Launch 2 Learn

Introductory Rocket Workshop

January 29-30, 2021

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

**Wisconsin Space Grant Consortium**
- Christine Bolz, *WSGC Assistant Director*
- Danielle Weiland, *WSGC Project Coordinator*
- Connie Engberg, *WSGC Project Support Assistant*

**Tripoli Rocketry Association**
- Frank Nobile, *CRL & FNL Technical Advisor*
- Bob Justus, *IL Tripoli Assistant*
- Kevin Harnack, *WI Tripoli Assistant*

**AIAA**
- Trent Cybela, *WSGC CRL Alumni*
- Jane Denali, *WSGC CRL Alumni*

**Faculty and Student Introductions**
- **Name**
- **Area of instruction/study**
- **Rocket experience**
- **Goals/expectations for the workshop**

Christine
Workshop Presentation – Formatting Note

Rocketry Overview & Fundamentals
  • Colored / Highlighted blue

Rocket Workshop Build
  • Colored / Highlighted green

Rocketry Simulations
  • Colored / Highlighted grey

Competition Support & Project Management
  • Colored / Highlighted yellow
Workshop Schedule

Friday Evening
- Introduction & Overview
- Rocket Build - First Level 1 Kit
- RockSim Intro
- Epoxy & Pre-Fit Check Overview
- Pre-Fit Check Overview & Build
- Motor Mount Assembly & Build

Saturday Morning
- Coupler Assembly & Build
- Motor Mount Assembly & Build
- Propulsion, Coupler, & Sustainer Overview
- RockSim Overview
- Nosecone Installation & Build
- Rail Button Alignment, Vent Hole Installation, & Build

*LUNCH BREAK*

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

**BREAK**

- Aft Centering Ring Installation Overview & Build
- Rail Button Installation Overview & Build
- RockSim Update
- Recovery Installation & Build
- Parachute Preparation & Build
- Recovery Electronics
- Choosing a Dual Deploy Rocket
- Certification Launch Guidelines
- Workshop Review, Survey, Q&A
Virtual Workshop Expectations

ZOOM platform
- Danielle will be our workshop moderator, helping you with technical difficulties
- Keep your camera/video on
  - 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
- Keep your audio muted during overviews, unmuted during build activities
- Breakout rooms – teams will be assigned to a breakout room for individualized assistance

Launch 2 Learn Handbook
- Handbook reference on bottom right-hand corner of slide
- Take notes
- Overview (sections 1-12), build (section 13), certification (section 14), and project management (section 15) with page references

RockSim
- Install RockSim with the “key” provided by WSGC

Rocket build
- Instructors will walk you through each build section
- You are encouraged to complete your build in real time with the instructors
- After the instructor completes the section walkthrough, you will be broken into small breakout rooms where you can ask for help, finish your build, and have it assessed by the instructors for safety and stability
**Workshop Materials & Supplies**

<table>
<thead>
<tr>
<th>ITEM DESCRIPTION</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launch 2 Learn Handbook*</td>
<td>1</td>
</tr>
<tr>
<td>LOC Precision – 3.10” Caliber ISP Rocket*</td>
<td>1</td>
</tr>
<tr>
<td>Epoxy*</td>
<td>1</td>
</tr>
<tr>
<td>Wooden Craft Sticks*</td>
<td>10</td>
</tr>
<tr>
<td>Sandpaper*</td>
<td>1</td>
</tr>
<tr>
<td>Pencil*</td>
<td>1</td>
</tr>
<tr>
<td>Wooden dowel*</td>
<td>1</td>
</tr>
<tr>
<td>X-Acto Knife*</td>
<td>1</td>
</tr>
<tr>
<td>Masking Tape*</td>
<td>1</td>
</tr>
<tr>
<td>Nitrile Gloves*</td>
<td>5</td>
</tr>
<tr>
<td>Alcohol (wipes or bottle)*</td>
<td>15 or 1</td>
</tr>
<tr>
<td>Ruler</td>
<td>1</td>
</tr>
<tr>
<td>Drill</td>
<td>1</td>
</tr>
<tr>
<td>Screw Driver Set</td>
<td>1</td>
</tr>
<tr>
<td>Paper Towel</td>
<td>1</td>
</tr>
<tr>
<td>Paper or Plastic Table Runner</td>
<td>1</td>
</tr>
</tbody>
</table>
Workshop Objectives

• Introduce design, build, fly concepts
  • Remember this is only an introductory workshop, there is not enough time to cover all aspects in greater detail

• Build a high-powered single deploy kit rocket
  • We will build the LOC Precision Caliber-ISP kit

• Present the difference between single deploy and dual deploy rockets

• 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
CRL - Website
Student - Tools & Tips

- CRL Resources
- Webinars & Presentations
- Reimbursement Request Forms
- Travel and Accommodations
- Local Contacts
- Safety
- Vendors
- Logos
- General Resources
- Team Building Resources
- Rocket Video/PDF Resources

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

• National Organizations and Regulation
  • National Association of Rocketry (NAR) [https://www.nar.org](https://www.nar.org)
  • Tripoli Rocketry Association (TRA) [http://www.tripoli.org](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
Rocketry 101 – General Flight

Figure 4-1: Single Deploy Flight Profile

Figure 4-2: Dual Deploy Flight Profile

Handbook Reference: 4c. Launch Profile Overview, pg 10-11
Rocketry 101 – Competition Flight
Rocketry 101 - Structures

Figure 5-1: High-Power Rocket with Coupler
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

Rocketry 101 – RockSim Introduction

• Simulations are THE key component to high powered rocket design

• Competition kit selection is made by researching the various rocket options on various vendor websites
  • Some vendors can be found on Tripoli website: http://www.tripoli.org/Vendors
  • Wildman and Apogee will sell kits manufactured by LOC Precision and Madcow

• For an introduction to RockSim
  • Import a pre-existing model of a LOC Precision-Caliber ISP kit
  • Can utilize website https://www.rocketreviews.com/rocksim-library.html
  • Once imported, ensure the model matches the actual rocket

Rocketry 101 – RockSim Introduction

Rocket Build – Assembly

Epoxy Overview

• Normally a two-part chemical mixture
  o A resin
  o A hardener
  o Usually mixed in a 1:1 ratio

• Various Types Based on Material and Strength
  o Time, Strength
  o JB Weld – metallic bonding
  o Silica additive can be used for fin fillets

• Epoxy Fillets
  o Creates a strong bond between two surfaces
  o Applied with a craft stick in single smooth line to create a valley between two surfaces

Learn more about epoxy:

Or see the NASA Handbook for construction tips
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 Ring

1. Identify and label centering rings
2. Sand MMT just enough to remove glassene
3. Sand inside of centering rings so they fit into MMT
4. Install eyebolt into the **Forward** centering ring
5. Install motor retention threaded T-Nuts onto **Aft** centering ring
6. One nut on the eyebolt side of the centering ring (depends on hardware)
7. Small washer and nut on the back end of the centering ring

Figure 13-2: Forward Centering Ring with Eyebolt Installed (top left); Aft Centering Ring with T-Nuts Installed (bottom left); Aligned Centering Rings (right)
Rocket Build – Pre-Fit Check

**Bulkplate**

1. Install an eyebolt into the bulkplate
2. One nut on the eyebolt side of the centering ring
3. Small washer and nut on the back end of the bulkplate
4. Dry-fit bulkplate into coupler tube (using eyebolt as handle)
5. Sand outside of bulkplate for proper fit
6. Place the **Coupler Bulkplate** 1/4” from end of the coupler

---

Figure 13-3: Bulkplate and Eyebolt

Figure 13-4: Eyebolt Installed in Bulkplate

Handbook Reference: 13a.ii. Pre-Fit Check - Bulkplate, pg 53
Rocket Build – Pre-Fit Check

Centering Ring Alignment

1. Centering rings should fit on motor mount tube

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

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

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

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

Handbook Reference: 13a.iii. Pre-Fit Check – Centering Ring Alignment, pg 54
Rocket Build – Pre-fit Check

**Airframe**
- Rough sand around fin slots of airframe tube (for adhesion)

**Fins**
- Fit fins into airframe tube slots – sand as needed to fit

**Nosecone**
- May sand seam of nosecone for finish (use fine sandpaper)

Handbook Reference: 13a.iv-vi. Pre-Fit Check, pg 56

Frank
Participant Work Session

Complete Pre-Fit Check

Return to Main Room at 7:35pm CST

Handbook Reference: 13a. Rocket Build – Pre-Fit Check, pg 51-57
Rocket Build – Assembly

Motor Mount Assembly

1. **Dry-fit Step**: Fit the mid-centering ring at the measurement marked in previous step – then slide ring down below lines
   a. Apply epoxy to the motor tube on the lines drawn for mid-centering ring
   b. Slide the mid-centering ring just ahead of the forward fin slot on the marked line, using twisting motion

2. **Dry-fit Step**: Fit the forward centering ring at the measurement marked in previous step – then slide ring down below lines
   a. Apply epoxy to the motor tube on the lines drawn for forward centering ring
   b. Slide the forward centering ring to the marked line(s), using twisting motion

3. Apply small dabs of epoxy to eyebolt threads and T-nuts (do not get epoxy in T-nut threads)

4. Set motor mount assembly aside, allow epoxy to dry
Participant Work Session

Complete Motor Mount Assembly

Return to Main Room at 7:55pm CST

Handbook Reference: 13a. Rocket Build – Pre-Fit Check, pg 58
Workshop Day 1 - Review

• What are the two types of rocket structures?
• Who is the manufacturer of the kit?
• Name the 6 phases of the single deploy flight profile.
• Name the parts of the rocket.
• What makes up the aft portion of the rocket?
• Where is the mid centering located on the motor mount tube?
• What is the purpose of sanding all of the rocket components?
Workshop Day 2 - Preparation

• Complete pre-fit checks
• Begin Motor Mount Assembly
• Review handbook content covered today and tomorrow

• See you on Zoom at 10:00am CST tomorrow!

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 Day 2

Questions from Day 1?

Schedule:

Morning
• Coupler Assembly & Build
• Motor Mount Assembly & Build
• Propulsion, Coupler, & Sustainer Overview
• RockSim Overview
• Nosecone Installation & Build
• Rail Button Alignment, Vent Hole Installation, & Build

*LUNCH BREAK*

Afternoon
• Inner Fin Installation Overview & Build
• Outer Fin Installation Overview & Build
• Stability Overview
• RockSim Update

**BREAK**

• Aft Centering Ring Installation Overview & Build
• Rail Button Installation Overview & Build
• RockSim Update
• Recovery Installation & Build
• Parachute Preparation & Build
• Recovery Electronics
• Choosing a Dual Deploy Rocket
• Certification Launch Guidelines
• Workshop Review, Survey, Q&A
Rocket Build – Assembly

Coupler Assembly

1. **Dry-fit Step:** Fit bulkplate inside coupler, ensuring level fit ~1/4” from the edge
2. Dab the threads and nut of eyebolt with epoxy
3. Apply epoxy around inside coupler ~¼” from the end
4. Twist the bulkplate into the coupler leaving ¼” gap from the edge of the coupler
5. Set coupler assembly aside, allow epoxy to dry

Handbook Reference: 13b.iii. Assembly – Coupler Assembly, pg 59

Figure 13-8: Bulkplate Installed in Coupler
Participant Work Session

Coupler Assembly

Return to Main Room at 10:20am CST

Handbook Reference: 13b.i-v. Assembly, pg 59
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

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

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

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

---


Frank
Rocket Build – Assembly

*Motor Mount*

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

7. Epoxy inside parameter of the air frame just in front of the forward center ring location using craft stick taped onto dowel rod

8. Slide the motor mount tube into position
   a. The **Mid-Centering** must be just forward of the forward fin slot. If the mid-centering 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

9. Allow epoxy to dry

Participant Work Session

Motor Mount Assembly

Return to Main Room at 10:50am CST
Rocketry 101 - Propulsion Overview

HPR Definition is based on Propulsion

- Uses a motor with more than 160 Newton-seconds of total impulse (and ‘H’ motor or larger) or motors that all together exceed 320 Newton-seconds
- Uses a motor with more than 80 Newtons average thrust (see rocket motor coding)
- Exceeds 62.5 grams of propellant
- Weighs more than 1,500 grams including motor(s)
- Includes any airframe parts of ductile metal

HPR motors cannot be purchased over the counter

- Must be certified to purchase

Table 6-1: Motor Class and Category
Rocketry 101 – Propulsion Overview

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

Figure 6-4: E-Match (top)
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

Rocket Build – Assembly

**Coupler/Sustainer**

1. Dry-fit coupler to upper airframe
2. Draw a line/mark around the center of the coupler
3. Apply epoxy around inside of the sustainer (about 1” from edge)
4. Place coupler into sustainer section aligning aft section of the sustainer with the center line drawn on the coupler
5. Use a twisting motion, to evenly distribute the epoxy
6. Set aside, let epoxy dry

Handbook Reference: 13b.iv. Assembly – Coupler/Sustainer, pg 60

Figure 13-9: Coupler Installed in Sustainer
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

Rocketry 101 - RockSim Motors


Trent 41
Rocket Build – Assembly

Nosecone

1. Fit the nosecone to the sustainer
   a. Should not require sanding
2. A single hole needs to be drilled at location shown, through both airframe and nosecone
3. The nosecone is then attached to the airframe with a machine screw, to keep the nosecone from separating in flight (but allow for removal of nosecone)
4. Seam along nosecone may be sanded with fine grain sandpaper (while waiting for fin epoxy to set)


Figure 13-13: Nosecone Fitted on Sustainer, Red Dot Indicates Drill Mark
Participant Work Session

Nosecone Installation

Return to Main Room at 11:55am CST

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

Rail Button Measurement
1. Mark a line half way between two fin slots on the aft portion of the air frame
2. Place the line marked on the air frame parallel to a door jam
3. Draw a line half way up the air frame
4. This is the line the rail buttons will be installed on after the fins have been installed

Figure 13-14: Markers to Indicate Rail Button Alignment
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

1. Drill first hole in the middle region of the sustainer
2. Drill second hole in the booster region above the fins

Handbook Reference: 13b.viii. Assembly – Vent Holes, pg 64

Figure 13-15: Vent Holes Indicated in Red on Rocket Airframe
Participant Work Session

Rail Button/Vent Hole Installation

Return to Main Room at 12:25pm CST

Handbook Reference: 13b.vi-viii. Assembly, pg 63-64
Workshop Day 2 – Morning Review

• Complete Assembly of:
  • Motor Mount
  • Coupler/Sustainer
  • Nosecone
  • Rail Buttons

• Enjoy lunch! See you at 1:00pm CST!
LUNCH

Return at 1:00pm CST
Workshop Day 2

Questions from morning session?

Schedule:

**Afternoon**

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

**BREAK**

- Aft Centering Ring Installation Overview & Build
- Rail Button Installation Overview & Build
- RockSim Update
- Recovery Installation & Build
- Parachute Preparation & Build
- Recovery Electronics
- Choosing a Dual Deploy Rocket
- Certification Launch Guidelines
- Workshop Review, Survey, Q&A
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

Rocket Build – Assembly

Fin Installation

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

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

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

8. Place assembly on fin installation guide, and align fins - tape fins to the air frame as needed

9. Do these steps quickly to get all fins tacked/aligned before the first fin cures


Figure 13-16: Apply Epoxy to Tang (top, middle); Insert Tang in Fin Slot (bottom)
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. Apply epoxy fillet to seam between motor mount tube and “tang” side of the fin
3. Use long dowel to apply along full length
4. Apply quickly with large dollops
5. Apply a total of 8 fillets (on each side of 4 fins)
6. Allow epoxy to set, remove tape while wet (within 15 minutes)

Handbook Reference: 13b.ix. Assembly – Fin Installation, pg 68
Participant Work Session

Inner Fin Installation

Return to Main Room at 1:50pm CST

Handbook Reference: 13b.ix Assembly, pg 65-68
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)

Figure 13-18: Tape and Dam Diagram

Handbook Reference: 13b.ix. Assembly – Fin Installation, pg 69
Rocket Build – Assembly

Fin Installation

Figure 13-19: Tape Locations for Epoxy Fillets (left); Dam Locations (right)
Rocket Build – Assembly

Fin Installation

Outer Fin Fillets (Epoxy)

1. For Side 1 (as shown):
   a. Fill in gap with epoxy (both fins) – let set few minutes, ensure epoxy is not leaking past dam on underside
   b. Epoxy along entire length of fin root, create smooth fillets (both fins)
   c. Remove dam tape from underside after 10 minutes
   d. Remove fillet tape from Side 1 (tube and fins)
   e. 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

Handbook Reference: 13b.ix. Assembly – Fin Installation, pg 70
Participant Work Session

Outer Fin Installation

Return to Main Room at 2:35pm CST
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
Rocketry 101 - RockSim Update
BREAK

Return at 3:10pm CST
Rocket Build – Assembly

Aft Centering Ring Installation

1. Install screw into retaining nut 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

2. Apply a band of epoxy around outside of MMT and inside of airframe

3. Twist centering ring into place, pushing in all the way until it stops against fin tabs

4. Ensure T-nut is offset from rail button mark

Handbook Reference: 13b.x. Assembly – Aft Centering Ring Installation, pg 71
Participant Work Session

Aft Centering Ring Installation

Return to Main Room at 3:40pm CST
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
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 screw into place

Figure 13-22: Rail Button Alignment on Launch Rail
Participant Work Session

Rail Button Installation

Return to Main Room at 4:05pm CST
Rocketry 101 - RockSim Update

Rocketry 101 - RockSim Update

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
- Drift range – expected drift is not to exceed 2500 feet downrange

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)
Rocket Build – Assembly
Recovery Installation

1. Tie a knot in the shock cord (at 1/3 total distance from end)
2. Untangle parachute shroud lines
3. Place arm through the shroud lines
4. Attach the parachute to the parachute with a knot (watch demonstration)

Failed parachute deployment:
https://www.youtube.com/watch?v=M2G-UVC07u0

Figure 13-23: Parachute Deployment (left); Shock Cord and Quicklink (bottom right)
Participant Work Session

Recovery Installation

Take break if needed

Return to Main Room at 4:45pm CST

Handbook Reference: 13b.xii-xiii. Assembly, pg 73
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.

Handbook Reference: 13b.xiii. Assembly – Parachute Preparation, pg 74-76
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.

Handbook Reference: 13b.xiii. Assembly – Parachute Preparation, pg 74-76
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

Handbook Reference: 13b.xiii. Assembly – Parachute Preparation, pg 74-76
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.

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.

Handbook Reference: 13b.xiii. Assembly – Parachute Preparation, pg 74-76
9. Place the newly-wrapped parachute bundle into the booster section of the rocket.

Figure 13-32: Step 9 of Parachute Prep
Participant Work Session

Parachute Installation

Take break if needed

Return to Main Room at 5:05pm CST

Handbook Reference: 13b.xii-xiii. Assembly, pg 74-76
Rocketry 101 - Recovery Electronics

COTS Altimeter

• Used to measure altitude of an object above a fixed level
• Normally a pressure sensor
• Can measure other data points

Some altimeters will also have accelerometers, GPS/telemetry

A few examples are shown

• Jolly Logic Chute Release, RRC2 Mini Alt, G-Wiz, AED R-Das Tiny, Perfectflite MAWD, Apogee Altimeter One, ARTS2 Flight Computer

RockSim – Choosing a Dual Deploy Rocket

VENDOR OPTIONS
• Wildman Rocketry
• Apogee Rockets

Manufacturers
• MadCow
• LOC Precision

• VENDORS
  • Rocketry Supply Vendors
  • Wildman Rocketry

FNL COMPETITION REQUIREMENTS
• Aerotech 38 mm motor
• Motor choices: H, I, J
• Apogee 3000-3500’ AGL
• Recovery 20 fps
• Main parachute deployment minimum altitude – 300’ AGL

CRL COMPETITION REQUIREMENTS
• Aerotech: All 38 mm - I435T, I366R, I284W, J350W, J500G, I600R
• Apogee 2500-3500’ AGL

CRL - Launch Day Safety

Tripoli Safety Code, NFPA 1127, etc.

HPR Launch Operations Overview

• Range Safety Officer (RSO)
  o 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.

• Launchpad Safety Officer (LSO)
  o The LSO is responsible for determining the status of range operations: site, airspace, and weather.

• Launch Pad Manager

Launch Failure

CRL - Certification Launch

NAR Level 1 Certification at Richard Bong Recreational Area
https://www.youtube.com/watch?v=EFm5sG7qgmo

FAA Waiver required – May take 45-90 days to secure

Tripoli Requirements
• Register
• Airframe
• Recovery
• Motor
• Electronics – Not required
• Post flight inspection

WSGC Information
• Certification Applications
• One motor provided
• Level I for workshop attendees only

CRL - Certification Launch

Steps for Completing Your Launch:

1. With your TRA/NAR mentor determine:
   a. launch site and travel budget
      i. Budget must be approved before travel
   b. launch date
   c. TRA/NAR member name and contact information who is conducting certification launch
   d. who will ship and receive the selected motor

2. 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

CRL - Certification Launch

Steps for Completing Your Launch:

3. WSGC requirements at the certification launch
   a. Take picture of you at launch site with your rocket and TRA/NAR mentor *prior* to launching rocket
   b. Take picture of you at launch site with your rocket and TRA/NAR mentor *after* recovering your rocket
   c. Take picture of completed membership application
   d. Complete and submit pictures by May 31, 2021

4. Fees associated with certification launch
   a. Reimbursable by WSGC using reimbursement form or coordinated with local TRA/NAR
      i. NAR/TRA one-year membership fee
      ii. Certification launch fee
      iii. Entry fee to the launch site facility
      iv. 38mm H219T - DMS/ H100W –DMS
      v. Mileage
   b. Complete and submit a reimbursement request no later than May 31, 2021

Workshop Day 2 Review

• What are the two professional rocketry associations?
• What must you do to become level one certified?
• What checkbox is critical to check or uncheck in RockSim?
• Where can rocket supply equipment files be downloaded from?
• Where can you find information about launch day logistics?
• Who are the key personnel at the rocket launch?
• What is the “Key Enemy” of your rocket build?
• What are three main differences between single and dual deploy rockets?
Fundamentals Review

• What does an altimeter do?
• What type of a knot can you use to attach the shock cord to the bulk plate?
• What can result from improper fin installation?
• What is a reasonable rocket descent rate?
• What is a reasonable black powder ejection charge size?
• What type of chart can your team use to prepare for the design reports and rocket launch? Describe how the motor ejection works?
• Describe the rocket CG?
• Describe the rocket CP?
• What is the optimal stability margin?
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-ICS kit
• Present the difference between single and dual deploy rockets
• 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%)

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

This is what I LOVED about your workshop!!!
QUESTIONS?