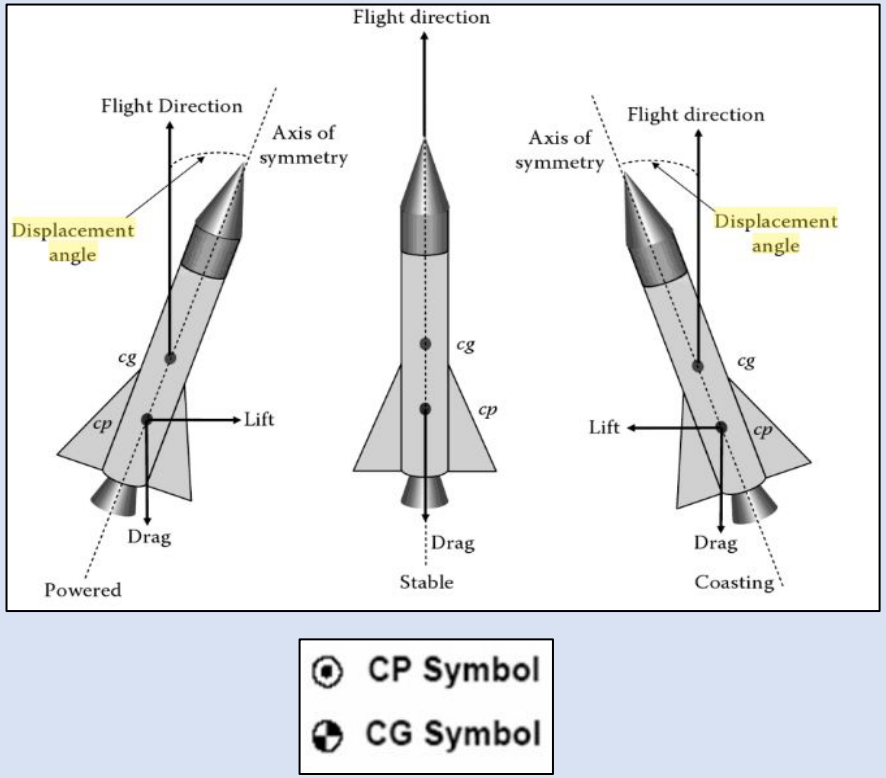


Figure 7-1: Rocket Stability Diagram

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)

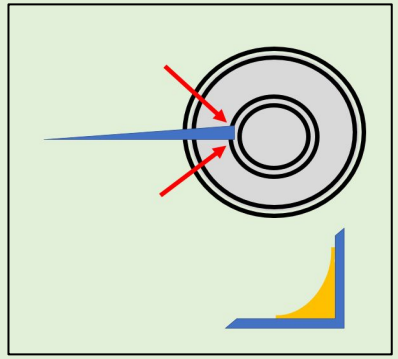


Figure 13-31: Epoxy Fillet to Seam Motor Mount and Tang

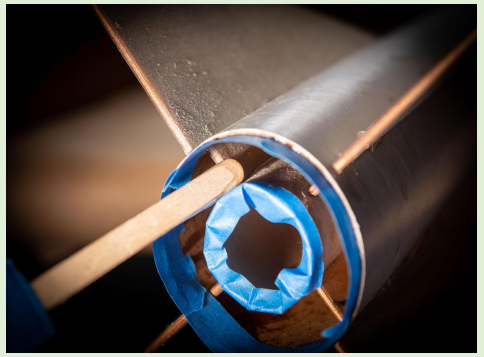


Figure 13-32: Use Craft Stick or Long Dowel to Apply Epoxy Fillet between Motor Mount and Fin

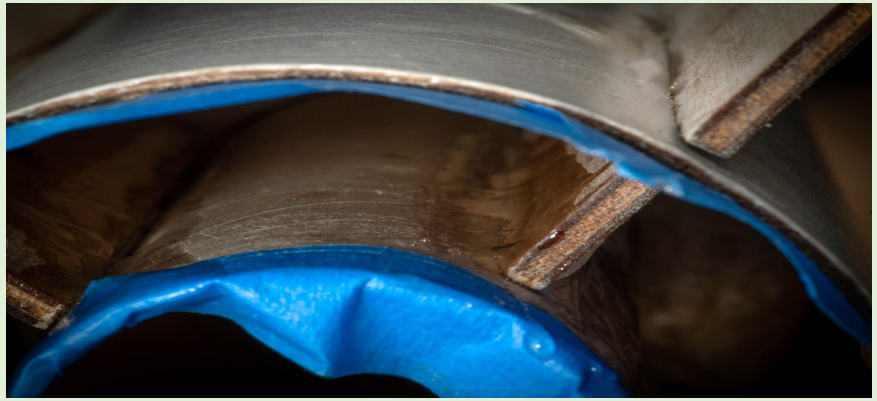
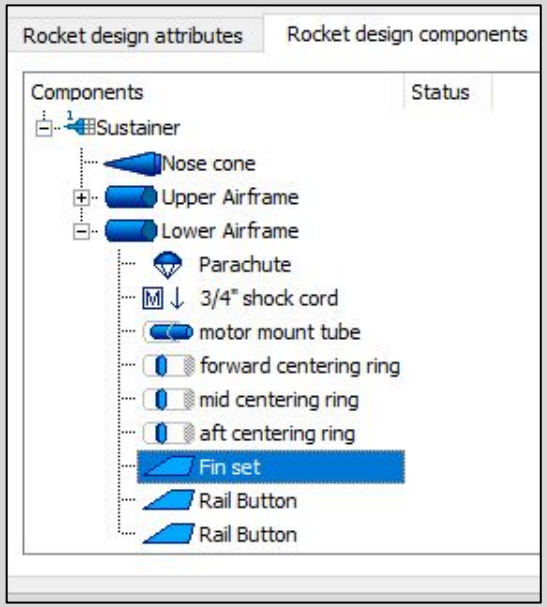
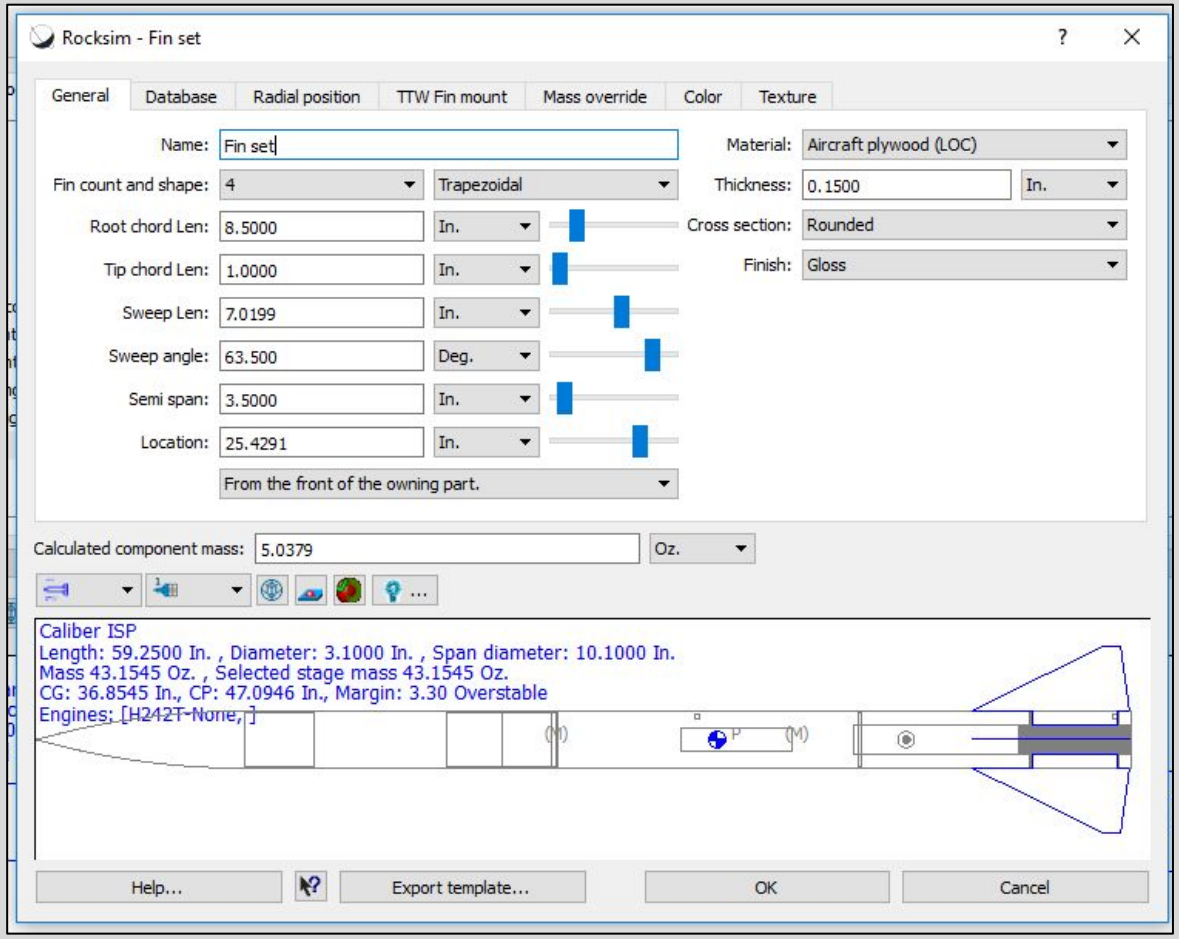


Figure 13-33: Fully Applied Epoxy Fillet between Motor Mount and Fin

Rocketry 101 - RockSim Update



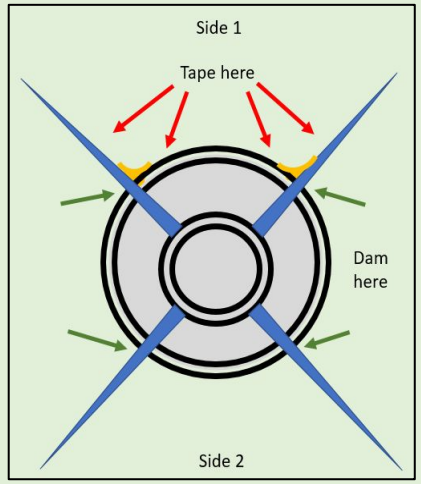


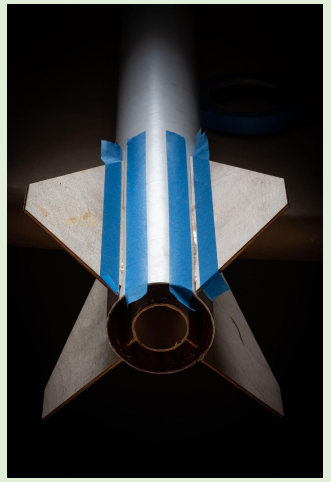
Rocket Build – Assembly

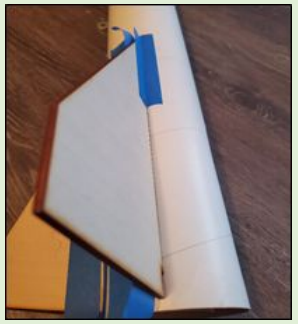
Fin Installation

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

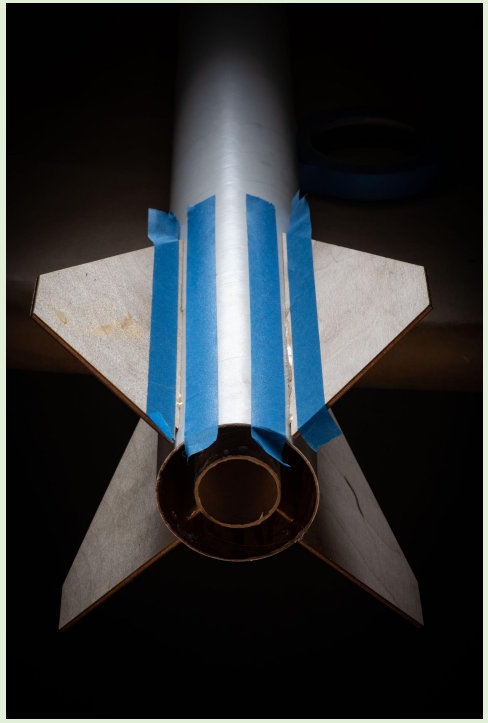


Figure 13-35: Tape Locations for Epoxy Fillets (Left, Center); Dam Locations (Right)

Rocket Build – Assembly

Fin Installation

Outer Fin Fillets (Epoxy)

1. For Side 1 (as shown):
   a. Put on gloves before preparing epoxy
   b. Prepare small amount of epoxy
   c. Fill in gap with epoxy (both fins) – let set few minutes, ensure epoxy is not leaking past dam on underside
   d. Epoxy along entire length of fin root, create smooth fillets (both fins)
   e. Remove dam tape from underside after 10 minutes
   f. Remove fillet tape from Side 1 (tube and fins)
   g. Let set up for 10 – 15 minutes
2. Rotate rocket 180 degrees, and repeat for Side 2
3. Sides 3 and 4 do not require a dam step, fillet only

Fin failure (1:00)

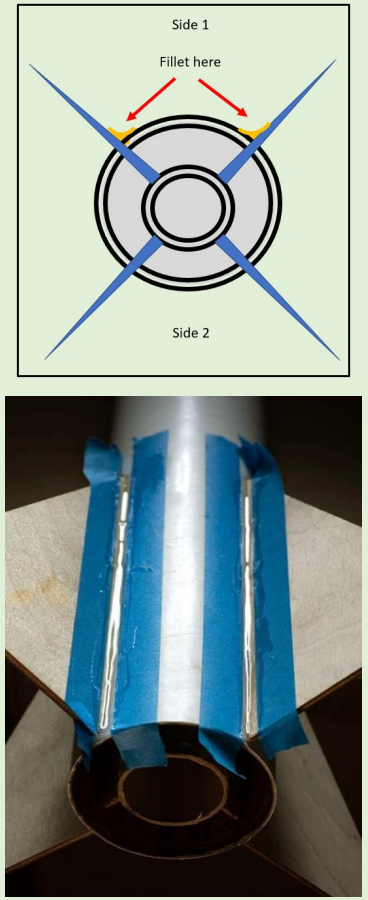


Figure 13-36: Fillet Diagram (Top); Fin Fillet Fill (Bottom)

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?
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 long machine screws into retaining nuts for use as handle
   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

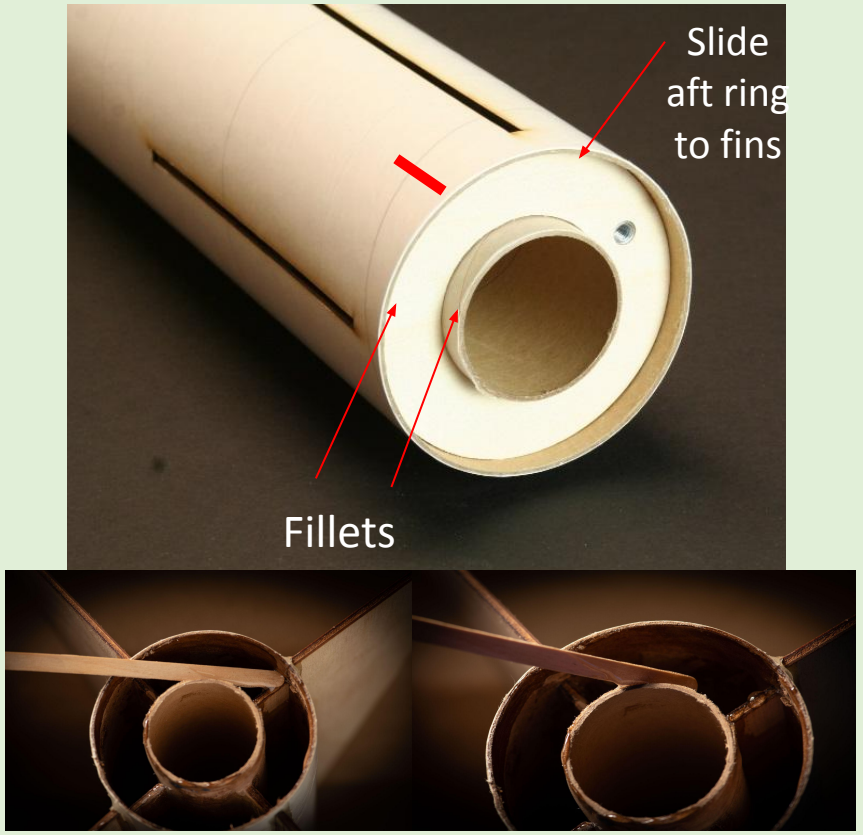


Figure 13-37: Slide Aft Ring to Fins (Top); Epoxy Outside of MMT (Left Middle); Epoxy Inside of Airframe (Right Middle)

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 T-nut is offset from rail button mark and fin tang**
7. Apply fillet on aft end of aft CR
   a. Avoid getting epoxy on T-nut, in MMT and in motor retention system
   b. (Optional) Tape MMT to avoid getting epoxy on MMT
   c. (Optional) Add screw into hole

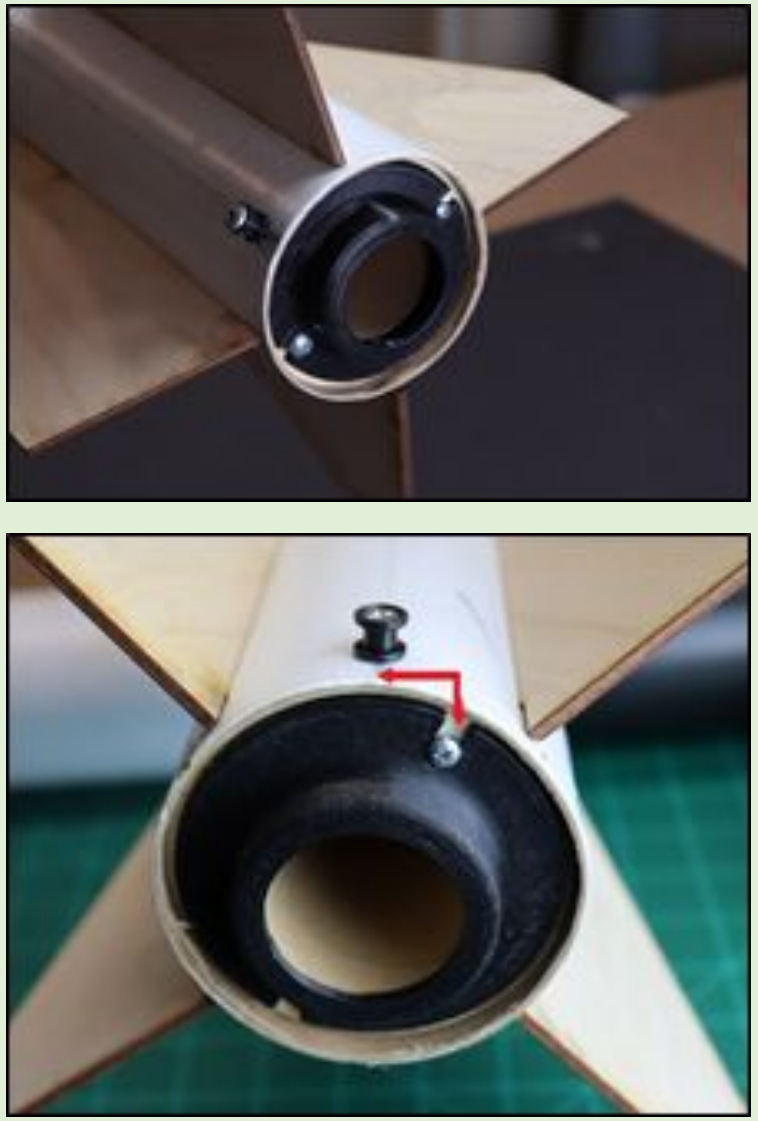


Figure 13-37: Rail Button, T-Nuts and MMT Cap Installed (Top); Offset between T-Nut and Rail Button (Bottom)

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

Rocket Build – Assembly

Rail Button Installation

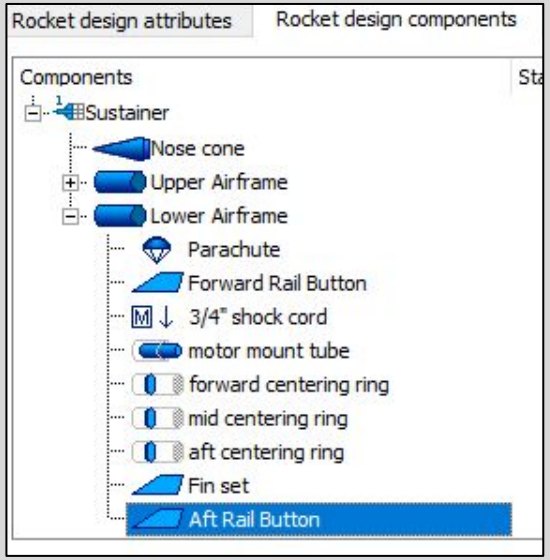
Rail Buttons are installed so that your rocket can be fit to a standard launch rail

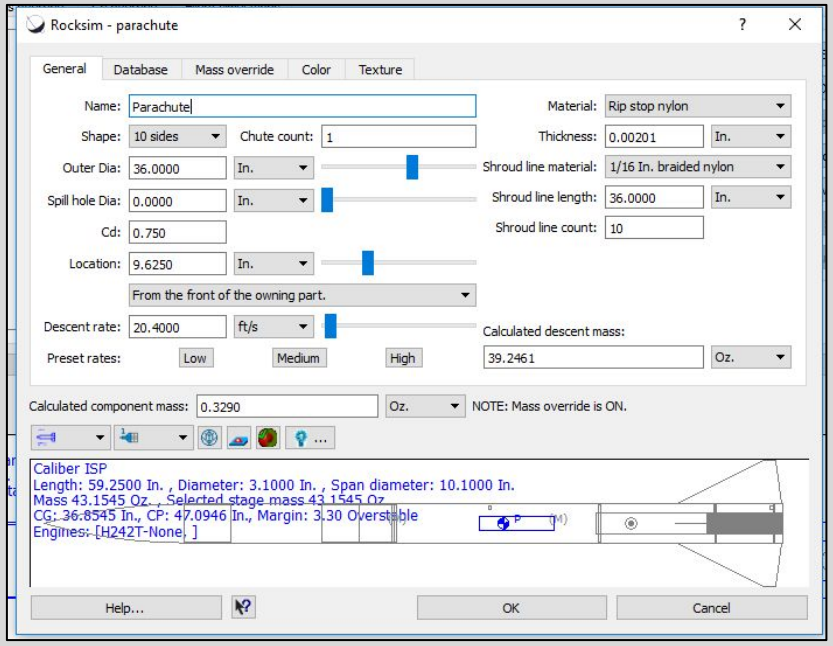
The bottom rail button will be installed into the aft centering ring, while the top rail button will be installed into the airframe (with backing nut – or into forward centering ring)

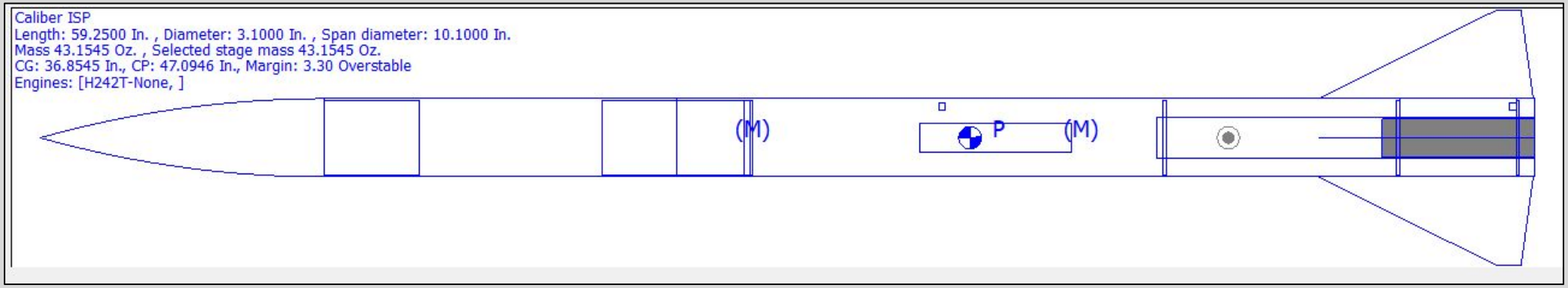
1. Mark an ‘X’ on the vertical line where it intersects the aft CR
2. Mark an ‘X’ on the vertical line near the forward CR
   a. Attach dowel to your ruler, insert into forward end of airframe until it touches the forward CR
   b. Mark line on dowel indicating end of airframe, remove and place on top of airframe to use as “measuring tape”
3. Drill holes using a 1/8” drill bit – ensure hole is perpendicular to surface
4. Dab epoxy in hole
5. Attach rail buttons and pointed screws into place

Figure 13-38: Rail Button Alignment on Launch Rail (Top); Marking an ‘X’ on the Vertical Line Where the Line Intersects with the Aft and Forward Centering Ring (Bottom)

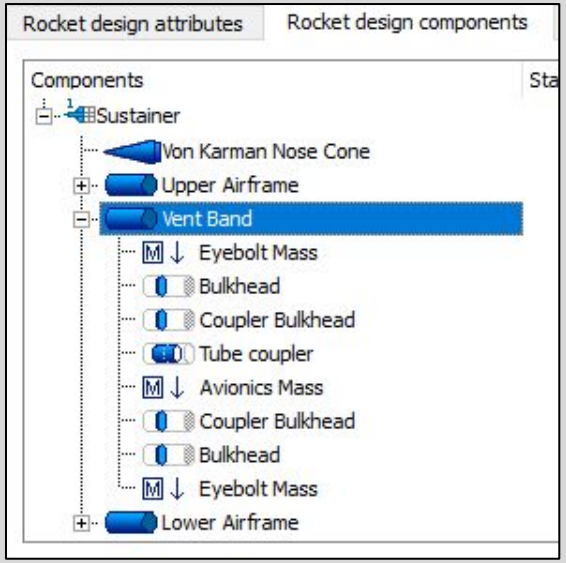
Rocketry 101 - RockSim Update

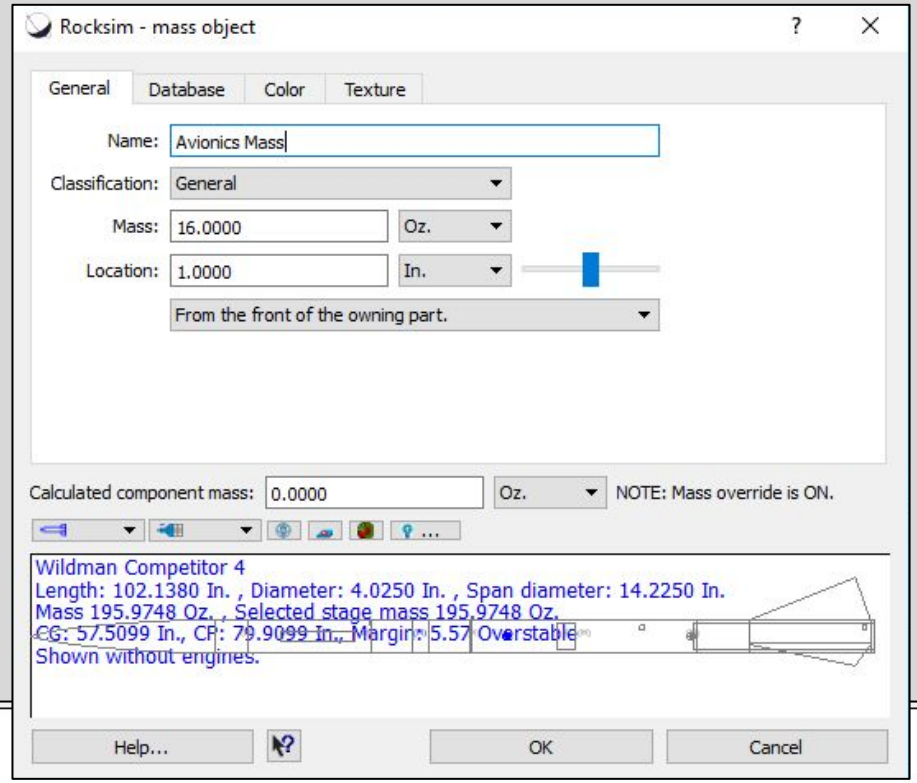


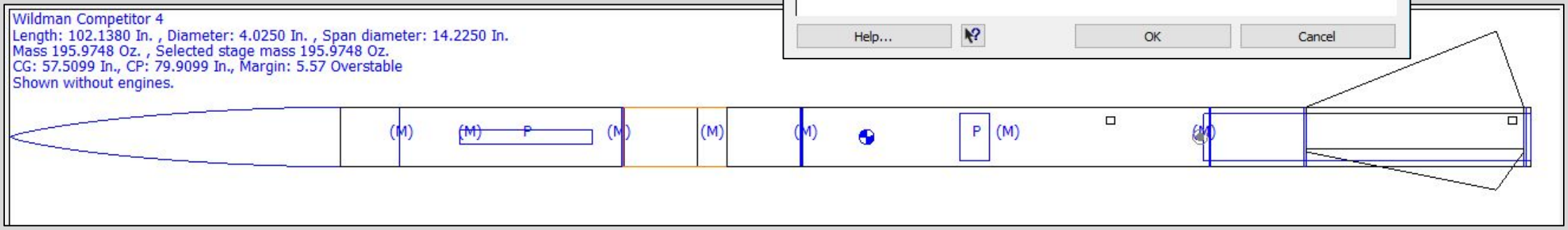




Rocketry 101 - RockSim Update







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

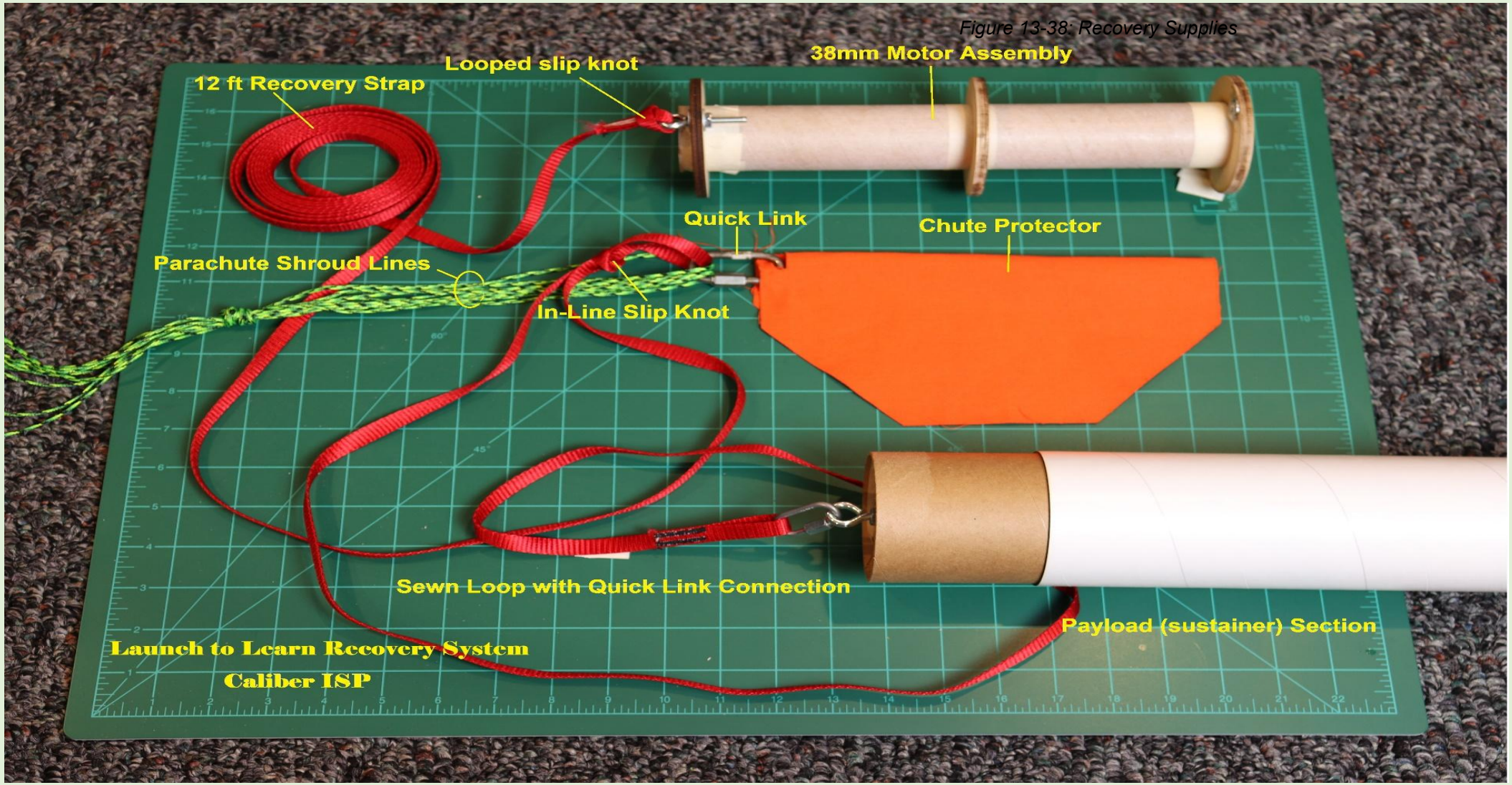


Figure 13-38: Recovery Supplies

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. 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

Figure 13-46: Step 3 of Parachute Prep

4. Fold the parachute like a zig-zag

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
   a. **COVID restrictions**: Limitations on # of people at the launch site/pad, social distancing, mask mandates and temperature check regulations may be in place
   b. Presiding organization may require a COVID release form be signed
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 **Megan Goller** mgoller@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

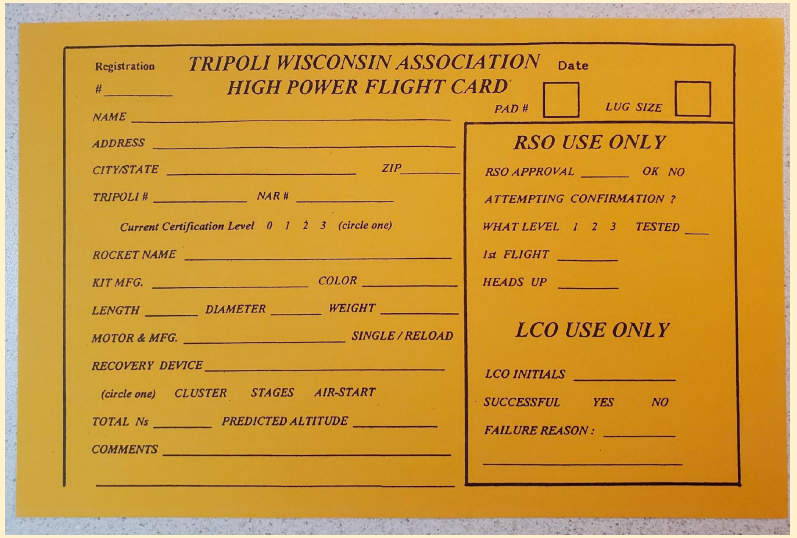
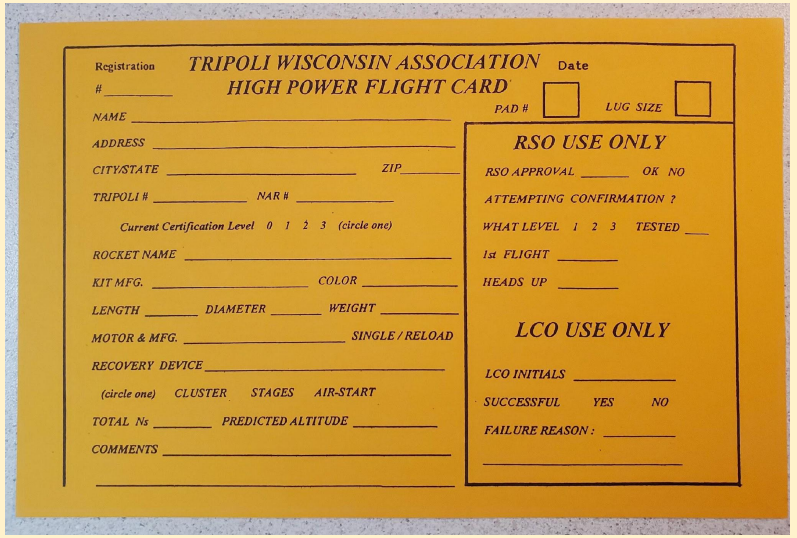

Registration # _____
TRIPOLI WISCONSIN ASSOCIATION
HIGH POWER FLIGHT CARD
Date
PAD #
LUG SIZE
NAME
ADDRESS
CITY/STATE ZIP
TRIPOLI # NAR #
Current Certification Level 0 1 2 3 (circle one)
ROCKET NAME
KIT MFG. COLOR
LENGTH DIAMETER WEIGHT
MOTOR & MFG. SINGLE / RELOAD
RECOVERY DEVICE
(circle one) CLUSTER 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
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
   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 :

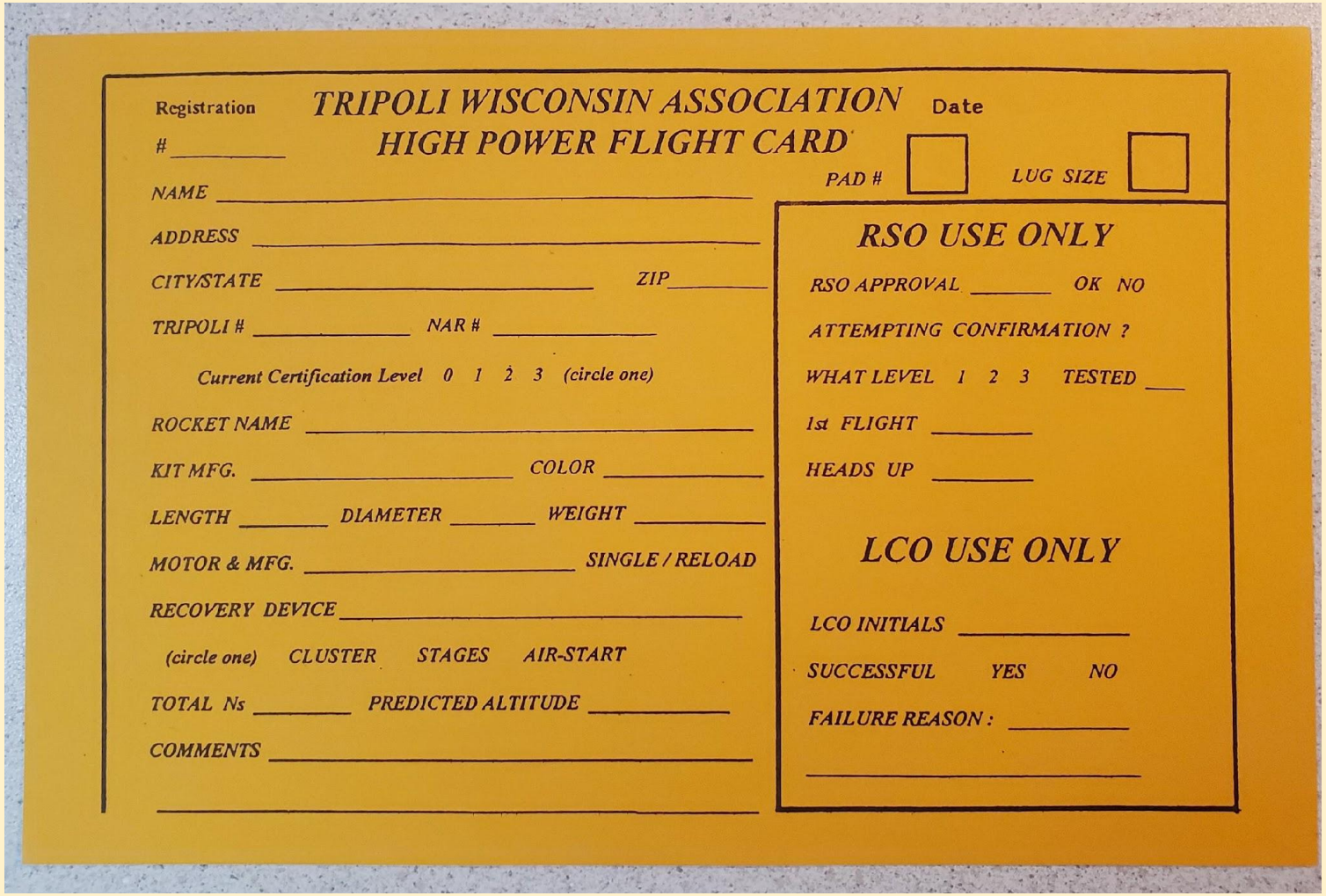
Figure 15-1: Tripoli Wisconsin Launch Card

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/Andrea

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

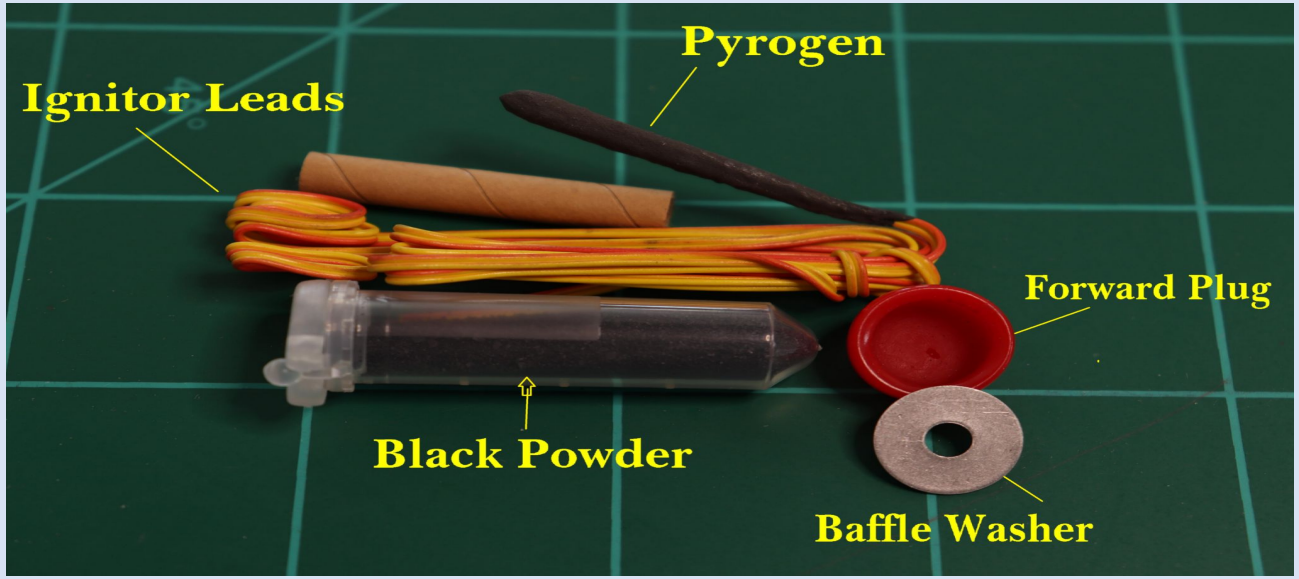


Figure 14-3: Certification Motor Parts

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

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
    b. Shake flakes out – discard
    c. Install Baffle Washer

Figure 14-4: Delay Tool

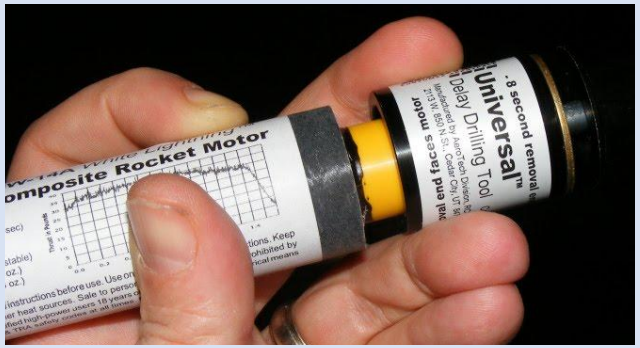


Figure 14-5 Removing seconds from delay

Figure 14-6: Install Baffle Washer

Certification Launch Preparation

Motor Preparation

d. Pour black powder into end

e. Place plug cap on end

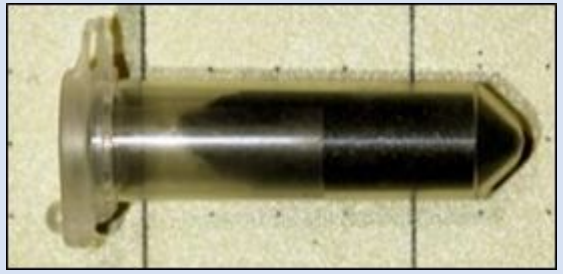


Figure 14-7: Black Powder Vial

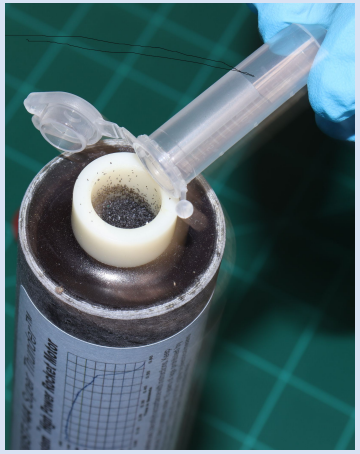


Figure 14-8: Pour Black Powder into Deployment Well

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)
2. If motor is difficult to insert
   a. May need to clean epoxy from inside of MMT
3. Attach motor retention to keep motor in place
4. Secure ignitor with tape to exterior of rocket for later

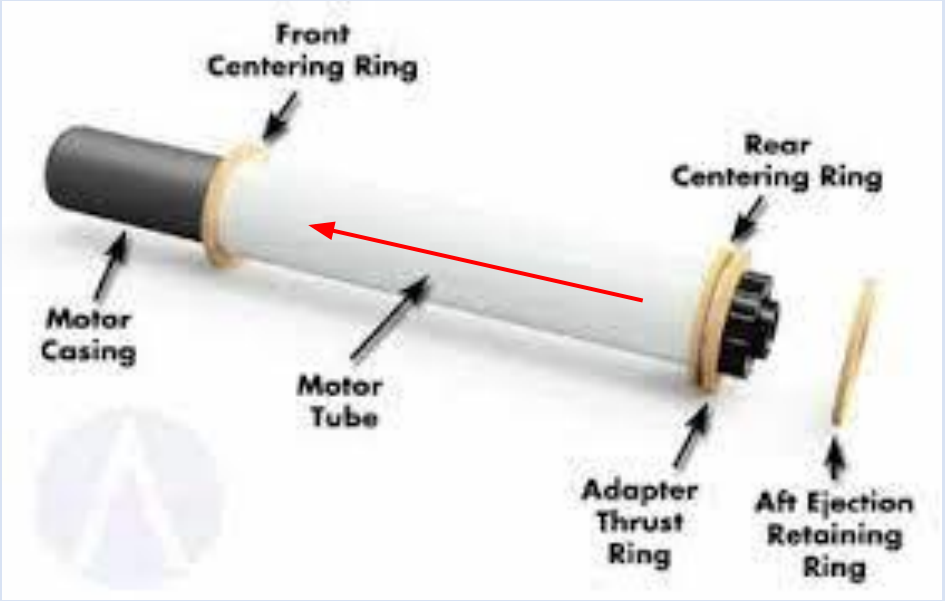


Figure 14-10: Motor Installation

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

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
2. Note the Landmarks
3. 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

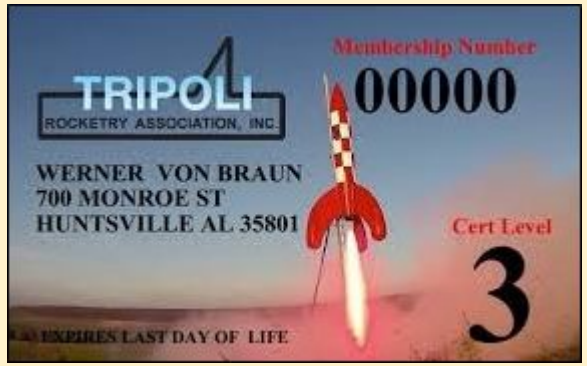


Figure 15-2: Tripoli Membership Card Example

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.
3. 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?

Christine

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 for The Everett Group:

Please fill out the workshop evaluation questionnaire here:

https://forms.gle/HfyoLWQUru2uq85c6

QUESTIONS?