2025 First Nations Launch

Flight Readiness Review Report

For Wisconsin Space Grant Consortium

Honolulu Community College
03/08/2025

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1 Team Summary

Team Name: EPIC

School Name: Honolulu Community College

Faculty Advisor: Shidong Kan

Co-Advisor: Mevan Ranasinghe

Team Lead: Teal Hoffman

Safety Lead: Arden Patoc

NAR/TRA Mentor: Jacob Hudson

NAR/TRA Membership: TRA 05343

NAR/TRA Certification: Level 3

Team Members:

Team Members			
Name	**Major**	**TRA Membership #**	**Role**
Teal Hoffman	Electrical Engineering	33123	Team Lead, Avionics Lead
Shelby Dixon	Computer Engineering	33122	Simulations and Motor Lead
Arden Patoc	Electrical Engineering	33125	Team Safety Officer, Payload Lead
Alex Anderson	Environmental Engineering	33124	Structures Lead
Shidong Kan		21553	Faculty Advisor

2 Summary of Flight Readiness Review Report

2.1 Launch Vehicle Summary

- Flight ready vehicle size and mass
    - Length: 98 in. (2.49 m)
    - Diameter: 5.5 in. (0.140 m)
    - Mass: 17.15 lb (7779 g)
- Flight ready motor choice
    - Aerotech 54mm DMS K535W
- Flight ready recovery details
    - Altimeter:
        - RRC3+
        - TeleMega (redundancy)
    - Drogue Parachute Diameter: 28 in.
        - 25 ft x ⅝ in. - TN-25 tubular nylon shock cord
    - Main Parachute Diameter: 78 in.
        - 25 ft x ⅝ in. - TN-25 tubular nylon shock cord
    - GPS Tracking System:
        - Big Red Bee Tracker
        - TeleMega GPS Tracker + Ground Station (redundancy)
- Flight ready rail button size
    - 1515 rail button
    - Length/Thickness: 0.44 in. (1.1 cm)
    - Inner Diameter: 0.313 in. (0.8 cm)
    - Outer Diameter: 0.630 in. (1.6 cm)

2.2 Challenge Summary

Flight Ready Payload Electronics Overview:

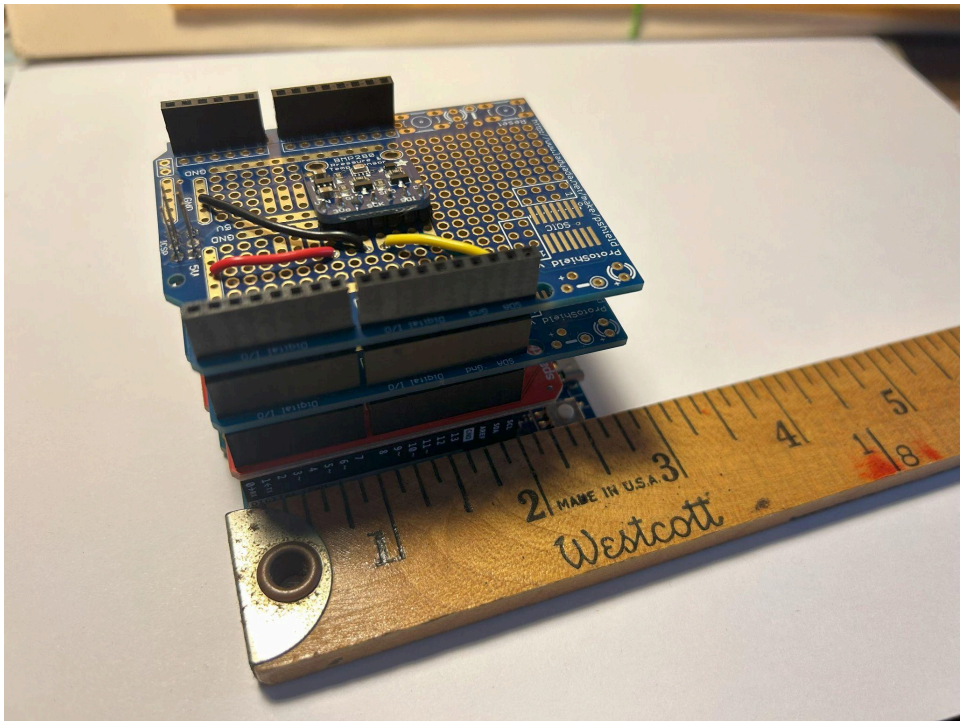


Figure 2.2.1: Final Payload Design

The final payload will collect static pressure and orientation data. The Adafruit LSM9DS1 payload component will be used to collect orientation sensor data. The Adafruit BMP280 payload component will be used to collect static pressure/temperature sensor data. The payload design uses a stackable shield to ensure a structurally sound unit with no exposed wires to prevent the risk of wires coming out during flight. The payload uses 4 layers with the Arduino Uno R4 Minima microcontroller set as the base, followed by the MicroSD breakout shield, the Adafruit LSM9DS1 sensor, and the Adafruit BMP280 I2C. The 4-stack shield will be on a board with a 9V battery to be directly connected to the Arduino Uno R4 Minima.

Flight Ready Payload Integration:

We plan to use a plywood board (sled) that is just under 5.5 inches wide and spans the entire payload section. The payload will be mounted on one side of the sled, with the battery mounted on the opposite side. The sled will serve to prevent movement during flight, ensuring stability and sturdiness.

The payload will be located in the payload bay before the nosecone.

2.3 Changes Made Since Critical Design Review

- Major Changes (not additions) Made Since Proposal
    - Major changes to vehicle criteria
        - No major change
    - Major changes to payload/challenge criteria
        - No major changes
    - Major changes to the project plan
        - No major changes

3 Vehicle Criteria

3.1 Design and Construction of Launch Vehicle

Launch Vehicle Overview:

- **Airframe**: The rocket body is constructed using high-strength composite materials, ensuring durability while maintaining a lightweight structure.
- **Fins**: Precisely aligned and epoxied to the airframe using high-strength adhesives and fillets to minimize drag and enhance stability during flight.
- **Bulkheads**: Securely installed to reinforce structural integrity and provide strong mounting points for avionics and payload components.
- **Attachment Hardware**: Includes high-strength eye bolts for shock cord connections, ensuring robust recovery system deployment.
- **Motor Retention System**: Utilizes a retention plate to secure the motor in place, preventing unintentional separation during thrust phases.

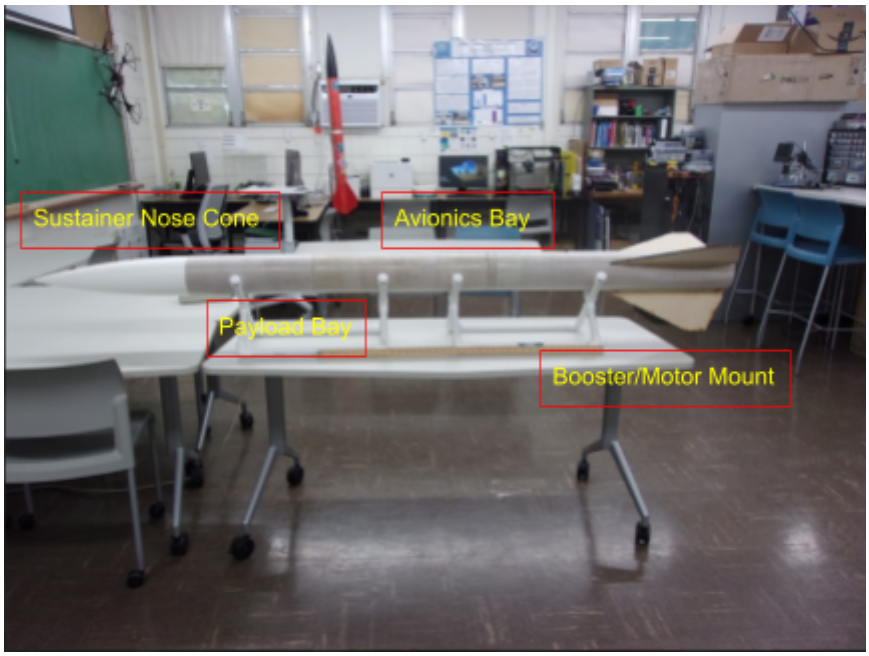


Figure 3.1.1: Structural elements of launch vehicle

Hardware and Construction Quality:

- **Bulkhead**: Inspected to confirm strong adhesive bonds, preventing separation under high forces.
- **Airframe Tube Fit & Alignments**: Sections are tightly fitted and reinforced to ensure structural continuity.

- **Fin Alignments & Fillets**: Ensured through precision alignment tools and high-strength epoxy fillets for aerodynamic stability.
- **Centering Ring Fillets**: Applied to reinforce motor mount retention and distribute forces evenly.
- **Eyebolt/Shock Cord Attachments**: Secured with lock nuts and thread-locking compounds for reliability in deployment forces.
- **Avionics Sled & Switches**: Mounted for easy access and secured against movement to protect sensitive electronics.
- **Rail Button Attachment & Alignment**: Ensured proper placement along the airframe for guided, stable rail launches.

Electrical Elements (Avionics Bay):

- RRC3+ (primary altimeter)
- TeleMega (secondary altimeter)
- 9V battery (for RRC3+)
- 3.7 V Lithium Ion battery (for TeleMega)
- Battery connector (for 9V)
- Battery encapsulate (from LocPrecision)
- x4 Ignition wires
- x4 Wire lever connectors
- x2 Rotary switches

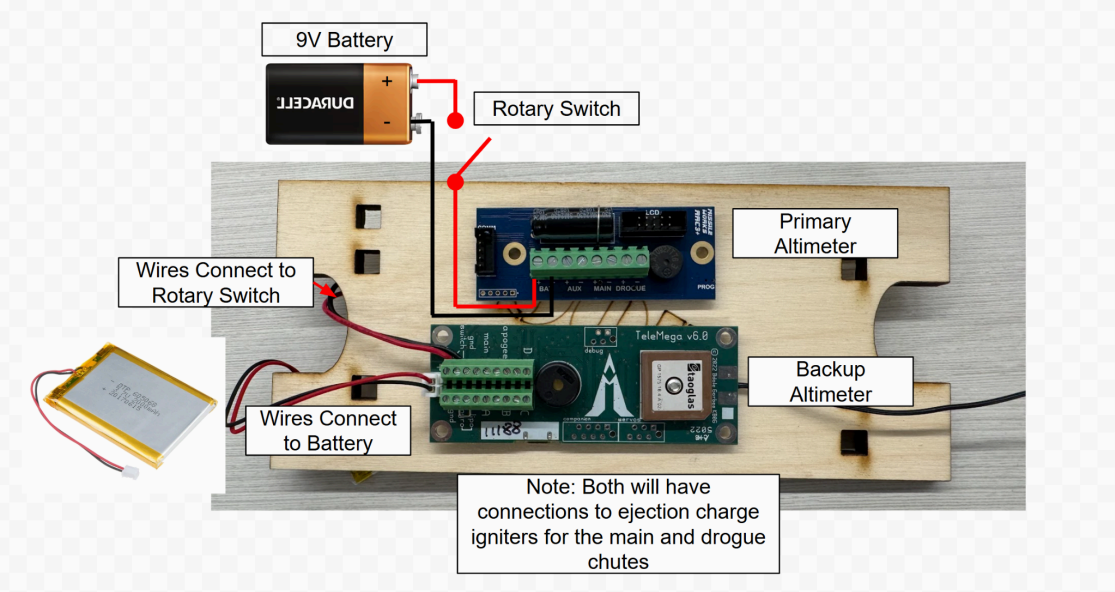


Figure 3.1.2: Wiring of the electrical elements

- The switches will be connected in this formation for the RRC3+:

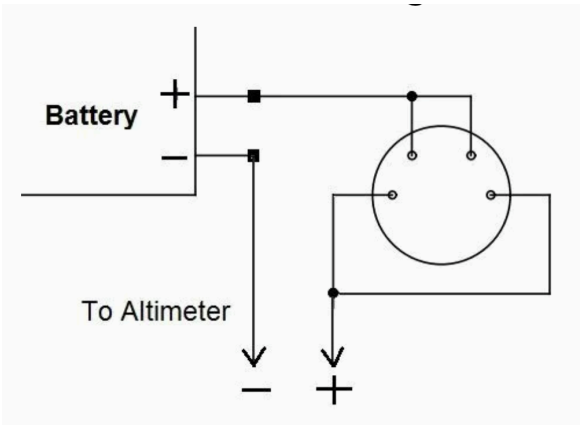


Figure 3.1.3: Rotary switch connections for the RRC3+. We have tested this connection.

- Battery Retention:

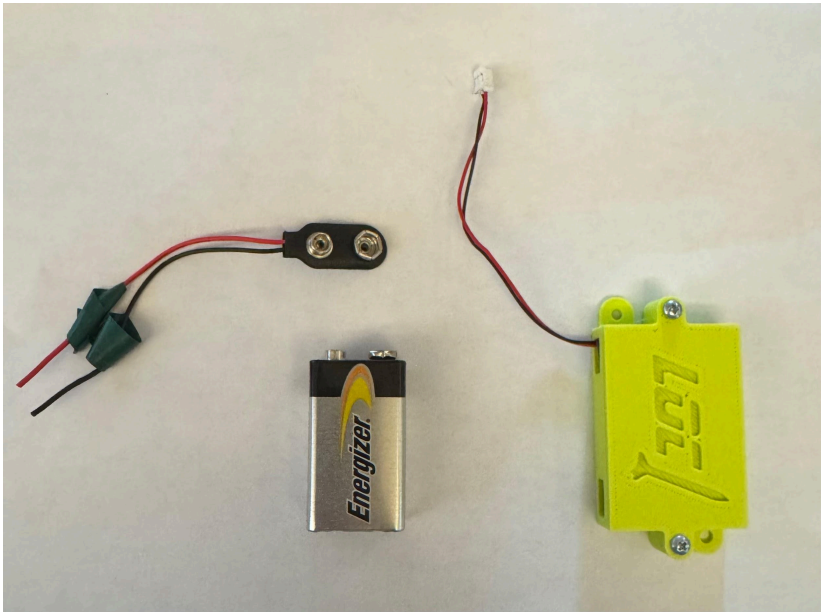


Figure 3.1.4: Battery retention of the lithium-ion battery for the Telemega is to the right and the 9V battery for the RRC3+ is to the left. The 9V battery will have a battery casing that will be mounted down on the opposite side of where the altimeters are. The lithium battery will also be screwed down onto the opposite side of the shield and in between the rods.

- Retention of Avionics Boards: Both altimeters will be screwed down to the avionics shield

Visual documentation of the vehicle build progress, including key stages from the initial assembly to the final integration, is provided. Simulation screenshots that corroborate

the build stages and final checks are included to visually substantiate the build integrity and design adherence.

Fully Constructed Vehicle:

- Motor Mount and Fins:

Figure 3.1.5: In-progress motor mount and epoxy process

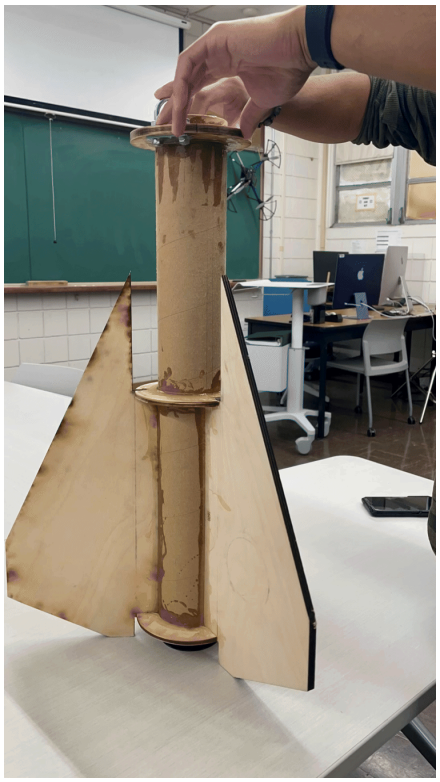


Figure 3.1.6: Final motor mount and fins with dried epoxy

Figure 3.1.7: Fin Fillets

- Bulkhead of Avionics Bay:

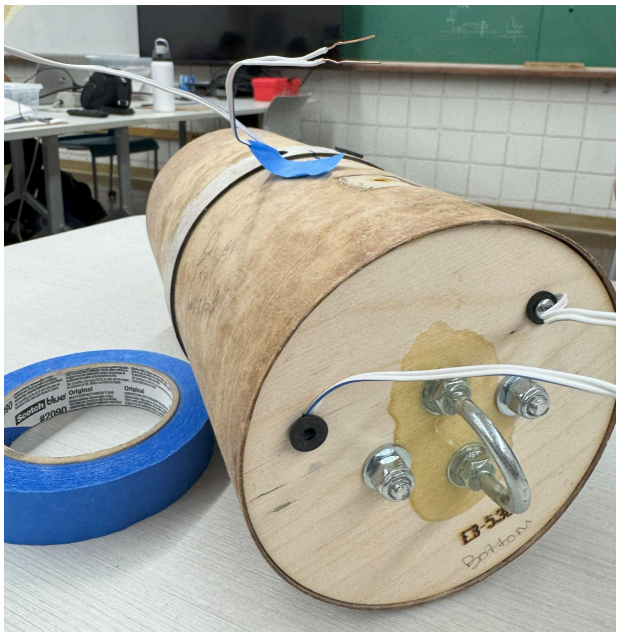


Figure 3.1.8: Bulkhead and Fillets

- Central Ring Fillet - Airframe - Rail Button Alignment:

Figure 3.1.9: Central ring fillet

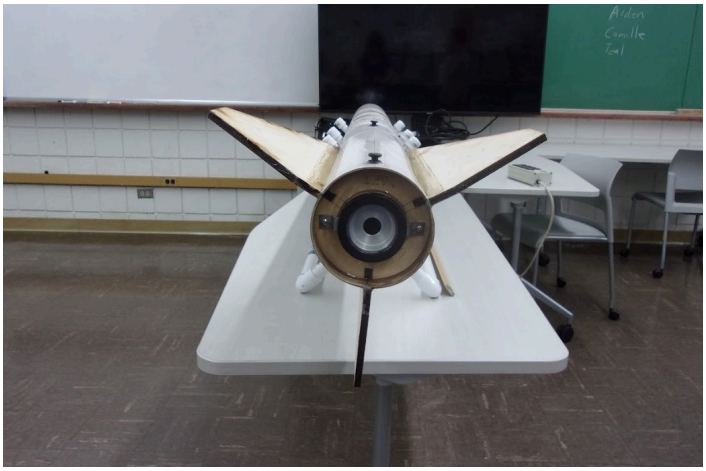


Figure 3.1.10: Airframe and Rail button alignment

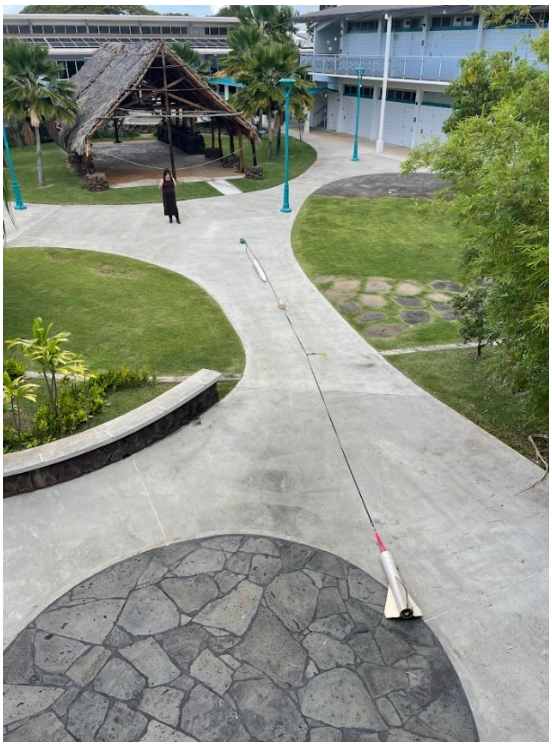


Figure 3.1.11: Layout of fully deployed rocket after touchdown. We did this exercise to determine where each section should be so they don't touch each other.

Figure 3.1.12: Assembled Rocket.

Figure 3.1.13: Fully assembled rocket next to students (to get a sense of scale)

- Vehicle Testing
    - Please see **Section 6.1** for the Drop Test and Ground/Gunpowder Test.

AS-BUILT Rocket Dimensions:

- No changes to size dimensions

Final Masses:

- Motor Adapter - 218 grams
- Rail Button Set - 18 grams
- Nose cone - 580 grams
- Booster - 2152 grams
- E-bay - 880 grams
- Sustainer - 516 grams
- Payload Bay - 786 grams
- Z-clips - 20 grams

During the construction process, we carefully measured the completed rocket to ensure it met our design specifications. The final build stands at 98 inches in length with a diameter of 5.5 inches, matching our simulation models. These dimensions were critical to achieve the desired aerodynamic properties and flight stability.

3.2 Recovery and Avionics Subsystem

As-Built and As-Tested Recovery System – Hardware and Electronics

The as-built recovery system of the PK-87 Hyperloc-1600 consists of a dual-parachute deployment system designed to ensure a controlled descent and minimize landing impact forces. The system includes structural components, shock-absorbing materials, and avionics to monitor deployment and descent performance.

Structural Elements

- Bulkheads – The rocket is equipped with multiple bulkheads made from high-strength composite materials to provide structural support for the parachute compartments and avionics bay.
- Shock Cords – The system utilizes 25 ft x ⅝” TN-25 tubular nylon shock cords for both the drogue and main parachute connections. These shock cords absorb energy during deployment to prevent excessive loads on the airframe.
- Attachment Hardware – The recovery system employs D-rings and U-bolts secured to the bulkheads, ensuring strong anchoring points for the parachute risers and harnesses.
- Parachute Components:
    - Drogue Parachute – A 28-inch ripstop nylon parachute is deployed at apogee to stabilize the descent and reduce velocity before main deployment.
    - Main Parachute – A 78-inch ripstop nylon parachute deploys at approximately 800 feet above ground level (AGL), slowing the rocket for a safe landing.

Avionics and Electronics

- Altimeters – The system incorporates a dual-redundant altimeter setup:
    - TeleMega Altimeter – A high-precision flight computer that records altitude, descent rates, and triggers deployment charges.
    - RRC3+ Altimeter – Serves as a backup deployment controller, ensuring redundancy in parachute deployment.
- Black Powder Ejection Charges – Two black powder canisters (30g total) are used to activate parachute deployment at the appropriate altitudes.
- Electronics Bay (E-Bay) – The avionics and altimeters are housed within an enclosed payload bay with a protective sled-mounted system for easy access and wiring management.
- Ground tests were conducted to verify the ejection charge strength and deployment sequence.

- The parachutes were successfully deployed in ground-based ejection tests, confirming proper function.
- The electronics and altimeters were tested for redundancy and synchronization to ensure reliability in actual flight.
- We have a big red bee GPS tracker and TeleMega (GPS) for redundancy

This recovery system ensures a safe and controlled descent, minimizing stress on the airframe and preserving the integrity of onboard payloads and avionics.

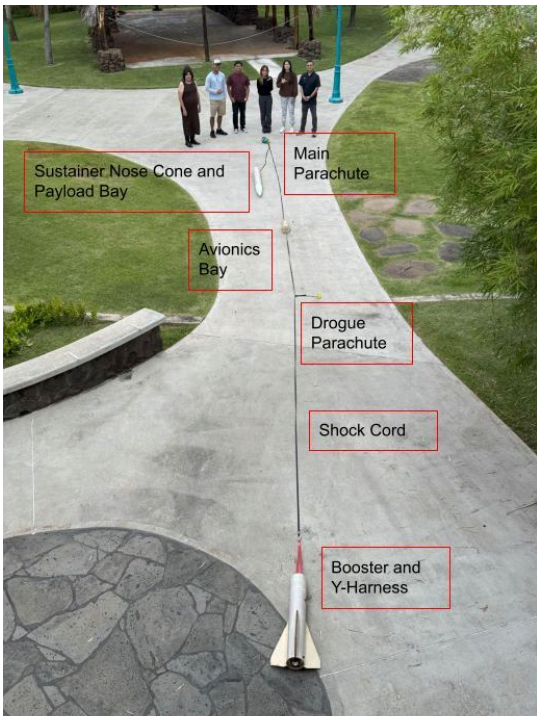


Figure 3.2.1: Structural elements of the recovery system

Electrical Elements:

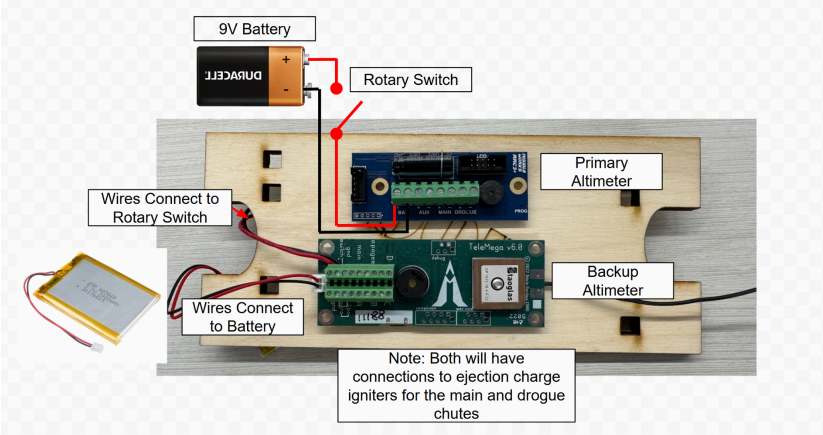


Figure 3.2.2: Electrical/Avionics system integration on the shield.

See Figure 3.3.8 for switch placements

In our final report, we detail the as-built and thoroughly tested recovery system of the HyperLOC-1600 rocket, which includes both the hardware and electronic components essential for a safe and effective descent. The recovery system features robust structural elements including precisely engineered bulkheads designed to withstand the stresses of launch and recovery, durable harnesses that ensure secure parachute attachment, and reliable attachment hardware that maintains structural integrity throughout the flight. The electronic components, such as the dual deployment altimeters (Telemega and RRC3+), are critical for accurate deployment of the main and drogue parachutes at predetermined altitudes. These systems were tested under various conditions to verify their reliability and performance, ensuring that they function as expected during the mission. This combination of advanced structural elements and electronics forms a recovery system that not only meets but exceeds safety and performance standards, ensuring the rocket's integrity upon touchdown.

Parachute Sizes and Descent Rates:

- **Drogue Parachute Diameter: 28 in**
  - 25 ft x ⅝” - TN-25 tubular nylon shock cord
- **Main Parachute Diameter: 78 in**
  - 25 ft x ⅝” - TN-25 tubular nylon shock cord
- Descent Rate at landing:
  - 15.9 mph (23.3 ft/s, 7.2 m/s)

Parameter	Drogue Parachute	Main Parachute
Diameter (in)	28.0	78.0
Mass (g)	27.658	198.603
Drag Coefficient (Cd)	0.75	0.8
Rocket Mass (g)	7779.0	7779.0
Rocket Mass (kg)	7.779	7.779
Air Density (kg/m³)	1.225	1.225
Gravity (m/s²)	9.81	9.81
Area (m²)	0.397	3.083
Descent Rate (m/s)	20.449	7.108
Descent Rate (ft/s)	67.091	23.319
Descent Rate (mph)	45.744	15.899

Flight Profile Analysis

1. **Launch and Ascent:**
    - **Thrust and Acceleration:** Initially, the rocket experiences maximum thrust and acceleration, as indicated by the steep rise in velocity. This phase continues until burnout.
    - **Velocity at Burnout:** The velocity at the end of the motor burn provides insights into the effectiveness of the motor selected and the rocket's initial mass ratio.
2. **Coasting to Apogee:**
    - **Time to Apogee:** This measures the time from launch to the highest point of flight. It is crucial for setting the delay time of the ejection charge to deploy the recovery system at the right moment.
    - **Max Altitude (Apogee):** The peak of the flight path, which should match or closely align with the simulations to validate the initial setup.
3. **Deployment and Descent:**
    - **Recovery System Deployment:**
        - **Drogue Parachute Deployment:** Occurs at a +2 seconds after apogee with the RRC3+ to stabilize and slow down the descent before the main parachute deployment. If this does not occur, the Telemega will deploy the drogue chute at +4 seconds after apogee.
        - **Main Parachute Deployment:** Ensures further reduction in descent velocity to safe levels for landing. The RRC3+ deploys the main chute at 600 ft and the Telemega (a secondary device used for redundancy) will deploy the main chute at 500 ft. On launch day, we will adjust the deployment altitudes based on wind conditions if needed.
    - **Descent Rate:** The velocity at which the rocket descends after parachute deployment, crucial for ensuring the payload's integrity upon landing.
    - **Altitude and Velocity at Parachute Deployment:** These metrics help verify the effectiveness of the recovery system and ensure the deployment occurs at the intended flight conditions.

Graphical Analysis

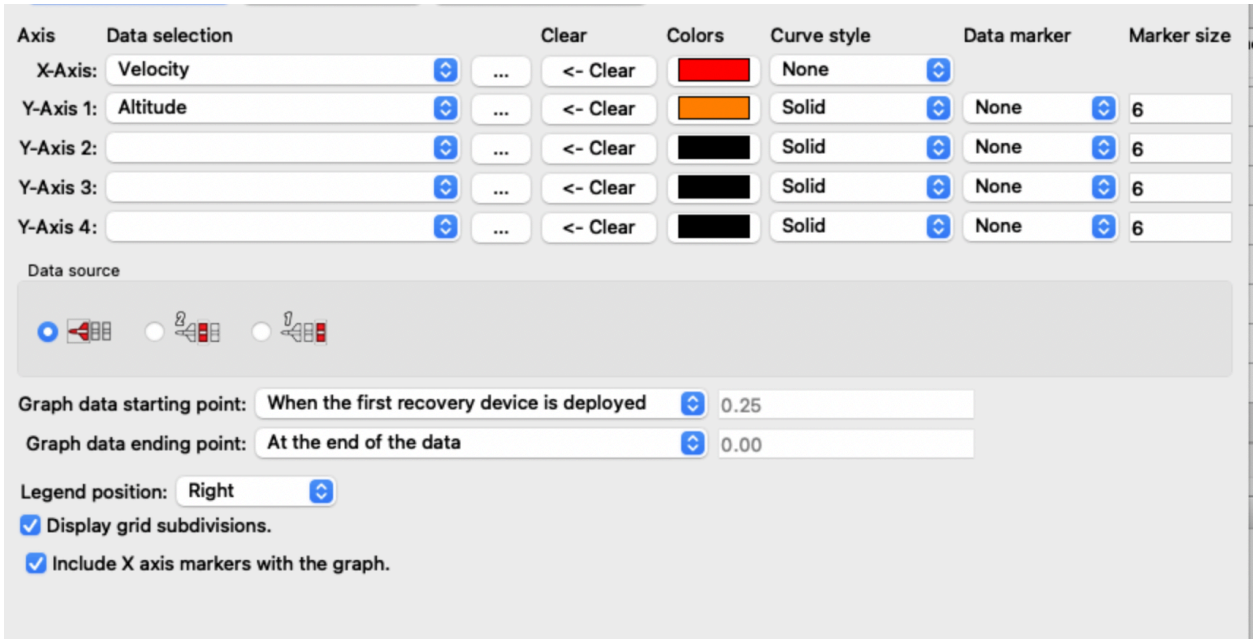
- The RockSim plot of altitude versus velocity visually represents the flight dynamics:
    - **Ascent:** Sharp increase in altitude with increasing velocity.
    - **Apogee and Descent Initiation:** Altitude peaks and velocity begins to decrease.
    - **Recovery Phase:** Rapid reduction in velocity at parachute deployments, which should align with the expected descent rates.

Parameter Settings in RockSim

- **Graph Data Points:**
    - **Starting Point:** Set to "When the first recovery device is deployed" to focus on the effectiveness and timing of the recovery system.
    - **Ending Point:** "At the end of the data" to capture the entire flight until landing.

Data Accuracy and Verification

- **Comparison with Hand Calculations:**
    - **Descent Rate Calculations:** Use the parachute diameters, total mass, and descent rate to calculate the expected velocity using formulas for parachute descent. Compare these with the simulated results to verify the model's accuracy.
    - **Stability and Drag Coefficients:** These affect the rocket's behavior during descent and should be validated against theoretical values or previous flight data.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Data selection
Clear
Colors
Curve style
Data marker
Marker size
X-Axis:
Velocity
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Y-Axis 1:
Altitude
Solid
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6
Y-Axis 2:
Y-Axis 3:
Y-Axis 4:
Data source
Graph data starting point:
When the first recovery device is deployed
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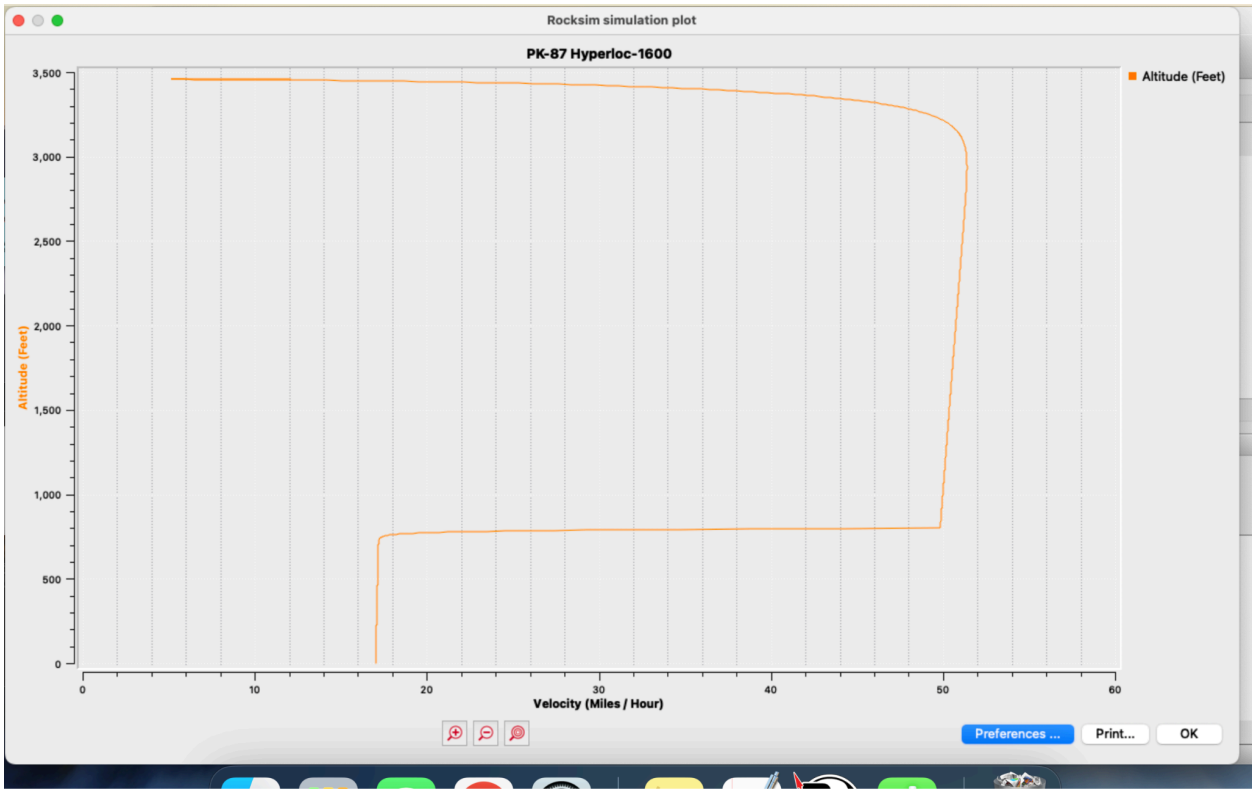
Display grid subdivisions.
Include X axis markers with the graph.


Rocksim simulation plot
PK-87 Hyperloc-1600
Altitude (Feet)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Altitude (Feet)
0
10
20
30
40
50
60
Velocity (Miles / Hour)
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Rocket Locating Devices: See **Figures 3.3.9 and 3.3.10** for the rocket locating devices we will use for recovery

The descent rate at landing for the HyperLOC-1600 rocket has been meticulously calculated to ensure a safe and controlled touchdown. Through precise simulations and field tests, we've established a descent rate of approximately 23 feet per second, facilitated by our dual-parachute recovery system. This rate has been optimized to minimize impact forces, thereby preserving the structural integrity of the rocket and the safety of the onboard payload. The main parachute is deployed at a strategic altitude to slow the rocket effectively, while the drogue parachute stabilizes the descent from higher altitudes. This carefully engineered approach ensures that the rocket descends at a rate that allows for a soft landing, reducing the risk of damage upon impact and increasing the likelihood of recovery for subsequent launches.

Please see section 6.1 for **ground and drop tests.**

3.3 Avionics Subsystem

Final Avionics Bay Structural Overview:

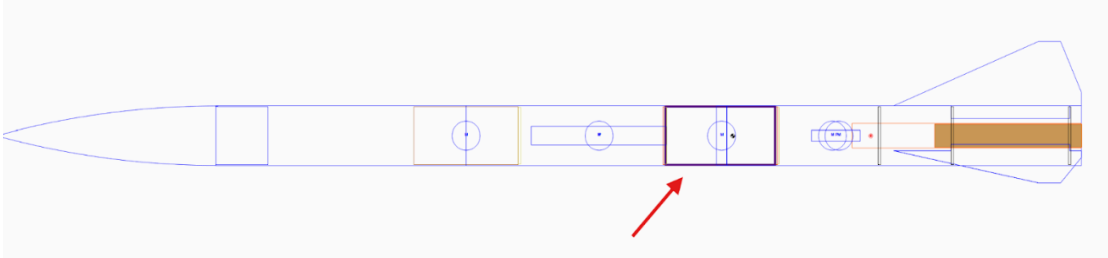

Figure 3.3.1: Location of the Avionics Bay

Major Structural Components of the Avionics Bay:

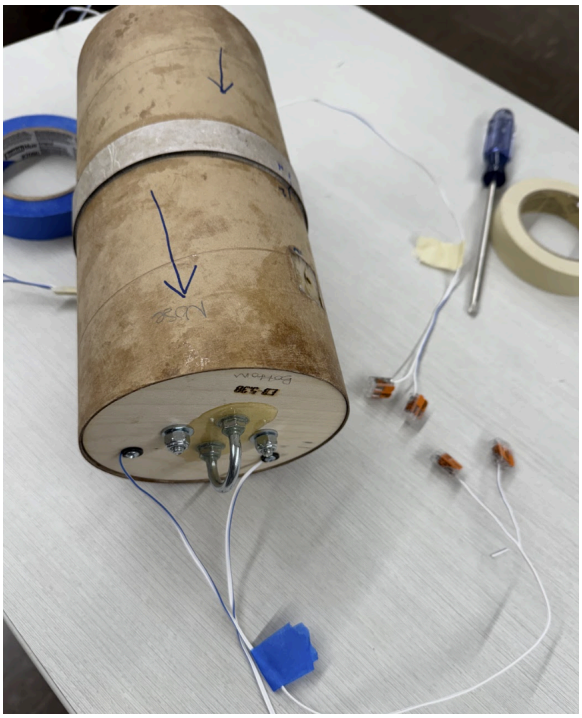

Figure 3.3.2: This is the 11 in. outside coupler of the avionics bay with a 1 in. switch band in the middle. This is a photo after we cut the holes on both bulkheads and placed 2 bulkhead sealing well nuts from missile works in each bulkhead (4 total).

The sealing well nuts will have the ignition charge wires coming out from them. The charges toward the nose cone will be connected to the main chute of the RRC3+ and Telemega, and the charges toward the booster section will be connected to the drogue chute.

Figure 3.3.3: Bulkhead sealing well nuts to prevent the pressure and gas from the ejection charges to go in the avionics bay.

Figure 3.3.4: This is what will be used to connect the ignition wires coming out of the avionics bay to the black powder.

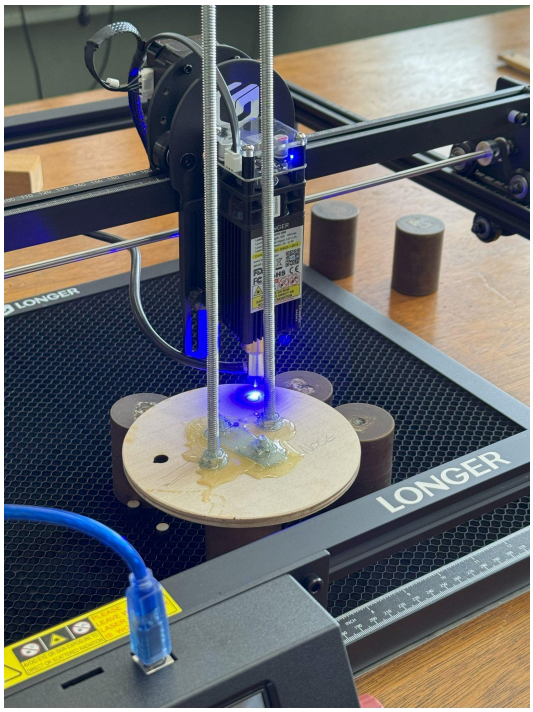

Figure 3.3.5: The laser cutter we used to cut holes in the bulkhead. This is the bulkhead closer to the nose cone. The rods of the avionics bay are also shown in this photo

Final Altimeter Selections:

We chose two different altimeters as our final selections, which are the RRC3+ as the primary and the Telemega as the backup.

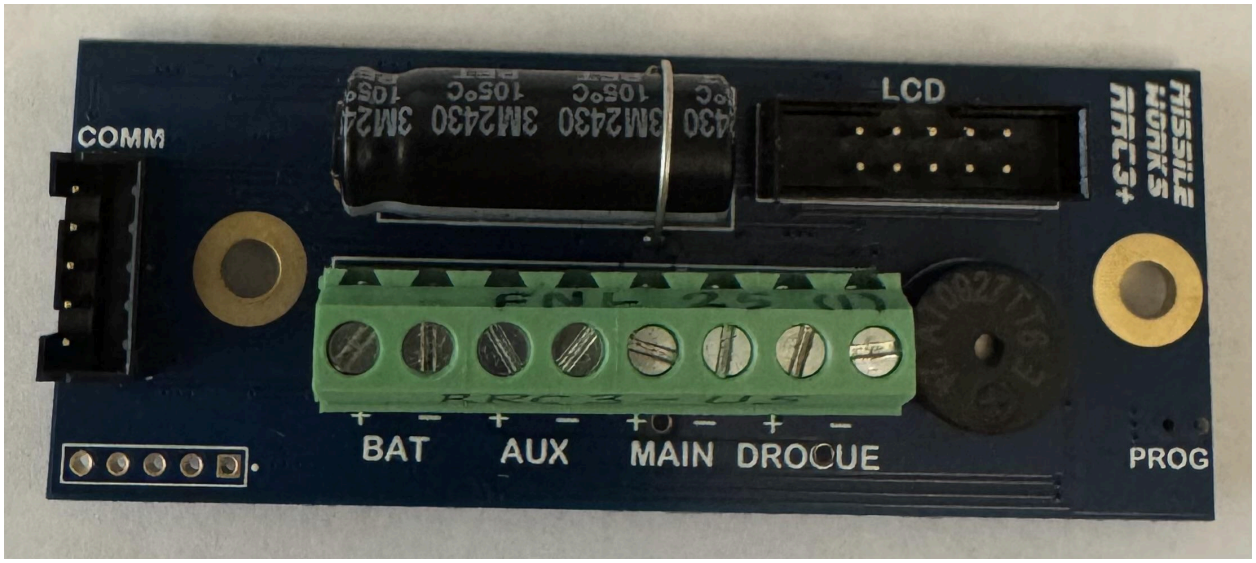

Figure 3.3.6: Final RRC3+ Altimeter System (Missleworks) used as the primary altimeter.

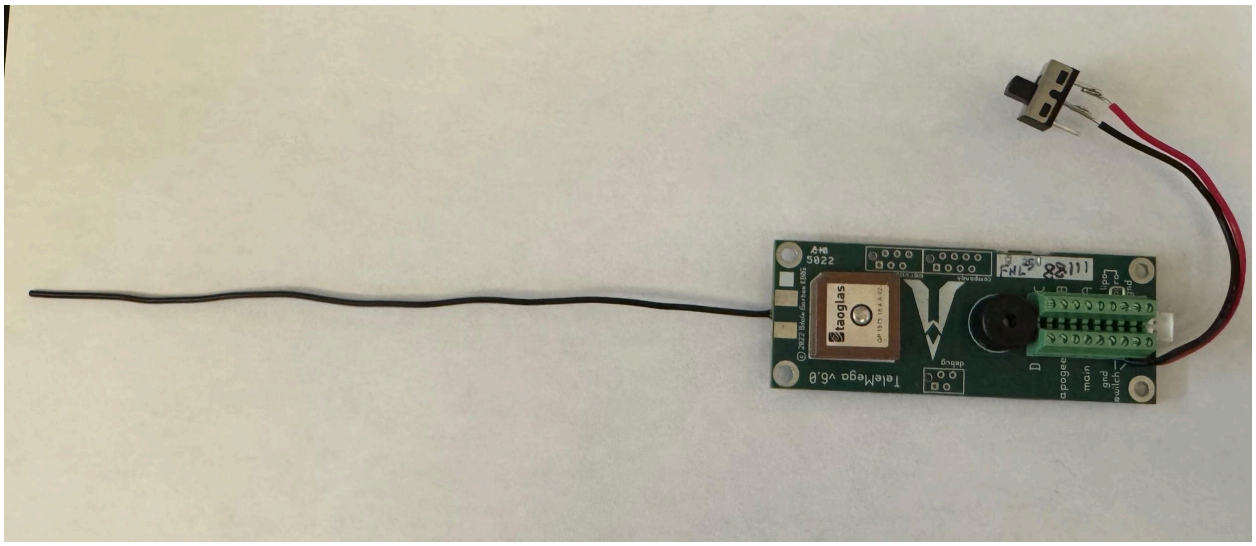

Figure 3.3.7: Final TeleMega Altimeter (Altus Metrum) used as the backup altimeter.

Final Switch Selections and Locations:

- Selection: 2-Pole Rotary Switches from Missileworks
- Location: On the switch band in the middle of the avionics coupler. The switches are located next to each other

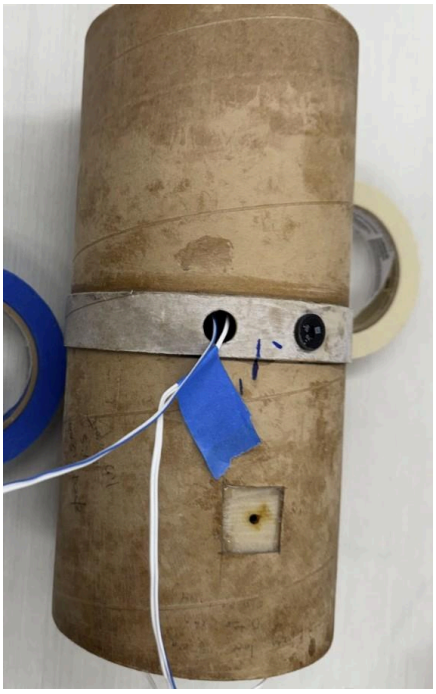

Figure 3.3.8: Switch band and switches' location

Final Size/Location of Vent Holes:

- 3 holes, each ¼ in. for a coupler with a length of 11 in. and a diameter of 5.5 in.

Final Recovery Tracking Electronics (GPS) Selection and Location:

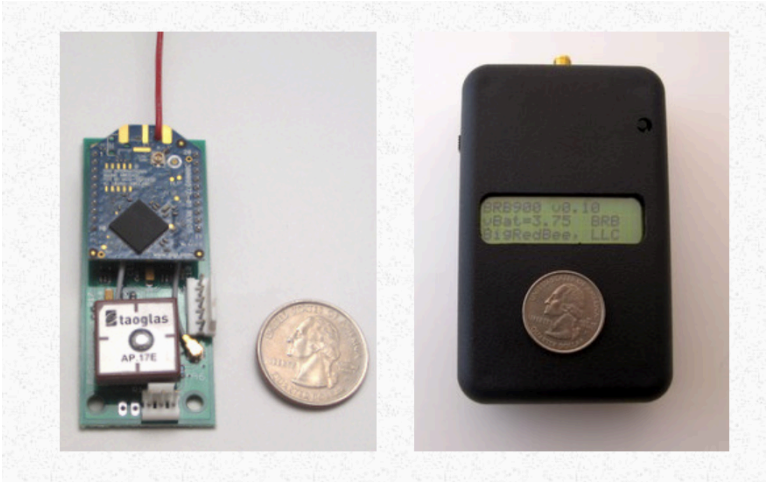

Fig 3.3.9: Final Big Red Bee GPS. Left: GPS transmitter. Right: Ground station of GPS.

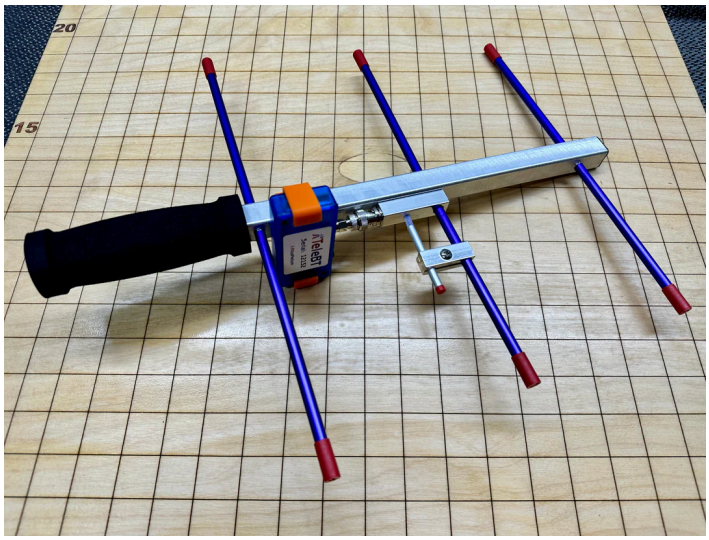

Fig. 3.3.10: Final TeleMega and TeleBT Tracking Ground System (used as backup)

3.4 Motor Selection

Motor Selection:
We chose the K535 motor over the K400 motor since it had approximately 100 - 200 ft greater altitude when we ran simulations for each. The need to change the motors as the design progresses would be if the rocket reached a higher altitude than planned. The likelihood of this happening is low due to the team adding more weight to the simulated rocket. In theory, this will decrease the altitude and the final simulated altitude will not go over 4000 ft.

Fig. 3.4.1: SLIMLINE Motor mount adaptor from 75mm to 54mm. This will be used with the HyperLOC-1600 kit since the standard is 75mm.

Motor Retention Plan:

We plan to use a retaining ring or a Z clip motor retainer set at the rear of the motor mount tube to keep the motor from moving out of the rocket at ejection.

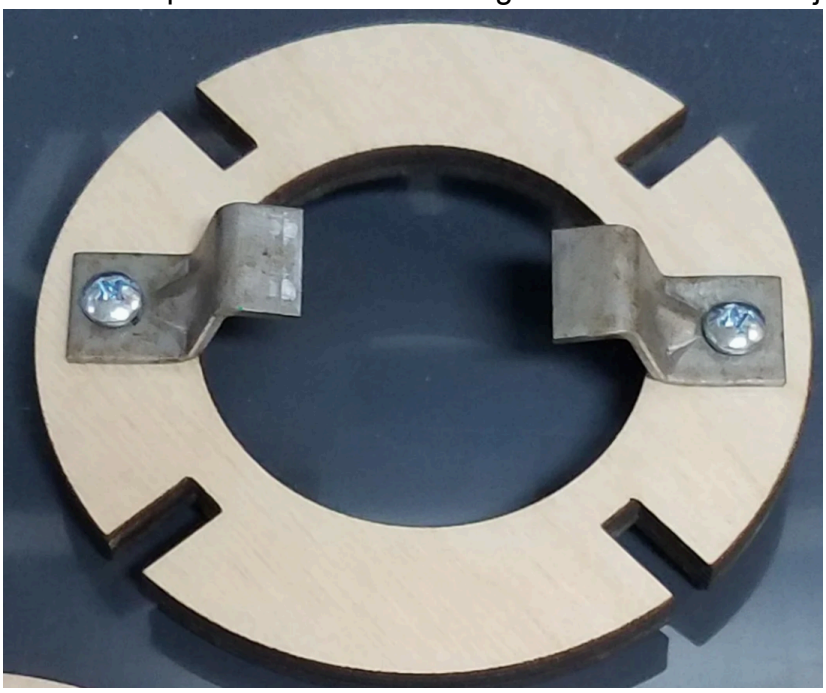

Fig. 3.4.2: Z Clip Motor Retainers from the Loc Precision website [3]

3.5 Mission Performance Predictions

Altitude vs. Time Graph

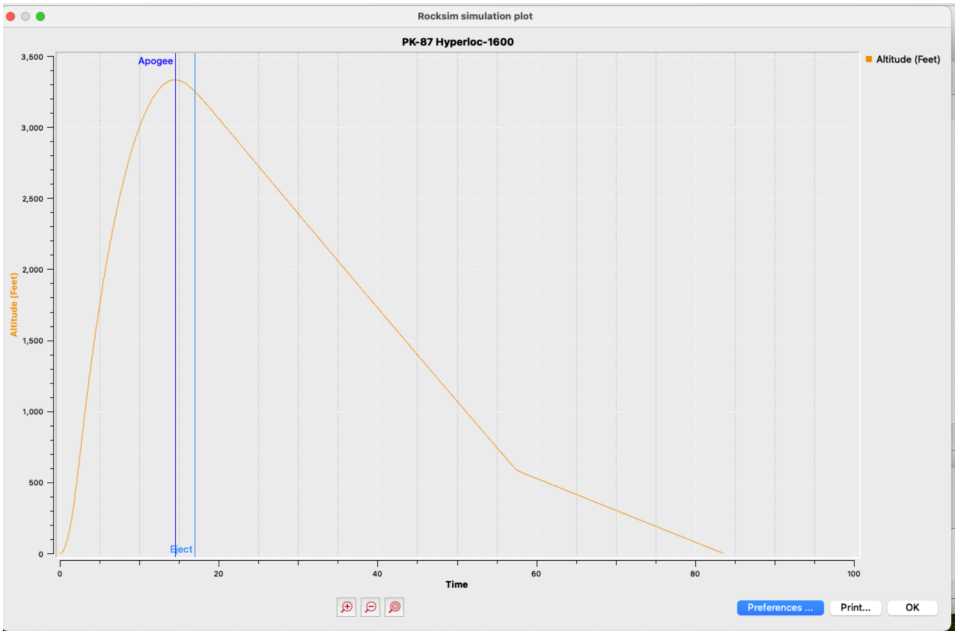

Fig. 3.5.1: HyperLOC-1600 RockSim simulation

Acceleration vs. Time Graph

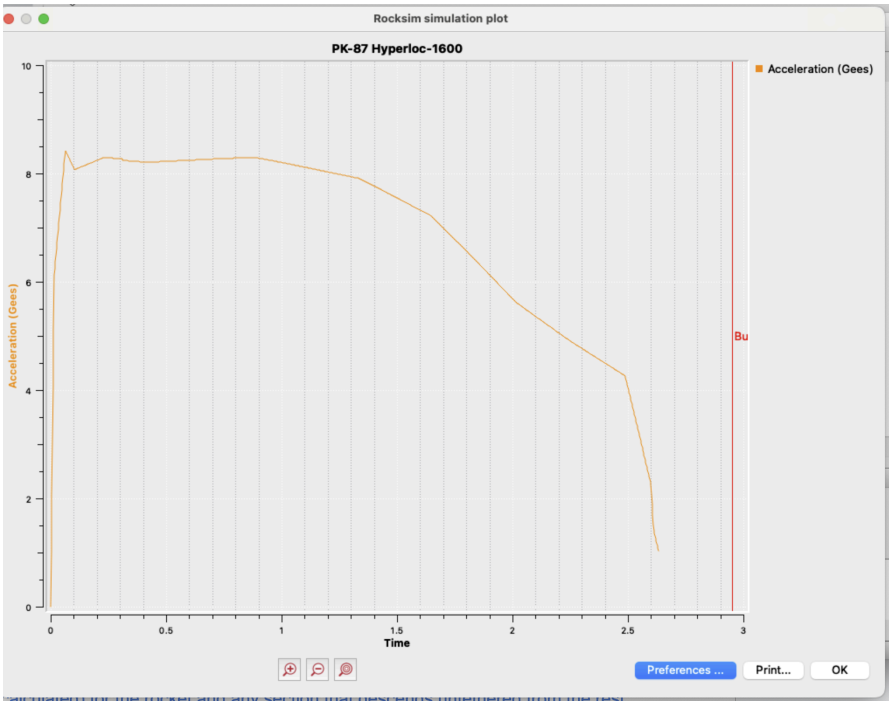

Fig. 3.5.2: HyperLOC-1600 RockSim simulation

Velocity vs. Time Graph

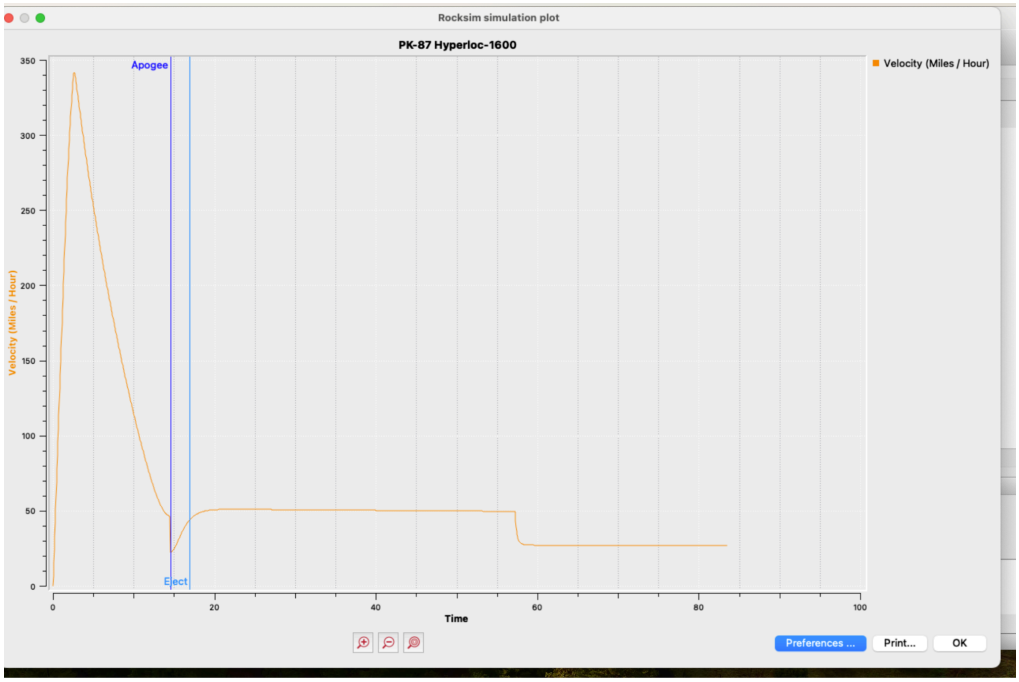

Fig. 3.5.3: HyperLOC-1600 RockSim simulation

Altitude Prediction Analysis:

The flight simulation of the **HyperLOC-1600** predicts a maximum altitude (**apogee**) of **3,457 feet (1,053 m)** under the given launch conditions. The engine's backup ejection charge activates at **3,390 feet (1,033 m)**, shortly after apogee, ensuring effective deployment of the drogue parachute. The main parachute deploys at **600 feet (183 m)**, reducing descent velocity for a safe landing.

These altitude predictions, derived from RockSim simulations and confirmed by Flysheet documentation, provide confidence in the rocket's performance and recovery systems.

Event	Time (s)	Altitude (ft)
Apogee	14.79	3457
Ejection Charge Deployment	14.0	3390
Main Parachute Deployment	52.24	600

Stability Margin and CP/CG Relationship:

Center of Gravity (CG): 62.35 inches

Center of Pressure (CP): 77.76 inches

Rocket Diameter: 5.5 inches

Stability Margin: 2.80

The stability margin is calculated as:

$$\text{Stability Margin} = \frac{\text{CP Position} - \text{CG Position}}{\text{Rocket Diameter}}$$

The stability margin of the HyperLOC-1600 was evaluated using RockSim simulations to ensure safe and stable flight. This configuration falls within the optimal range of 1.5 to 2.5, ensuring the rocket maintains a stable trajectory throughout ascent. The stability margin, derived from the distance between CP and CG divided by the rocket's diameter, confirms the vehicle is well-balanced and capable of resisting external forces like wind.

Altitude vs. Time for Different Wind Conditions:

Wind Condition	Max Altitude (ft)	Drogue Deployment Altitude (ft)	Main Deployment Altitude (ft)	Time to Apogee (s)	Time to Landing (s)	Range at Landing (ft)	Velocity at Landing (MPH)
Very Windy (20-30 MPH)	3285.08	3285.08	599.95	14.415	76.839	1612.93	31.55
Breezy (15-25 MPH)	3321.36	3321.36	599.98	14.494	77.4	1364.19	28.53
Slightly Breezy (8-14 MPH)	3438.23	3438.23	599.98	14.751	79.205	459.95	18.69
Light (3-7 MPH)	3462.79	3462.79	599.97	14.808	79.586	154.74	16.55
Calm (0-2 MPH)	3465.94	3465.94	599.97	14.815	79.636	21.36	16.28
No Wind	3466.05	3466.05	599.92	14.816	79.636	0.0	16.27

The table above presents altitude and descent data extracted from RockSim simulations under varying wind conditions. These simulations were conducted to analyze the performance of the Hyperloc-1600 during flight and recovery. The maximum altitude achieved decreases as wind speed increases, with the highest altitude recorded at 3466.05 feet under no wind conditions and the lowest at 3285.08 feet in very windy conditions (20-30 MPH). The drogue parachute deployment altitude closely follows the maximum altitude across all conditions, ensuring controlled descent initiation. The main parachute consistently deploys around 600 feet, allowing for a safe landing.

Additionally, the time to apogee remains relatively constant across all scenarios at approximately 14.8 seconds, while the time to landing varies slightly, with the shortest descent occurring in very windy conditions (76.839 seconds) due to increased horizontal drift and turbulence. The range at landing demonstrates how wind influences drift, with a significant increase in downrange displacement in higher wind speeds (e.g., 1612.93 feet in very windy conditions compared to 0 feet in no wind conditions). The velocity at landing also increases with stronger winds, indicating the effects of lateral wind forces during descent.

These results validate the expected aerodynamic behavior of the rocket under real-world atmospheric conditions and highlight the importance of adjusting for wind conditions when planning launch and recovery operations.

Descent Analysis and Recovery Performance:

The expected descent velocity of the HyperLOC-1600 under the main parachute is calculated to be approximately **15.90 ft/s**. With the main parachute deploying at **600 ft**, the total descent time is estimated at **50.3 seconds**. These updated values align with the latest simulation results, ensuring a safe and controlled landing while minimizing impact forces to protect the payload and structural integrity of the vehicle.

To calculate the descent time, we use the formula for the descent rate of the rocket under a parachute:

$$v = \sqrt{\frac{2W}{\rho A C_d}}$$

Where:

- v = descent velocity (ft/s)
- W = weight of the rocket (lb)
- ρ = air density (slug/ft³)
- A = cross-sectional area of the parachute (ft²)
- C_d = drag coefficient of the parachute (unitless)

4 Payload / Challenge Criteria

4.1 Design of Challenge Solution

To fulfill the Moon Challenge requirements, the payload will be designed to collect static pressure and orientation data. The Adafruit LSM9DS1 payload component will be used to collect orientation sensor data, and the Adafruit BMP280 payload component will be used to collect static pressure/temperature sensor data. The design of the payload will use a stackable shield to ensure a structurally sound unit with no exposed wires to prevent the risk of wires coming out during flight. The Arduino Uno R4 Minima microcontroller will be layered at the base of the payload, followed by the MicroSD breakout shield, the Adafruit 9-DOF LSM9DS1 sensor, and the Adafruit BMP280 I2C. The 4-stack shield will be on a board with a 9V battery, and the Uno has a connector to connect the 9V battery to it. The stackable shield design will also help identify potential errors when troubleshooting.

Final Selected Payload Components:

Payload Components					
Description	**Vendor**	**Part #**	**Price**	**Amount**	**Status**
Arduino Uno R4 Minima	DigiKey	1050-ABX00080-ND	$17.00	1	Received
MicroSD Shield	DigiKey	1568-1331-ND	$17.50	1	Received
Proto Shield	Adafruit	2077	$9.95	2	Received
LSM9DS1	Adafruit	4634	$19.95	1	Received
BMP280	Adafruit	2651	$9.95	1	Received

Commercial Off-The-Shelf (COTS) Electronics Components

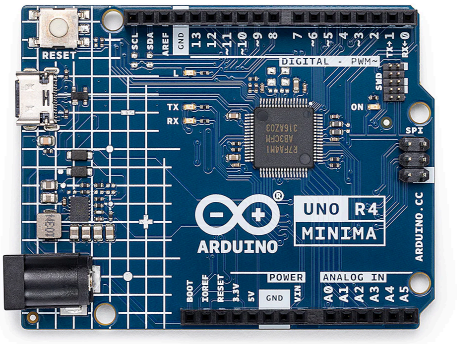

Figure 4.1.1: Arduino UNO R4 Minima (ABX00080)

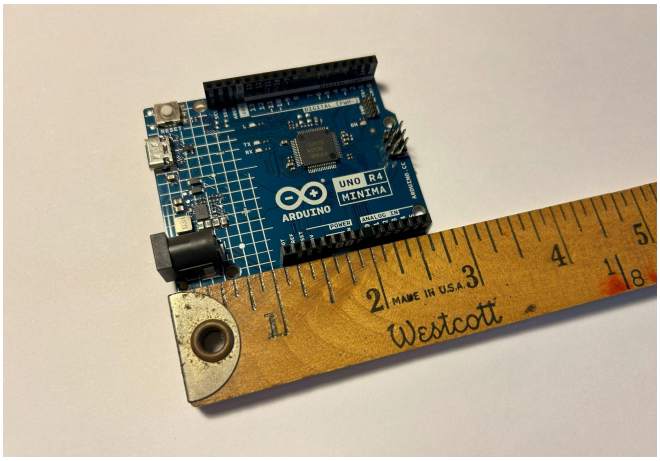

Figure 4.1.2: Arduino UNO R4 Minima Section of Payload

Considering the amount of RAM needed for the MicroSD Shield and sensors, the Arduino Uno R4 Minima was selected for the higher amount of RAM. The microcontroller was designed to be the base of the payload to incrementally develop and add the microSD shield and two sensor devices as additional layers.

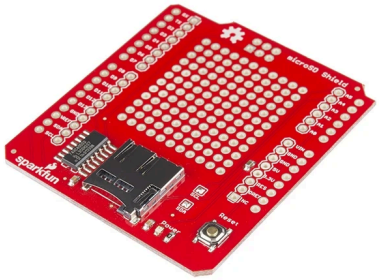

Figure 4.1.3: SparkFun MicroSD Shield (DEV-12761)

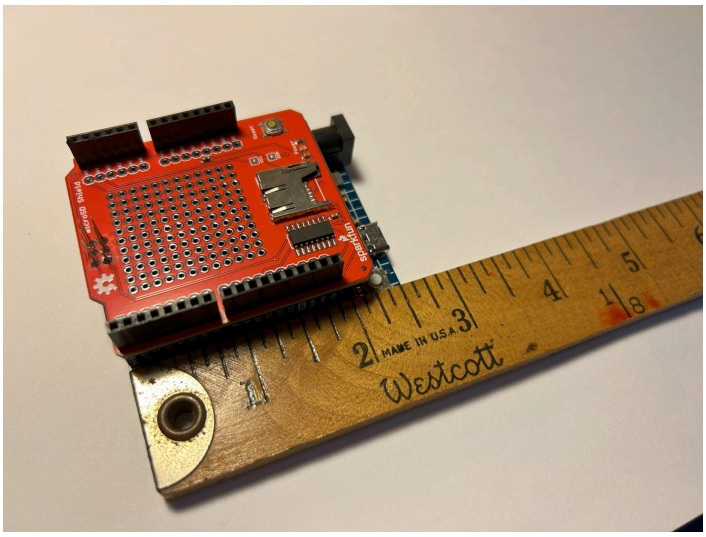

Figure 4.1.4: SparkFun MicroSD Shield Section of Payload

To utilize the shield design of the payload, the SparkFun MicroSD Shield was selected for the Moon Challenge. The MicroSD shield was designed to be layered on top of the Arduino R4 Uno Minima in the payload.

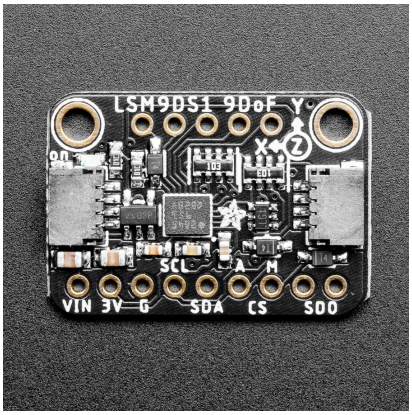

Figure 4.1.5: Adafruit 9-DOF LSM9DS1 (4634)

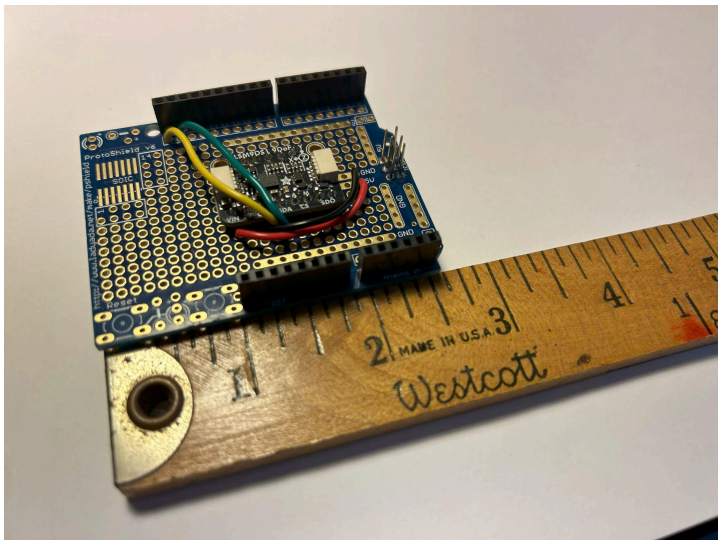

Figure 4.1.6: Adafruit 9-DOF LSM9DS1 Section of Payload

The Adafruit 9-DOF LSM9DS1 was selected for its cost and variety of data it can collect. The Adafruit 9-DOF LSM9DS1 was connected to an Adafruit Proto Shield to be layered on top of the SparkFun MicroSD Shield in the payload.

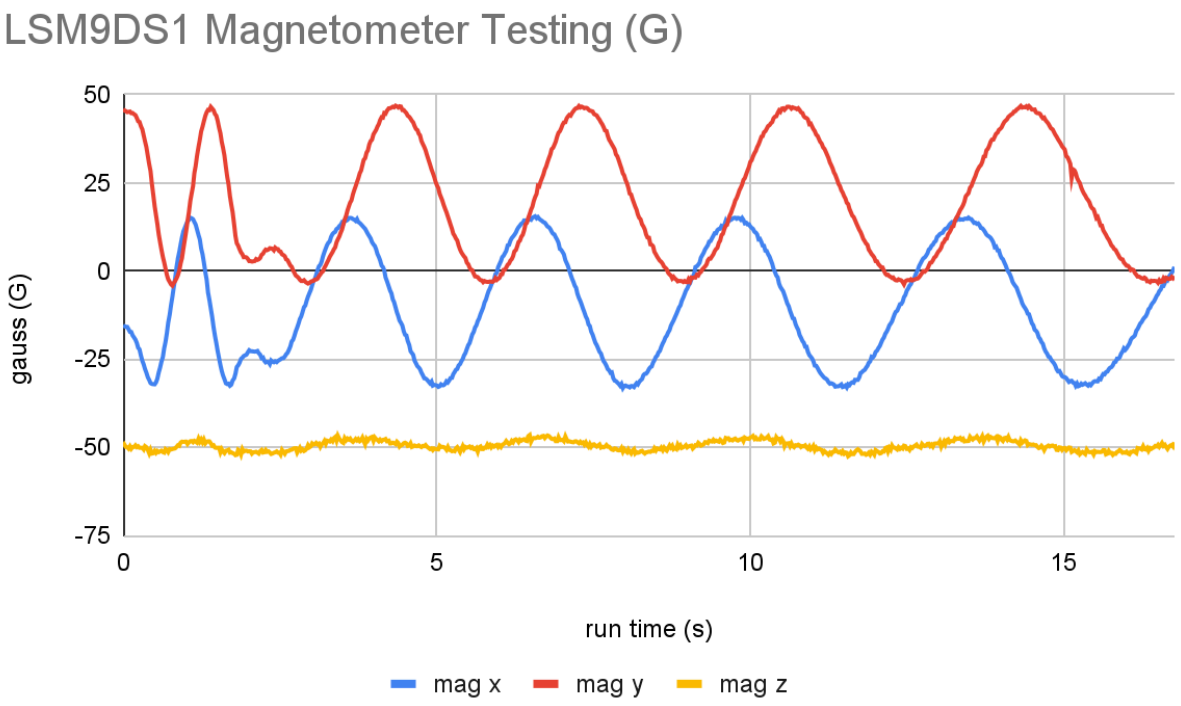

Figure 4.1.7: Adafruit 9-DOF LSM9DS1 Magnetometer Test Data Run

The magnetometer of the Adafruit 9-DOF LSM9DS1 was tested using the Go-Direct Centripetal Force System to rotate the payload to measure the magnetic field of the Earth's north pole relative to the device.

Figure 4.1.8: Adafruit 9-DOF LSM9DS1 Magnetometer Test Setup with Go-Direct Centripetal Force System

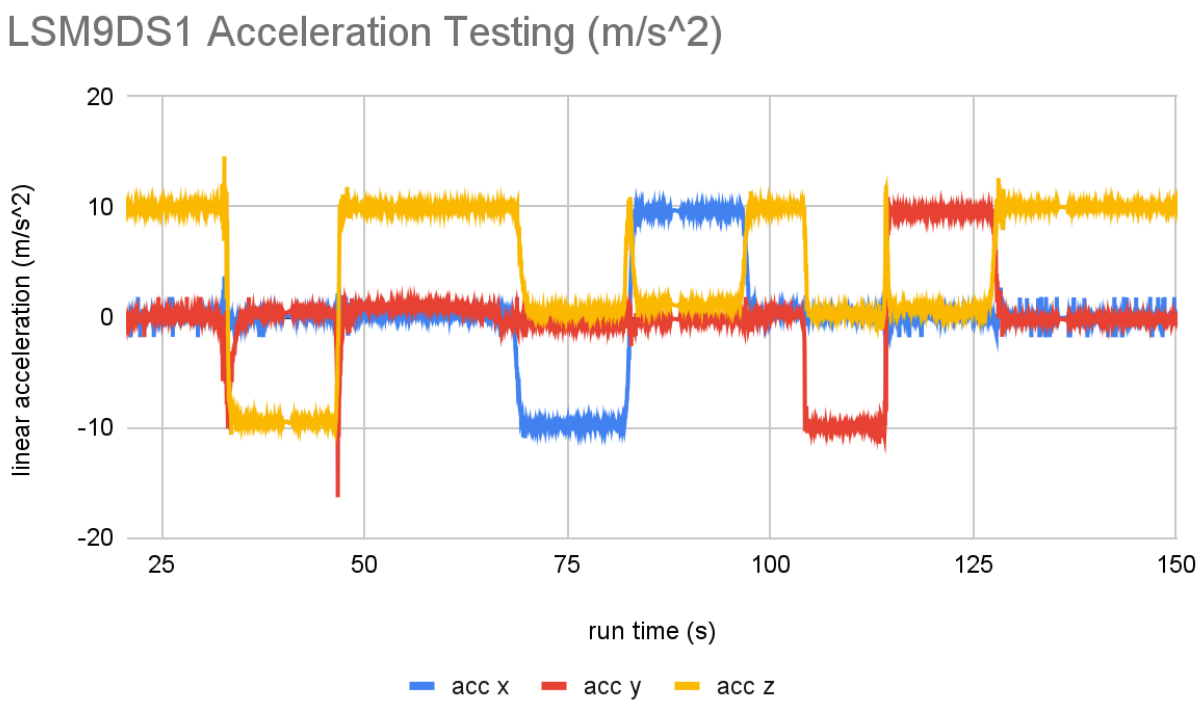

Figure 4.1.8: Adafruit 9-DOF LSM9DS1 Acceleration Test Data Run

Acceleration data collection was tested by orienting the Adafruit 9-DOF LSM9DS1 to face in the positive z/negative z, to negative x/positive x, to negative y/positive y directions during a data run.

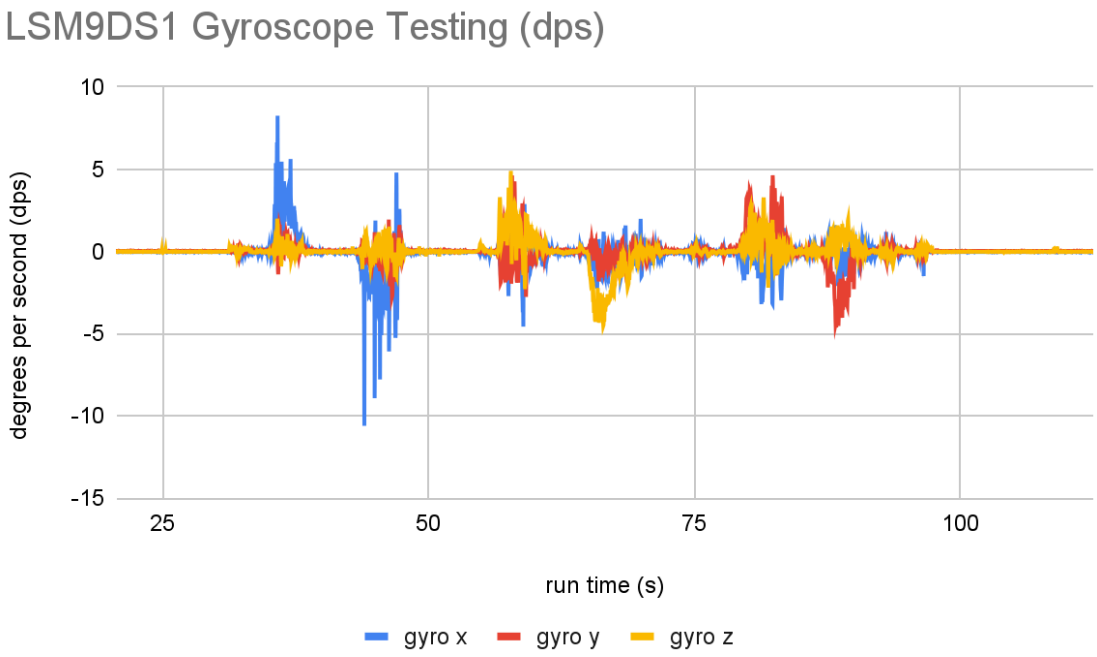

Figure 4.1.9: Adafruit 9-DOF LSM9DS1 Gyroscope Test Data Run

The gyroscope of the device was tested by rotating the Adafruit 9-DOF LSM9DS1 to face in the positive x/negative x, to positive z/negative z, to positive y/negative y directions during a data run.

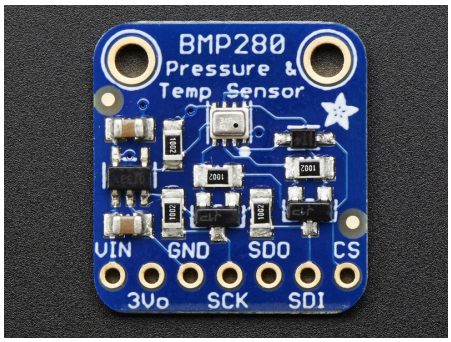

Figure 4.1.10: Adafruit BMP280 I2C (2651)

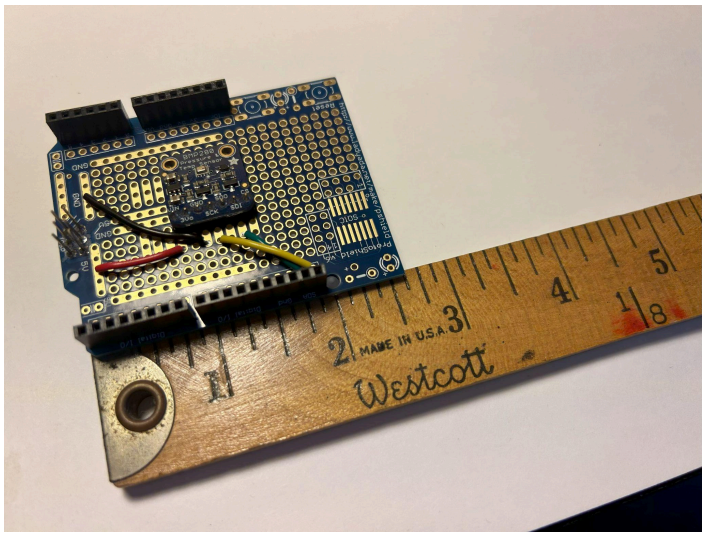

Figure 4.1.11: Adafruit BMP280 I2C Section of Payload

The Adafruit BMP280 was selected for its cost and sample rate. The Adafruit BMP280 was connected to an Adafruit Proto Shield on top of the Adafruit LSM9DS1 as the final layer of the payload to increase exposure to air and temperature.

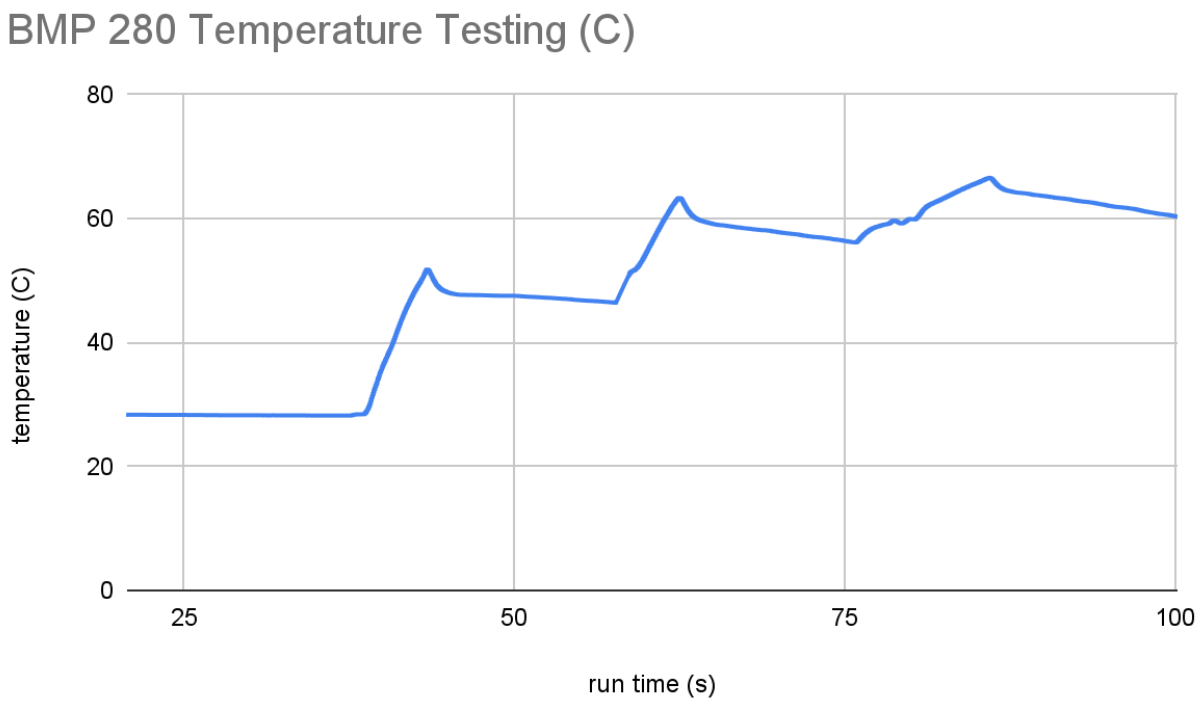

Figure 4.1.12: Adafruit BMP280 I2C Temperature Test Data Run

Temperature data collection of the Adafruit BMP280 was tested by applying a heat source around the sensor, removing the heat source to allow the temperature to fall, and reapplying the heat source for three intervals.

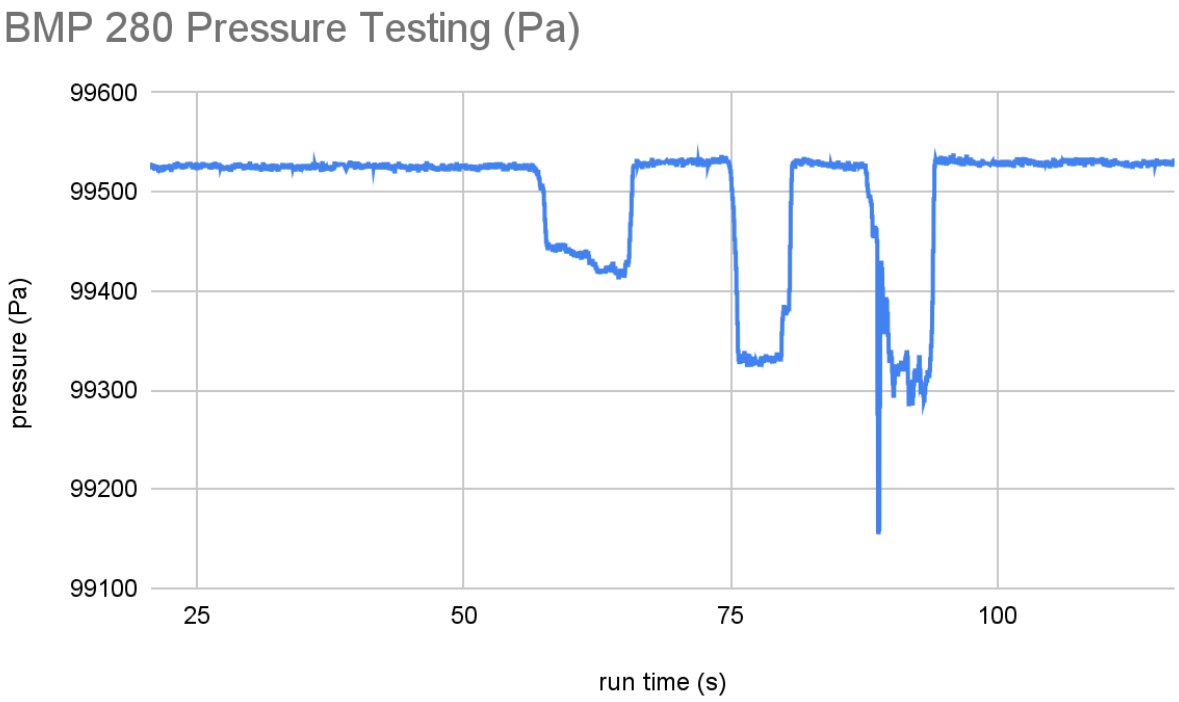

Figure 4.1.13: Adafruit BMP280 I2C Pressure Test Data Run

Pressure data collection of the Adafruit BMP280 was tested by applying a vacuum at various distances around the sensor, removing the vacuum, and reapplying the vacuum for three intervals.

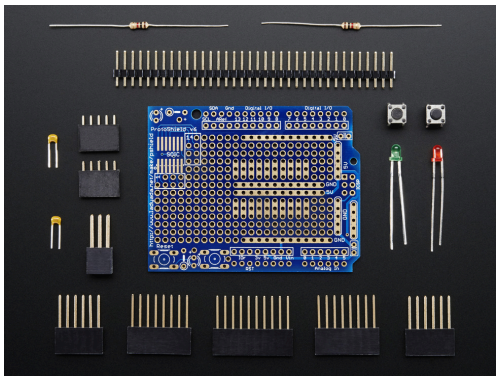

Figure 4.1.14: Adafruit Proto Shield V6 (2077)

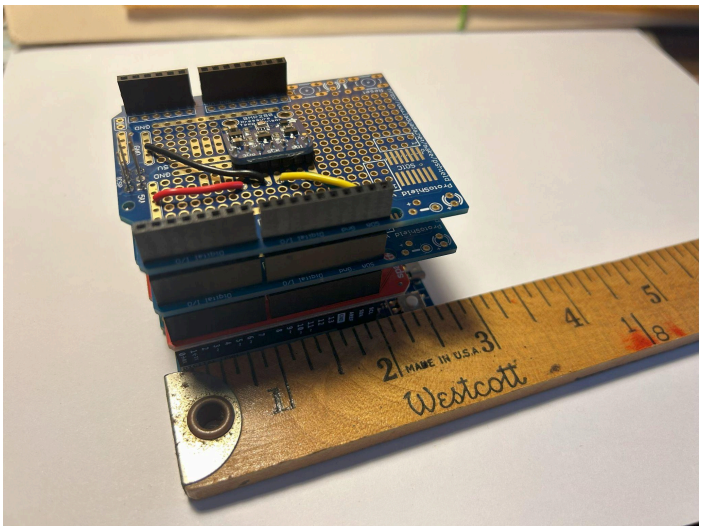

Figure 4.1.15: Final Payload Assembly

Payload Integration Approach

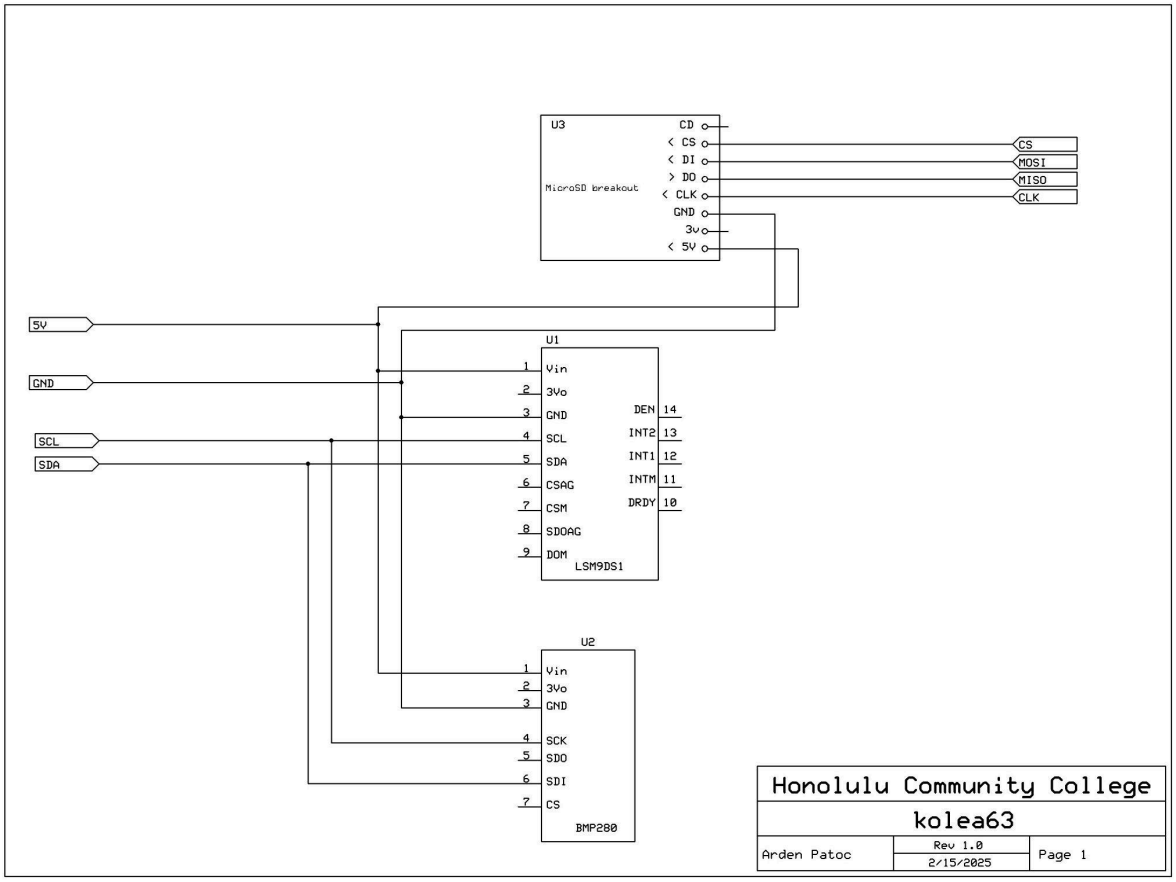

Figure 4.1.16: Payload Circuit Diagram

The payload will be located in the payload bay (before the nosecone) and blocked with a bulkhead to avoid interfering with the parachute ejections. The payload will be powered on before entering the rocket and before reaching the launch pad.

The sensors and controllers will be located after the last coupler closest to the rocket's nose cone. The location of the sensors and controllers will allow the payload to collect atmospheric data while not interfering with the parachute ejections and motor ejections to ensure a safe operation of the rocket's features.

Considering the need for the payload to be securely fit into the payload bay, our team decided to follow the backup plan, having a basswood board as a sled that is slightly less than 5.5 inches in width and fit the internal length of the payload bay. The payload will be mounted to the board with the battery on the other side. The board will be used to prevent movement during flight and to keep it sturdy and stable.

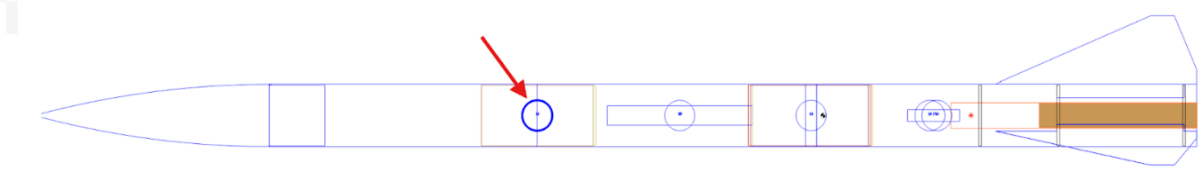

Fig. 4.1.17: Payload location shown by the red arrow and bolded blue circle

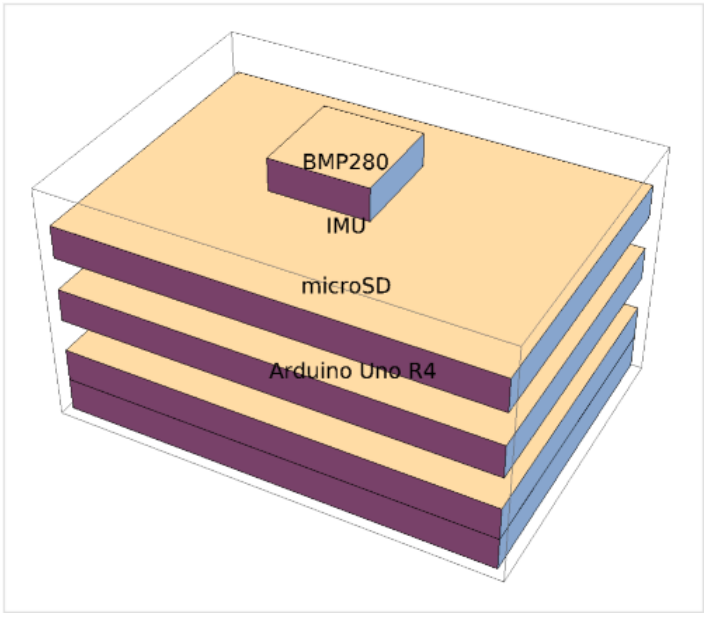

Figure 4.1.18: 3D CAD Rendering of Payload Design

The final as-built payload follows the layers of the original 3D CAD design of the Arduino Uno R4 Minima microcontroller at the base of the payload, followed by the MicroSD breakout shield, the Adafruit 9-DOF LSM9DS1 sensor, and the Adafruit BMP280 I2C.

A testing procedure and checklist were developed for the payload sensors to use during test data runs to confirm proper data collection (see Appendix for Flight Code Testing Checklist).

5 Safety and Procedures

Launch Concerns and Operation Procedures

Avionics Preparation Checklist:

1. Separate the nose cone chute from the body of the rocket to open access to the payload chute
   HAZARD: If needed, attach colored streamers (engineering tape) to any electronics inserted into the chute to allow the payload to be easily spotted if separated from the rocket during the launch.
   HAZARD: Lithium-ion batteries used pose a potential fire hazard. (See Appendix for Safety Data Sheet for Lithium-ion batteries)
2. Level payload horizontally and carefully slide payload into payload chute
3. Reattach the nose cone chute to the body of the rocket

Recovery Preparation Checklist

1. Fold the parachute and drogue chute
2. Attach main parachute to shock chord
   HAZARD: If the main parachute is improperly folded, it may not deploy correctly and may damage the rocket upon launching
3. Pack firecloth between the main parachute and the black powder charge
   HAZARD: If the fire cloth is not properly packed, it may damage the parachute when the black power charge ignites and needs to be replaced as needed.
   HAZARD: Handle the black powder in a well-ventilated environment to avoid inhaling particles or having particles irritate the eyes. Avoid operating black powder near any potential charges and heat sources (See Appendix for Safety Data Sheet for Black Powder)
   SAFETY: Gloves must be worn when using graphite powder in the next step.
4. Pack main parachute into between upper body tube and nose cone
5. If needed, use graphite powder to lubricate the inside of section
6. Insert drogue chute

Final Vehicle Assembly Checklist

1. Load motor into rocket
   SAFETY: Epoxy resin and hardeners emit toxic fumes that can irritate the eyes, nose, and throat skin, and can cause reproductive problems. Avoid epoxy spills, look to apply epoxy in a well-ventilated area using masks and goggles if needed. (See Appendix for Safety Data Sheet for Bob Smith Industries Epoxy)
2. Secure motor retainer

HAZARD: Ensure the motor is secured properly to prevent the motor from falling out or the rocket from taking off at a dangerous angle

3. Align launch buttons
4. Install igniter

   SAFETY: At least one team member must have attended an igniter installation workshop
5. Attach alligator clips to igniter ends
6. Attach alligator clips to launch box

Launch Pad Setup Checklist

1. Attach rocket to launch rail
2. Prime altimeters

   HAZARD: Do not prime altimeters until the rocket is at the launch pad to avoid potentially causing the charges to go off
3. Check for any altimeter malfunctions
4. Install the igniter properly
5. Have all personnel retreat to a safe distance
6. Launch

   SAFETY: The Range Safety Officer must be present for launch pad set up and ensure all steps are performed correctly

Troubleshooting Checklist:

1. Motor - Check wirings to ensure they are securely attached
2. Altimeter - Listen for beeps that indicate if the altimeter is working properly
3. Charges - Ensure safety switch is engaged

Post-Flight Inspection Checklist:

1. Locate the rocket, request assistance if landed in an unsafe location to retrieve

   SAFETY: The Range Safety Officer must be present during recovery to determine the safety of the rocket's retrieval, and if additional assistance is needed depending on the location
2. Inspect the airframe and fins for visible damage

   HAZARD: Acetone and plastic cement were used in the construction of rockets. See Appendix for Safety Data Sheet for Klean-Strip Acetone and Paragon Plastic Cement).
3. Inspect parachutes to ensure no holes or damage are present
4. Inspect the inside of the rocket, including the payload chute, to make sure no significant damage has occurred.
5. Recover and record data from microcontrollers and altimeters

Additional Launch Rocket Preparation Notes:

Wadding sheets were inserted between the motor and rocket frame to prevent burning inside the rocket frame

The type of fold of the main parachute and the drogue parachute determines how quickly the parachutes deploy from the rocket

Acknowledgement of safety regulations

As a team, we collectively acknowledge and prioritize the importance of safety in all our research activities. We are committed to using the hazard recognition, accident avoidance, and pre-launch briefing plan provided by our mentors and policies regulated by research and launch areas. It means that if a research activity, launch, or recovery is deemed unsafe for a launch by the eyes of our safety officer and mentors, by all means necessary, it will be halted for a safer solution even if the solution is a discontinuation.

I, Arden Patoc, hereby acknowledge and accept all regulations and safety procedures applicable to First Nations Launch. I understand that any potential harm or injury resulting from my actions will be my sole responsibility.

I, Teal Hoffman, hereby acknowledge and accept all regulations and safety procedures applicable to First Nations Launch. I understand that any potential harm or injury resulting from my actions will be my sole responsibility.

I, Shelby Dixon, hereby acknowledge and accept all regulations and safety procedures applicable to First Nations Launch. I understand that any potential harm or injury resulting from my actions will be my sole responsibility.

I, Alexander Anderson, hereby acknowledge and accept all regulations and safety procedures applicable to First Nations Launch. I understand that any potential harm or injury resulting from my actions will be my sole responsibility.

6 Project Plan

6.1 Test Plan

Drop Test:
Successful? Yes!

Figure 6.1.1: Drop test to determine if the shear pins can withstand the weight of gravity and some tension after dropping.

We learned that two shear pins are enough to confirm our predictions that they will not come apart. The design is verified and successful.

Black Powder/Ground Test:
Successful? Yes!

Ejection Charge for the Drogue Chute:

Figure 6.1.: The ejection charge tests for the drogue chute. At first, we tried 2 grams (calculated amount) of black powder and it separated, although the drogue chute did not become exposed. So we chose to use 4 grams of black powder, and it worked very well.

We learned from doing these tests that rotating the black powder capsule in the rocket will boost it more.

Figure 6.1.: Ejection charge test to see if the black powder will be able to break the shear pins and eject the main chute. After thorough ground deployment testing, we concluded that both the main and drogue parachutes required 4 grams of black powder to adequately deploy from the rocket.

Payload Tests (Please see section 4)

6.2 Project Budget

We have accepted $4,000 in funding from WSGC, along with an additional $4,000 from HSGC and the B2B grant, ensuring the project is fully funded. If further funding is required, HSGC is available to provide additional support.

Honolulu Community College					
First Nations Launch 2025 Budget Report					
Component Description	Vendor/Manufacturer	Status	Quantity	Cost Per Unit	Total
Vehicle					
Rail buttons + shipping	Missile Works	Ordered	4	$6.25	$25.00
Rocket Kit, parts + shipping	Loc Precision	Ordered	1	$715.02	$715.02
Payload section, electronic bay ect. + shipping	Loc Precision	Ordered	1	$111.04	$111.04

				Total	$851.06
Challenge					
Arduino + shipping	Digikey	Ordered	2	$35.00	$70.00
Sensors + shipping	Digikey	Ordered	4	$25.00	$101.35
Arduino Shield + shipping	Digikey	Ordered	4	$41.00	$163.42
				Total	$334.77
Avionics					
Telemega Flight Computer, battery, TeleBT + shipping	Altus Metrum	Ordered	1	$713.28	$713.28
RRC3+ Duel Deployment Altimeter, battery + shipping	Missile Works	Ordered	2	$87.35	$174.70
				Total	$887.98
Recovery					
Parachutes + shipping	Loc Precision	Ordered	1	$60.00	$60.00
Shock cord + shipping	Loc Precision	Ordered	1	$50.00	$50.00
				Total	$110.00
General Materials & Supply					
Large Sturdy Cardboard Boxes & Tape	Local store	Not Ordered	4	$30.00	$120.00
TRA Membership	TRA website	Ordered	4	$20.00	$80.00
Fiberglass and hardware	Home Depot	Ordered	1	$100.00	$100.00
Epoxy + mixing cups	Amazon	Ordered	1	$98.00	$98.00
Adhesives, hardwares	Chris' Rocketry	Ordered	1	$202.33	$202.33
RockSim	Apogee	Ordered	3	$50.00	$150.00
Paint, brush, mask tape and hardwares for painting	Home Depot	Not Ordered	1	$120.00	$120.00
				Total	$870.33
Travel					

Airfare	Airlines	Ordered	4	$660.00	$2,640.00
Check-in baggage	Airlines	Not Ordered	4	$50.00	$200.00
Car	Rental car	Ordered	1	$484.36	$484.36
Gas	Gas station	Not Ordered	1	$60.00	$60.00
Hotel	Assigned	Not Ordered	3	$120.00	$360.00
Meal	Local in WI	Not Ordered	4	$200.00	$800.00
				Total	$4,544.36
Grand total					
				Grand total	$7,598.50

6.3 Project Timeline

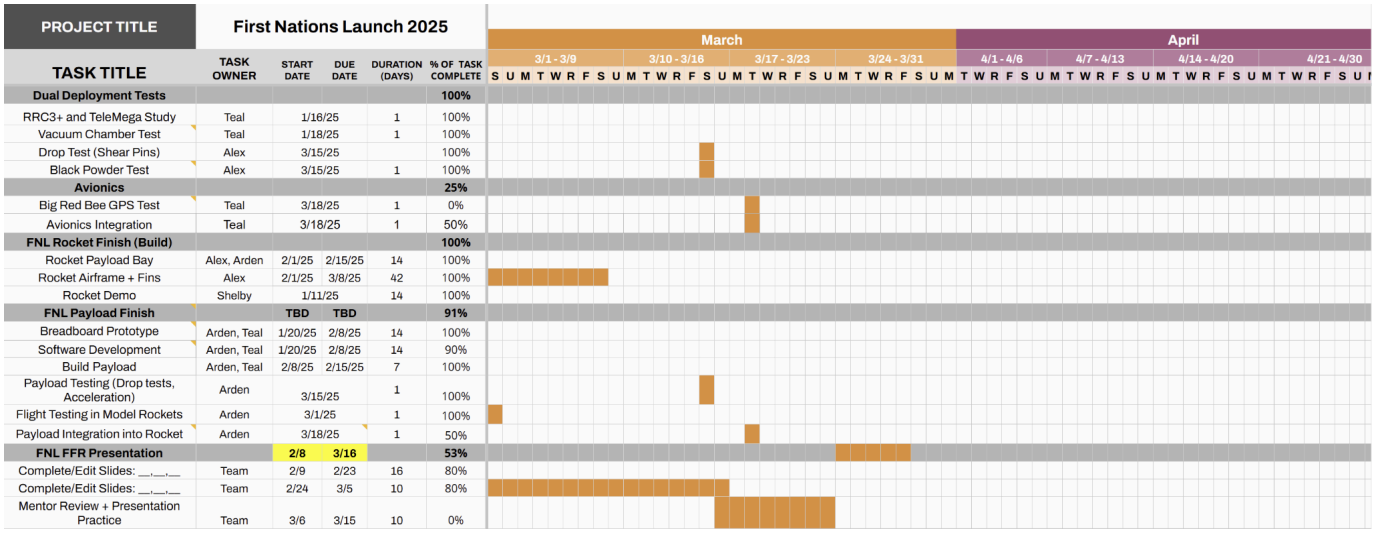

Figure 6.3.1: Timeline for March - April 2025

The rocket structures are fully completed, and we are currently working on the final touches, including painting, which will be finished by 3/29/25.

The payload design is fully complete. Both the prototype and flight units are fully assembled and tested. We plan to assemble a backup flight unit by 03/29/2025.

Additionally, we will continue improving the code/software and aim to integrate it into the rocket by 3/20/25.

The avionics subsystem has been thoroughly tested and is nearly complete. The final steps involve integrating the altimeters and batteries. We are on track to complete this, along with the BigRedBee GPS tracker test, by 3/20/25, tentatively.

Summary Table of Progress		Estimated % Completion
Structures	The structure of the rocket is complete.	100%
Simulations	The simulations of RockSim are completed.	100%
Avionics	The avionics have all been tested for their ejection charges and we have gathered practice data during a launch at Aloun Farms. The altimeter components just need to be mounted onto the sled and will be completed this spring break (3/17/25 - 3/23/25).	95%
Payload	The payload design is complete and all tests from the test plan have been completed. Some software can be improved.	95%
Safety	The team has kept up with the safety procedures outlined in the safety section.	TRUE
Budget	The team has a sufficient budget.	TRUE
Timeline	The team is on track to completion.	TRUE

7 Appendix

Please see section 6.2 for the budget and 6.3 for the timeline.

7.1 Works Cited

[1] Wolfram Alpha. (2024). *Wolfram|Alpha: Making the world's knowledge computable*. Wolframalpha.com. https://www.wolframalpha.com/

[2] Adafruit Industries. (2019). *Adafruit Industries, Unique & fun DIY electronics and kits*. Adafruit.com. https://www.adafruit.com/

[3] *High Power Model Rocketry Supplies | Advance Model Rockets Kits*. (n.d.). LOC Precision / Public Missiles Ltd. https://locprecision.com/

[4] Benson, T. (n.d.). *Velocity During Recovery*. Nasa.gov. https://www.grc.nasa.gov/WWW/k-12/VirtualAero/BottleRocket/airplane/rktvrecv.html

7.2 Flight Code Testing Checklist

Checklist	Result	Notes
Flight Code Verifications		
Flight Code Compiled/Uploaded		*(Y/N)*
Verify Lights Upon Connection		*Green Light LSM9DS1, Red Light MicroSD Breakout, Green Light Arduino Uno (Y/N)*
Connection Verifications		
Arduino disconnected from Laptop		*Disconnected (Y/N)*
Measure 9V Battery Voltage		*Record Voltage MM Reading*
Connect 9V Battery		*Connected? (Y/N)*
Verify Light Show		*Flashing yellow light on Arduino? (Y/N)*
Timer Started After Light Show		*20 minute timer (Y/N)*
Pressure (BMP 280)		
SHIELD Board Flat		*5 seconds*
Sodler sucker with adaptor		*5 seconds*
SHIELD Board Flat		*5 seconds*
Solder sucker with adaptor		*5 seconds*
SHIELD Board Flat		*5 seconds*
Temperature (BMP 280)		
SHIELD Board Flat		*5 seconds*
Warm Source		*5 seconds*
SHIELD Board Flat		*5 seconds*
Warm Source		*5 seconds*
SHIELD Board Flat		*5 seconds*
Accelerometer (LSM9S1)		
SHIELD Board Flat		*5 seconds*
X-Accel Up		*5 seconds*
SHIELD Board Flat		*5 seconds*
X-Accel Down		*5 seconds*
SHIELD Board Flat		*5 seconds*
Y-Accel Up		*5 seconds*
SHIELD Board Flat		*5 seconds*
Y-Accel Down		*5 seconds*
SHIELD Board Flat		*5 seconds*
Z-Accel Up		*5 seconds*
SHIELD Board Flat		*5 seconds*
Z-Accel Down		*5 seconds*
SHIELD Board Flat		*5 seconds*
Gyroscope (LSM9DS1)		
SHIELD Board Flat		*5 seconds*
Rotate X CCW		*5 seconds*
SHIELD Board Flat		*5 seconds*
Rotate X CW		*5 seconds*
SHIELD Board Flat		*5 seconds*
Rotate Y CCW		*5 seconds*
SHIELD Board Flat		*5 seconds*
Rotate Y CW		*5 seconds*
SHIELD Board Flat		*5 seconds*
Rotate Z CCW		*5 seconds*
SHIELD Board Flat		*5 seconds*
Rotate Z CW		*5 seconds*
SHIELD Board Flat		*5 seconds*
Magnetometer (LSM9DS1)		
SHIELD Board Flat		*5 seconds*
Rotate magnetic around IMU		*5 seconds*
SHIELD Board Flat		*5 seconds*
Rotate magnetic around IMU		*5 seconds*
SHIELD Board Flat		*5 seconds*
Final Steps		
SHIELD Board Flat		*5 seconds*

Checklist	Result	Notes
Shake SHIELD carefully		*5 seconds*
SHIELD Board Flat		*5 seconds*
Disconnect 9V Battery		*Disconnected? (Y/N)*
Measure 9V Battery Voltage		*Record Voltage MM Reading*
Data Analysis		
Eject microSD Card		*(Y/N)*
Rename KOLEA63 output file to format "KOLEA63-YYYY-MM-DD-VV"		*YYYY - year, MM - month, DD - day, VV - version # (starting from 01)*
Pressure		*Record in POST Testing Checklist (Y/N)*
Temperature		*Record in POST Testing Checklist (Y/N)*
Accel IMU		*Record in POST Testing Checklist (Y/N)*
Gyroscope IMU		*Record in POST Testing Checklist (Y/N)*
Magnetometer IMU		*Record in POST Testing Checklist (Y/N)*
Graph/Label Temperature and Pressure vs Time		*(Y/N)*
Graph/Label Accelerometer, Gyroscope, and Magnetometer vs Time		*(Y/N)*
Copy log file to laptop (testdata/datarun in local drive)		*(Y/N)*
Copy log file to "olddata" folder in MicroSD		*(Y/N)*
Copy log file to "olddata" folder in MicroSD		*(Y/N)*
Erase KOLEA63 output file from root folder of Micro SD		*(Y/N)*

Checklist	Result	Notes
Temperature and Pressure (BMP 280)		
Temp C		*Range 20-30 C*
Temp F		*Range 60-90 F*
Pressure psi		*Range 12-14 psi*
Responds to temperature changes		*(Y/N)*
Responds to pressure changes		*(Y/N)*
Accelerometer (LSM9S1)		
X up		*Range 8 to 10m/s^2*
X down		*Range -8 to -10m/s^2*
Y up		*Range 8 to 10m/s^2*
Y down		*Range -8 to -10m/s^2*
Z up		*Range 8 to 10m/s^2*
Z down		*Range -8 to -10m/s^2*
Responds to movement		*(Y/N)*
Gyroscope (LSM9DS1)		
X values at rest		*Record Actual*
Y values at rest		*Record Actual*
Z values at rest		*Record Actual*
X CCW		*Varies*
X CW		*Varies*
Y CCW		*Varies*
Y CW		*Varies*
Z CCW		*Varies*
Z CW		*Varies*
Magnetometer (LSM9DS1)		
X values at rest		*Record Actual*
Y values at rest		*Record Actual*
Z values at rest		*Record Actual*
X Magnet Response		*Varies*
Y Magnet Response		*Varies*
Z Magnet Response		*Varies*
Orientation (LSM9DS1)		
Roll Response		*-90 to +90*
Pitch Response		*-180 to +180*
Heading Response		*0 or 360 North (0-360)*

7.3 Material Safety Data Sheets

- Bob Smith Industries Epoxy
- Lithium Ion Battery (Module)
- Klean-Strip Acetone
- Paragon Plastic Cement
- Black Powder

BOB SMITH INDUSTRIES INCORPORATED

Safety Data Sheet

Revision Number: 02.4 **Issue date:** 04/11/2023

1. PRODUCT AND COMPANY IDENTIFICATION

Product name: Quik-Cure™
Product type: 2-Part epoxy adhesive
Restriction of Use: None identified
Company address:
Bob Smith Industries, Inc.
155 Cow Meadow Place,
Paso Robles, CA 93446

IDH number: 201-202/211
Item number: 201-202/211
Region: United States
Contact information:
Telephone: (805) 466-1717
MEDICAL EMERGENCY Phone: Poison Control Center
1-877-671-4608 (toll free) or 1-303-592-1711
TRANSPORT EMERGENCY Phone:
1-800-223-7699 (toll free)
www.bsi-inc.com

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

WARNING: CAUSES SKIN IRRITATION
MAY CAUSE AN ALLERGIC SKIN REACTION
CAUSES SERIOUS EYE IRRITATION

HAZARD CLASS	HAZARD CATEGORY
SKIN IRRITATION	2
EYE IRRITATION	2A
SKIN SENSITIZATION	1

PICTOGRAM(S)

Precautionary Statements

Prevention: Avoid breathing vapors. Wash thoroughly after handling. Use only outdoors or in a well-ventilated area. Wear protective gloves, eye protection and face protection.

Response: IF ON SKIN: Wash with soap and water. IF INHALED: Remove person to fresh air and keep comfortable for breathing.
IF IN EYES: Rinse with water for several minutes. If eye irritation persists: Get medical attention. In case of fire: Use water spray to extinguish.
IF INGESTED: Do not induce vomiting without medical advise.

Storage: Store in a well-ventilated place. Keep container tightly closed.
Keep in a cool and dry area.

Disposal: Dispose of contents and/or container according to Federal, State/Provincial and local governmental regulations.

H-3, F-1, R-0

Classification complies with OSHA Hazard Communication Standard (29 CFR 1910.1200) and is consistent with the provisions of the United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

3. COMPOSITION / INFORMATION ON INGREDIENTS

Hazardous Component(s)	CAS Number	Percentage*
Bisphenol A Epoxy Resin	25068-38-6	>45
Poly-Mercaptan Resin	Proprietary	>45

* Exact percentage is a trade secret. Concentration range is provided to assist users in providing appropriate protections.

4. FIRST AID MEASURES

Inhalation: Move to fresh air.

Skin contact: Wash contact area with soap and water. Remove contaminated clothing. Launder contaminated clothing before use.

Eye contact: Immediately flush thoroughly with water and get medical attention.

Ingestion: Seek immediate medical attention. Do not induce vomiting.
Irritating to mouth, throat and stomach.

Symptoms: See Section 11.

Notes to physician: If ingested, material may be aspirated into the lungs and cause chemical pneumonitis. Treat appropriately. Application of corticosteroid cream has been effective in treating skin irritation.

5. FIRE FIGHTING MEASURES

Extinguishing media: Water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special firefighting procedures: In enclosed spaces, wear a self-contained breathing apparatus. Prevent runoff from entering streams, sewers or drinking water supply.

Unusual fire or explosion hazards: None

Hazardous combustion products: May generate ammonia and nitrogen oxide gases. Halogenated compounds.

6. ACCIDENTAL RELEASE MEASURES

Use personal protection recommended in Section 8, isolate the hazard area and deny entry to unnecessary and unprotected personnel.

Environmental precautions: Ventilate area. Do not allow product to enter sewer or waterways.

Clean-up methods: Absorb or cover with dry earth, sand or other absorbent, non-combustible material. Dispose of via a licensed waste disposal contractor. Refer to Section 8 "Exposure Controls / Personal Protection" prior to clean up.

7. HANDLING AND STORAGE

Handling: Prevent contact with eyes and avoid contact with skin Avoid breathing vapor and mist. Wash thoroughly with soap and water after handling. Persons with a history of skin sensitization problems should not use.

Storage: For safe storage, store between 2°C (36°F) and 40°C (104°F).
Keep in a well ventilated, dry area. Keep container tightly closed until ready for use.

For information on product shelf life contact BSI Customer Service at (800) 223-7699

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Employers should complete an assessment of all workplaces to determine the need for, and selection of, proper exposure controls and protective equipment for each task performed.

Hazardous Component(s)	ACGIH TLV	OSHA PEL	AIHA WEEL	OTHER
Bisphenol A Epoxy Resin	200 ppm TWA	None	None	None
Poly-Mercaptan Hardener	150 ppm TWA	None	None	None

Engineering controls: Use positive down-draft exhaust ventilation if general ventilation is insufficient to maintain vapor concentration below established exposure limits.

Respiratory protection: Not required for properly ventilated areas.

Eye/face protection: Safety goggles or safety glasses with side shields. Full face protection should be used if the potential for splashing or spraying of product exists.

Skin protection: Use chemical-resistant, impervious gloves as necessary to prevent contact.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Liquid
Color: **Clear to** Slight amber
Odor: Amine
Odor threshold: N/D
pH: Alkaline
Vapor pressure: 1.17 mm hg (0.156 kPa)
Boiling point/range: >200°C (>392°F)
Melting point/ range: Not determined
Specific gravity: 0.97 / 1.15
Vapor density: N/A
Flash point: 101°C (214°F) ASTM D-56
Flammable/Explosive limits - lower: N/A
Flammable/Explosive limits - upper: N/A
Auto-ignition temperature: N/A
Evaporation rate: N/A
Solubility in water: Some
Partition coefficient (n-octanol/water): 3.8
VOC content: < 2 %; < 20 g/l (California SCAQMD Method 316B) (Estimated)
Viscosity: 10,000 to 12,000 cps..
Decomposition temperature: >200°C (>392°F)

10. STABILITY AND REACTIVITY

Stability: Material is stable under recommended storage conditions.

Hazardous reactions: Hazardous polymerization will not occur.

Hazardous decomposition products: Material does not decompose at ambient temperatures.

Incompatible materials: Organic and mineral acids, strong oxidizers

Reactivity: Not available.

Conditions to avoid: No specific data

11. TOXICOLOGICAL INFORMATION

Relevant routes of exposure: Skin, Inhalation, Ingestion, Eyes

Potential Health Effects/Symptoms

Inhalation: May cause respiratory tract irritation. Exposure to vapors above the established exposure limit results in respiratory irritation, which may cause headaches, dizziness, anesthesia and drowsiness. Is not a respiratory sensitizer.
Skin contact: May cause skin irritation. Prolonged skin contact may cause burns. May cause sensitization of skin.
Eye contact: May cause severe irritation to eyes.
Ingestion: Harmful if swallowed.
Aspiration: No data available.

Hazardous Component(s)	LD50s and LC50s	Immediate and Delayed Health Effects
Bisphenol A Epoxy Resin	200 ppm	Irritant
Poly-Mercaptan	None	Irritant, skin sensitization

Hazardous Component(s)	NTP Carcinogen	IARC Carcinogen	OSHA Carcinogen (Specifically Regulated)
Bisphenol A Epoxy Resin	No	No	No
Poly-Mercaptan	No	No	No

12. ECOLOGICAL INFORMATION

Ecological information: May cause long-term adverse effects in the aquatic environment. Moderate bioaccumulation potential. Not readily biodegradable.

13. DISPOSAL CONSIDERATIONS

Information provided is for unused product only.

Recommended method of disposal: Follow all local, state, federal and provincial regulations for disposal. May be disposed by supervised incineration at very high temperatures.

Hazardous waste number: May be subject to RCRA regulations (40 CFR 261).

14. TRANSPORT INFORMATION

The transport information provided in this section only applies to the material/formulation itself, and is not specific to any package/configuration.

U.S. Department of Transportation Ground (49 CFR)
Proper shipping name: Environmentally hazardous substance Liq n.o.s.
Hazard class or division: 9
Identification number: 3082
Packing group: III

International Air Transportation (ICAO/IATA)
Proper shipping name: Environmentally hazardous substance Liq. n.o.s.
Hazard class or division: 9
Identification number: UN 3082
Packing group: III

Exceptions: **Primary packs containing less than 500ml are unregulated by these modes of transport and may be shipped unrestricted. Marine pollutant mark is not required in sizes <5 L.**

Water Transportation (IMO/IMDG)

Proper shipping name:	Environ. Hazardous Substance, Liq, n.o.s.
Hazard class or division:	9
Identification number:	3082
Packing group:	III
Marine pollutant:	Yes

15. REGULATORY INFORMATION

United States Regulatory Information

TSCA 8 (b) Inventory Status:	All components are listed or are exempt from listing on the Toxic Substances Control Act Inventory.
TSCA 12 (b) Export Notification:	None above reporting de minimis.
CERCLA/SARA Section 302 EHS:	None above reporting de minimis.
CERCLA/SARA Section 311/312:	Immediate Health, Delayed Health
CERCLA/SARA Section 313:	None above reporting de minimis.
ODS	This product does not contain nor is it manufactured with ozone depleting substances.
California Proposition 65:	This product may contain chemicals know to the state of California to cause cancer or reproductive harm.

Canada Regulatory Information

CEPA DSL/NDSL Status:	Contains one or more components listed on the Non-Domestic Substances List. All other components are listed on or are exempt from listing on the Domestic Substances List. Components listed on the NDSL must be tracked by all Canadian Importers of Record as required by Environment Canada. They may be imported into Canada in limited quantities. Please contact Regulatory Affairs for additional details.

16. OTHER INFORMATION

REACH & RoHS2.0 Compliant

Schedule B HS #3506990000

Ingredients are not currently designated as hazardous substances under current OSHA guidelines.

DISCLAIMER: The data contained herein are furnished for information only and are believed to be reliable. However, BSI does not assume responsibility for any results obtained by persons over whose methods BSI has no control. It is the user's responsibility to determine the suitability of BSI's products or any production methods mentioned herein for a particular purpose, and to adopt such precautions as may be advisable for the protection of property and persons against any hazards that may be involved in the handling and use of any BSI's products. In light of the foregoing, BSI specifically disclaims all warranties, express or implied, including warranties of merchantability and fitness for a particular purpose, arising from sale or use of BSI's products. BSI further disclaims any liability for consequential or incidental damages of any kind, including lost profits.

EnerSys
Power/Full Solutions

PRODUCT SAFETY DATA SHEET

Form # SDS 829515
Issued: AB
Supersedes: AA
ECO #: 1002195

1. IDENTIFICATION

Product Identifier used on the label:
Lithium Ion Battery (Module)

Chemical Family/Classification:
Rechargeable Battery (Module)

Other Means of Identification:
Industrial Battery

Recommended Use and Restrictions on Use:
For use as a rechargeable battery (module); this product contains a SNUR substance, see Section 15.

Manufacturer's Name/Address:
EnerSys
P.O. Box 14145
2366 Bernville Road
Reading, PA 19605

Canada Corporate Office
3-61 Parr Boulevard
Bolton, Ontario
L7E 4E3

Telephone:
For information and emergencies, contact EnerSys'
Environmental, Health & Safety Dept. at 610-208-1996
24-Hour Emergency Response Contact:
CHEMTREC DOMESTIC: 800-424-9300 CHEMTREC INT'L: 703-527-3877

2. HAZARD IDENTIFICATION

Hazard Classifications:

HEALTH		ENVIRONMENTAL		PHYSICAL	
Skin Corrosion	Category 1	Aquatic Chronic Toxicity	Category 2	Flammable Liquid	Category 2
STOT RE	Category 1				

Hazard Symbols:

HEALTH	ENVIRONMENTAL	PHYSICAL
		

Signal Word: DANGER!

Hazard Statements
Causes severe skin burns and eye damage.
Causes damage to organs (teeth, bones) through prolonged or repeated exposure
Highly flammable liquid and vapor.
Toxic to aquatic life.

Precautionary Statements

Prevention
Do not breathe dusts/fume/gas/mist/vapors/spray.
Wash exposed skin thoroughly after handling.
Wear protective gloves/protective clothing/eye protection/face protection.
Do not eat, drink, or smoke when using this product.
Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
Keep container tightly closed.
Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilating/lighting/equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Avoid release to the environment.

Hazards Not Otherwise Classified: None Identified.

Precautionary Statements (continued)

Response
If swallowed: Rinse mouth. Do NOT induce vomiting.
If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower. Wash contaminated clothing before reuse.
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do so. Continue rinsing.
If inhaled: Remove person to fresh air and keep comfortable for breathing.
Immediately call a poison center or doctor.
Specific treatment: See Section 4.
Get medical attention if you feel unwell.
In case of fire: Use water spray, foam, CO2 or dry chemical fire extinguishers
Continue cooling with excessive water.

Storage
Store locked up in a well-ventilated place. Keep dry, cool and protect from sunlight

Disposal
Dispose of contents in accordance with local/regional/national/international regulations.

EnerSys Power/Full Solutions

PRODUCT SAFETY DATA SHEET

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3. COMPOSITION/INFORMATION ON INGREDIENTS

Components	CAS Number	Approximate % by Weight
Graphite	7782-42-5	7-25
Cobalt lithium manganese nickel oxide	182442-95-1	5-40
1-Propene,1,1,2,3,3,3-hexafluoro-, polymer with 1,1-difluoroethene	9011-17-0	3-15
Lithium hexafluorophosphate	21324-40-3	0-5
Carbon black	1333-86-4	0-2
Diethyl carbonate	105-58-8	0-15
Dimethyl carbonate	616-38-6	0-15
Ethyl methyl carbonate	623-53-0	0-15
Propylene carbonate	108-32-7	0-15
Ethylene carbonate	96-49-1	0-15

4. FIRST AID MEASURES

Inhalation:
Provide fresh air and seek medical attention. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Ingestion:
Seek medical attention immediately. Do not induce vomiting or give food or drink.

Skin:
Remove contaminated clothing and wash skin with soap and water. If a chemical burn occurs or if irritation persists, seek medical attention.

Eyes:
Flush immediately with large amounts of water for at least 15 minutes while lifting lids until no evidence of the chemical remains. Seek medical attention.

Most important symptoms/effects, acute and delayed:
Battery (module) internal components can cause chemical burns to skin and eyes and prolonged or repeated exposure to fluorides (e.g., hexafluorophosphate) can cause fluorosis of bones and

Immediate medical attention and special treatment needed:
Seek immediate attention if internal components come into contact with skin, eyes, or are ingested. If ingested, treatment to prevent fluorosis may be required.

5. FIRE FIGHTING MEASURES

First responders:
Wear self-contained breathing apparatus and protective suit.

Special protective equipment and precautions for fire-fighters:
Wear self-contained breathing apparatus, protective clothing, gloves, face and eye protection

Suitable extinguishing media in this order: excess of water spray, dry chemical, CO2 or foam.
The cooling effect of water effectively impedes fire from spreading to battery cells which still have not reached the critical ignition temperature (thermal runaway)

Specific hazards arising from the chemical:
Burning battery (module) and batteries may produce highly toxic carbon monoxide, suffocating carbon dioxide and toxic corrosive hydrogen fluoride gas.
Fumes may cause dizziness or suffocation.

Unusual fire and explosion hazards:
Do not allow metallic materials to simultaneously contact negative and positive terminals of battery (module) as this may cause a short circuit and generate heat which may start a fire. Follow manufacturer's instructions for installation and service. Explosion hazard in well sealed containers, keep in a well ventilated area.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment, and emergency procedures:
Wear protective clothing, boots, gloves, and face shield. Ensure adequate ventilation.

Methods and materials for containment and cleaning up:
Place material into suitable containers and call the local fire/police department.

7. HANDLING AND STORAGE

Precautions for safe handling:
Wear protective clothing, eye and face protection when charging or handling of batteries (module). Do not touch eyes, nose, or mouth. Do not allow metallic materials to simultaneously contact positive and negative terminals of battery (module). Packaged batteries (modules) must be separated in a way to prevent short circuits or damage to terminals. Keep battery (module) away from incompatible materials (see Section 10). Use banding or stretch wrap to secure items for shipping.

Conditions for safe storage:
Store battery (module) in cool, dry areas away from heat and incompatible materials (see Section 10). Cover the terminals with protective case when not in use. Avoid damage to containers. Keep away from fire, sparks and heat. Avoid excessive physical shock or vibration.
Battery (module) should be stored at between 25% and 75% of full charge during long-term storage.

EnerSys Power/Full Solutions

PRODUCT SAFETY DATA SHEET

Form # SDS 829515
Issued: AB
Supersedes: AA
ECO #: 1002195

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits:

INGREDIENTS	OSHA PEL	ACGIH TLV	US NIOSH REL
Graphite	2.5 mg/m^3 (respirable)	2 mg/m^3 (respirable, natural, all forms except fibers)	2.5 mg/m^3
Cobalt lithium manganese nickel oxide*	None	None	None
1-Propene,1,12,3,3,3-hexafluoro-, polymer with 1,1-difluoroethene			
Lithium hexafluorophosphate	None	None	None
Carbon black	3.5 mg/m^3	3 mg/m^3 (IHL)	3.5 mg/m3 (without PAHs); when PAHs
Diethyl carbonate	None	None	None
Dimethyl carbonate	None	None	None
Ethyl methyl carbonate	None	None	None
Propylene carbonate	None	None	None
Ethylene carbonate	None	None	None

* The New Chemical Exposure Limit (NCEL) listed in the TSCA Section 5(e) consent order for this substance is 0.1 mg/m3 as an 8-hour time-weighted average. However the requirements of the SNUR are not required after the substance has been completely reacted (cured), as is the case with this product.

Appropriate engineering controls:
Keep away from heat and open flame. Store and handle in well-ventilated area. If dust is generated, mechanical ventilation should be used. General dilution ventilation is acceptable.

Individual protection measures, such as personal protective equipment:

Respiratory Protection:
None required under normal handling and use. If dust is generated, use a full-face respirator with particle filter cartridge.

Skin Protection:
Wear gloves and other necessary clothing such as suit with long sleeves to prevent skin contact with plates or lead dust.

Eye Protection:
None required under normal handling and use. If handling an open or leaking battery (module), wear safety glasses with side shields.

Other Protection:
When operators handle the battery which voltage is more than 50 volts DC, they should review local regulations to ensure proper insulation is worn to protect against electrical shock.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Battery (module) product.
Odor:	None.
Odor threshold:	Not applicable.
pH:	Not applicable.
Melting point/freezing point:	Not applicable.
Initial boiling point and boiling range:	Not applicable.
Flash point:	Not applicable.
Evaporation rate:	Not applicable.
Flammability (solid, gas):	Contains flammable substances.
Upper/lower flammability or explosive limits:	Not applicable.
Vapor pressure:	Not applicable.
Vapor density:	Not available.
Relative density:	Not available.
Solubility(ies):	Not applicable.
Partition coefficient (n-octanol/water):	Not available.
Auto-ignition temperature:	Not applicable.
Decomposition temperature:	Not available.
Viscosity:	Not available.

10. STABILITY AND REACTIVITY

Reactivity:
Not considered reactive under normal conditions at ambient temperature.

Chemical stability:
This product is stable under normal conditions at standard temperature.

Possibility of hazardous reactions:
Violent reaction may occur in contact with hot, concentrated acid, strong oxidizers, and water.

Conditions to avoid:
Avoid heat, sources of ignition, and contact with strong acids, strong oxidizers, and corrosive material.

Incompatible materials:
Combustible materials, organic chemicals, strong acids (such as nitric, hydrochloric, or sulfuric acids), reducing substances, strong oxidizers (such as perchlorates, peroxides, permanganates, chlorates, and nitrates), and chemically active metals (such as potassium, sodium, magnesium, and zinc). If aluminum foil packaging is damaged, avoid contact with water or acid because these may damage the battery (module) or cause a short circuit. If the aluminum foil packaging is damaged, strong oxidizers, acids and high temperatures may cause hydrogen fluoride gas to be formed.

Hazardous decomposition products:
Not available.

Hazardous polymerization:
Will not occur.

11. TOXICOLOGICAL INFORMATION

Information on the likely routes of exposure:
Inhalation:
Not expected under normal handling and use. Inhalation may occur if fumes are generated upon heating. Inhalation of fumes may cause irritation of the upper respiratory tract and lungs.

Ingestion:
Not expected under normal handling and use. Ingestion may occur if mouth is touched prior to washing hands. Ingestion can cause serious chemical burns of mouth, esophagus, and gastrointestinal tract.

Skin Contact:
Not expected under normal handling and use. Ethylene carbonate, diethyl carbonate and dimethyl carbonate may be absorbed through the skin causing localized inflammation.

Eye Contact:
Not expected under normal handling and use. Contact with eyes may cause irritation and chemical burns.

Symptoms related to the physical, chemical and toxicological characteristics:
Effects of overexposure - acute:
battery (module) internal components can cause chemical burns to skin and eyes.

Effects of overexposure - chronic:
Repeated exposure to battery (module) internal component (hexafluorophosphate) can cause fluorosis of bones and teeth.

Delayed and immediate effects and also chronic effects from short- and long-term exposure:
Repeated exposure to battery (module) internal component (hexafluorophosphate) can cause fluorosis of bones and teeth.

Numerical measures of toxicity:
Acute Oral toxicity:
Oral LD50 (graphite): > 2000 mg/kg
Oral LD50 (lithium hexafluorophosphate): 200 mg/kg
Oral LD50 (carbon black): > 8000 mg/kg
Oral LD50 (diethyl carbonate): 4876 mg/kg
Oral LD50 (dimethyl carbonate): 5000 mg/kg
Oral LD50 (ethyl methyl carbonate): 5000 mg/kg
Oral LD50 (propylene carbonate): 5000 mg/kg
Oral LD50 (ethylene carbonate): 10400 mg/kg

Acute dermal toxicity:
Dermal LD50 (dimethyl carbonate): >2500 mg/kg body weight

Carcinogenicity:
Carbon black is listed as a Group 2B carcinogen by IARC, and cobalt compounds are listed as Group 2B. Per the guidance found in OSHA 29 CFR 1910.1200 Appendix F, this is approximately equivalent to GHS Category 2. Carbon black is not identified as a carcinogen by OSHA and is not listed by the 14th Report on Carcinogens by the NTP. Cobalt and cobalt compounds that release cobalt ions in vivo are listed on the 14th Report on Carcinogens by the NTP.

Reproductive Toxicity:
No components of this product are known to be reproductive toxins.

Medical Conditions Generally Aggravated by Exposure:
None known.

Additional Health Data:
All heavy metals, including the hazardous ingredients in this product, are taken into the body primarily by inhalation and ingestion. Most inhalation problems can be avoided by adequate precautions such as ventilation and respiratory protection covered in Section 8. Follow good personal hygiene to avoid inhalation and ingestion: wash hands, face, neck and arms thoroughly before eating, smoking or leaving the worksite. Keep contaminated clothing out of non-contaminated areas, or wear cover clothing when in such areas. Restrict the use and presence of food, tobacco and cosmetics to non-contaminated areas. Work clothes and work equipment used in contaminated areas must remain in designated areas and never taken home or laundered with personal non-contaminated clothing. This product is intended for industrial use only and should be isolated from children and their environment.

12. ECOLOGICAL INFORMATION

Eco toxicity:
No data on Eco toxicity.

Persistence and degradability:
No data on environmental degradation.

Bio accumulative potential:
No data on bio accumulative potential.

Mobility in soil:
No data on mobility in soil.

Other adverse effects:
• No known effects on stratospheric ozone depletion.
• Water Endangering Class (WGK): NA

13. DISPOSAL CONSIDERATIONS (UNITED STATES)

Recycle and dispose of material waste to an approved waste disposal facility in accordance with local, state, and federal requirements. Do not release to sewer or waterways. Following local, State/Provincial, and Federal/National regulations applicable to end-of-life characteristics will be the responsibility of the end-user.

EnerSys Power/Full Solutions

PRODUCT SAFETY DATA SHEET

Form # SDS 829515
Issued: AB
Supersedes: AA
ECO #: 1002195

14. TRANSPORT INFORMATION

U.S. DOT:
Proper shipping name: Lithium ion batteries
UN number: UN3480
Hazard Class: 9
Packing group: N/A
Note: Although not assigned a packing group, packaging material for lithium batteries (modules) must meet packaging requirements outlined in 49 CFR 173.185(b).

IATA: Not Applicable

IMDG:
Proper shipping name: Lithium ion batteries
UN number: UN3480
Hazard Class: 9
Packing group: N/A
Note: Lithium ion batteries (modules) must meet specific packing requirements according to IMDG Packing Instruction P903.

Environmental hazards:
Lithium-ion batteries (modules) contents are hazardous to the aquatic environment.

Transport in bulk (according to Annex II of MARPOL 73/78 and the IBC Code):
Not applicable.

Special precautions which a user needs to be aware of, or needs to comply with, in connection with transport or conveyance either within or outside their premises:
No special precautions in connection with transport or conveyance.

15. REGULATORY INFORMATION

UNITED STATES:
EPA SARA Title III:
Section 302 EPCRA Extremely Hazardous Substances (EHS):
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302. For more information consult 40 CFR Part 355.

Section 313 EPCRA Toxic Substances:
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313

TSCA:
TSCA Section 8b – Inventory Status: All chemicals comprising this product are listed on the TSCA Inventory.
Cobalt lithium manganese nickel oxide is subject to a Section 5(a) Significant New Use Rule (SNUR) and Section 5(e) Consent Order (40CFR 721.10201). However the requirements of the SNUR are not required after the substance has been completely reacted (cured), as is the case with this product.

16. OTHER INFORMATION

Revised: **04/07//20**

USA
SDS's are a subclause of the Hazard Communication Standard 29 CFR section 1910.1200 of the Occupational Safety and Health Administration (OSHA). This standard is not applicable on "articles" Li-Ion batteries are defined as "articles" they are exempted from the requirements of the Hazard Communication Standard.

EC
These batteries are neither "compounds" nor "blends" according to REACH regulation (EC) 1907/2006. Instead of this they have to be regarded as products. An intended release of compounds is not planned. Therefore there is no obligation to provide a Safety Data Sheet according to article 31 of the REACH regulation.

Additonal Safety:
Modules may only be operated with the designated battery.
Use only by EnerSys approved chargers.
Do not short circuit or deep discharge.
Do not damage or perforate.
Do not tear down.
Do not heat aboved the allowed limits. (see instructions of use)
Cells in Lithium-Ion batteries are sealed and are not hazardous as long as use of all manufacturer's instructions are applied.
Violation of manufacturer's instructions may lead to a release of ingredients of cells.
In case of damage to the cell, corrosive and poisenous liquied can be released.
In case of fire, corrosive and pisonous vapors and gases may be released.

DISCLAIMER
This Product Safety Data Sheet is created by the manufacturer according to the OSHA standard of 29 CFR 1910.1200. To the extent allowed by law, the manufacturer hereby expressly disclaims any liability to any third party, including users of this product, including, but not limited to, consequential or other damages, arising out of the use of, or reliance on, this Product Safety Data Sheet.

SAFETY DATA SHEET

Klean-Strip Acetone

Revision: 05/24/2017
Supersedes Revision: 04/15/2015

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name:	Klean-Strip Acetone	
Company Name:	W. M. Barr 2105 Channel Avenue Memphis, TN 38113	**Phone Number:** (901)775-0100
Web site address:	www.wmbarr.com	
Emergency Contact:	3E 24 Hour Emergency Contact	(800)451-8346
Information:	W.M. Barr Customer Service	(800)398-3892
Intended Use:	Paint, stain, and varnish thinning.	
Product Code:	CAC18, DAC18, GAC18, GAC182, QAC18, QAC184, PA12270, GAC18HDQP, GAC18HDWS, GAC18P, PAC181	

2. HAZARDS IDENTIFICATION

Flammable Liquids, Category 2
Serious Eye Damage/Eye Irritation, Category 2
Specific Target Organ Toxicity (single exposure), Category 3

GHS Signal Word:	**Danger**
GHS Hazard Phrases:	H225: Highly flammable liquid and vapor. H319: Causes serious eye irritation. H335: May cause respiratory irritation. H336: May cause drowsiness or dizziness.
GHS Precaution Phrases:	P233: Keep container tightly closed. P210: Keep away from heat/sparks/open flames/hot surfaces. - No smoking. P280: Wear protective gloves/protective clothing/eye protection/face protection. P240: Ground/bond container and receiving equipment. P241: Use explosion-proof electrical/ventilating/lighting equipment. P243: Take precautionary measures against static discharge. P242: Use only non-sparking tools. P264: Wash hands thoroughly after handling. P261: Avoid breathing gas/mist/vapours/spray. P271: Use only outdoors or in a well-ventilated area.
GHS Response Phrases:	P370+378: In case of fire, use dry chemical to extinguish. P303+361+353: IF ON SKIN (or hair): Remove/take off immediately all contaminated clothing. Rinse skin with water/shower. P305+351+338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P337+313: If eye irritation persists, get medical advice/attention. P304+340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. P312: Call a POISON CENTER/doctor if you feel unwell.
GHS Storage and Disposal Phrases:	P403+235: Store in cool/well-ventilated place. P501: Dispose of contents/container according to local, state and federal regulations. P403+233: Store container tightly closed in well-ventilated place - if product is as volatile as to generate hazardous atmosphere. P405: Store locked up.

Hazard Rating System:

HMIS:

HEALTH	* 2
FLAMMABILITY	3
PHYSICAL	0
PPE	X

NFPA:

OSHA Regulatory Status: This material is classified as hazardous under OSHA regulations.

Potential Health Effects (Acute and Chronic):

Inhalation Acute Exposure Effects:
Vapor harmful. May cause dizziness, headache, watering of eyes, irritation of respiratory tract, drowsiness, nausea, and numbness in fingers, arms and legs. Inhalation of high vapor concentrations can cause central nervous system depression and narcosis. May lead to unconsciousness.

Skin Contact Acute Exposure Effects:
May cause skin irritation. Liquid is absorbed readily and can transport other toxins into the body. Prolonged or repeated skin contact with liquid may cause defatting resulting in drying, redness and possible blistering.

Eye Contact Acute Exposure Effects:
This material is an eye irritant. Causes itching, burning, redness and tearing. May cause corneal injury.

Ingestion Acute Exposure Effects:
Harmful if swallowed. Aspiration hazard if swallowed - can enter lungs and cause damage. May cause irritation of the gastrointestinal tract. May cause systemic poisoning with symptoms paralleling those of inhalation.

Chronic Exposure Effects:
Reports have associated repeated and prolonged overexposure to solvents with neurological and other physiological damage. May cause weakness, fatigue, skin irritation, and numbness in hands and feet.

May cause target organ or system damage to the respiratory system, nervous system, kidney, blood system, and liver.

Target Organs:
Eyes, skin, respiratory system, central nervous system, heart

Medical Conditions Generally Aggravated By Exposure: Skin, eye, respiratory and asthma, cardiac irregularities

3. COMPOSITION/INFORMATION ON INGREDIENTS

CAS #	Hazardous Components (Chemical Name)	Concentration
67-64-1	Acetone {2-Propanone}	100.0 %

4. FIRST AID MEASURES

Emergency and First Aid Procedures:

Skin:
Immediately begin washing the skin thoroughly with large amounts of water and mild soap, if available, while removing contaminated clothing. Seek medical attention if irritation persists.

Eyes:
Immediately begin to flush eyes with water, remove any contact lens. Continue to flush the eyes for at least 15 minutes, then seek immediate medical attention.

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention.

Ingestion:
If swallowed, do NOT induce vomiting. Seek immediate medical attention. Call a physician, hospital emergency room, or poison control center immediately. Never give anything by mouth to an unconscious person.

Signs and Symptoms Of Exposure:

Primary Routes of Exposure:
Inhalation, ingestion, and dermal.

Note to Physician:

Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.

5. FIRE FIGHTING MEASURES

Class IB

Flash Pt: 0.00 F Method Used: TAG Closed Cup

Explosive Limits: LEL: 2.5 % at 77.0 F UEL: 13.0 % at 77.0 F

Autoignition Pt: 869.00 F

Suitable Extinguishing Media: Use carbon dioxide, dry powder, or alcohol-resistant foam.

Fire Fighting Instructions:

Self-contained respiratory protection should be provided for fire fighters fighting fires in buildings or confined areas. Storage containers exposed to fire should be kept cool with water spray to prevent pressure build-up. Stay away from heads of containers that have been exposed to intense heat or flame.

Flammable Properties and Hazards:

Extremely Flammable! Vapors are heavier than air and may spread along floors. Forms or accumulates static electricity, may cause fire or explosion.

Acetone/water solutions that contain more than 2.5% acetone have flash points. When the acetone concentration is greater than 8% by weight in a closed container, it would be within the flammable range and cause fire or explosion if a source of ignition were introduced.

Do not spread this product over a large surface area because the fire and health safety risks will increase dramatically.

SAFETY DATA SHEET
Klean-Strip Acetone

Revision: 05/24/2017
Supersedes Revision: 04/15/2015

6. ACCIDENTAL RELEASE MEASURES

Steps To Be Taken In Case Material Is Released Or Spilled:

Vapors may cause flash fire or ignite explosively.

Clean up: Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind, out of low areas, and ventilate closed spaces before entering. Shut off ignition sources; keep flares, smoking or flames out of hazard area. Use non-sparking tools. Use proper bonding and grounding methods for all equipment and processes. Keep out of waterways and bodies of water. Be cautious of vapors collecting in small enclosed spaces, sewers, low lying areas, confined spaces, etc.

Small spills: Take up with sand, earth or other noncombustible absorbent material and place in a plastic container where applicable.

Large spills: Dike far ahead of spill for later disposal.

Waste Disposal: Dispose in accordance with applicable local, state and federal regulations.

7. HANDLING AND STORAGE

Precautions To Be Taken in Handling:

Read carefully all cautions and directions on product label before use. Since empty container retains residue, follow all label warnings even after container is empty. Dispose of empty container according to all regulations. Do not reuse this container.

Do not use this product near any source of heat or open flame, furnace areas, pilot lights, stoves, etc.

Do not use in small enclosed spaces, such as basements and bathrooms. Vapors can accumulate and explode if ignited.

Do not spread this product over large surface areas because fire and health safety risks will increase dramatically.

Precautions To Be Taken in Storing:

Keep container tightly closed when not in use. Store in a cool, dry place. Do not store near any source of heat or flame, furnace areas, pilot lights, stoves, etc. Do not reuse this container. Use product within one year of purchasing.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

CAS #	Partial Chemical Name	OSHA TWA	ACGIH TWA	Other Limits
67-64-1	Acetone {2-Propanone}	PEL: 1000 ppm	TLV: 500 ppm STEL: 750 ppm	No data.

Respiratory Equipment (Specify Type):

For use in areas with inadequate ventilation or fresh air, wear a properly maintained and properly fitted NIOSH approved respirator for organic solvent vapors.

For OSHA controlled work places and other regular users - Use only with adequate ventilation under engineered air control systems designed to prevent exceeding the appropriate TLV.

A dust mask does not provide protection against vapors.

Eye Protection:

Splash goggles.

Protective Gloves:	Wear gloves with as much resistance to the chemical ingredients as possible. Glove materials such as nitrile rubber, natural rubber, and neoprene may provide protection. Glove selection should be based on chemicals being used and conditions of use. Consult your glove supplier for additional information. Gloves contaminated with product should be discarded and not reused.
Other Protective Clothing:	Various application methods can dictate use of additional protective safety equipment, such as impermeable aprons, etc., to minimize exposure.
Engineering Controls (Ventilation etc.):	Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Use only with adequate ventilation to prevent buildup of vapors. Do not use in areas where vapors can accumulate and concentrate, such as basements, bathrooms or small enclosed areas. Whenever possible, use outdoors in an open air area. If using indoors open all windows and doors and maintain a cross ventilation of moving fresh air across the work area. If strong odor is noticed or you experience slight dizziness, headache, nausea or eye-watering -- STOP -- ventilation is inadequate. Leave area immediately and move to fresh air.
Work/Hygienic/Maintenance Practices:	Wash hands thoroughly after use and before eating, drinking, smoking, or using the restroom. Do not eat, drink, or smoke in the work area. Discard any clothing or other protective equipment that cannot be decontaminated. Facilities storing or handling this material should be equipped with an emergency eyewash and safety shower.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical States:	[ ] Gas [X] Liquid [ ] Solid
Appearance and Odor:	Clear colorless liquid with a characteristic ketone odor. Odor may be described as a sweet pungent odor.
Melting Point:	No data.
Boiling Point:	> 133.00 F
Autoignition Pt:	869.00 F
Flash Pt:	0.00 F Method Used: TAG Closed Cup
Explosive Limits:	LEL: 2.5 % at 77.0 F UEL: 13.0 % at 77.0 F
Specific Gravity (Water = 1):	0.789
Density:	6.572 LB/GA at 77.0 F
Vapor Pressure (vs. Air or mm Hg):	213 MM HG at 77.0 F
Vapor Density (vs. Air = 1):	No data.
Evaporation Rate:	No data.
Solubility in Water:	Complete

SAFETY DATA SHEET
Klean-Strip Acetone

Revision: 05/24/2017
Supersedes Revision: 04/15/2015

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method: Dispose of in accordance with all applicable local, state, and federal regulations.

14. TRANSPORT INFORMATION

LAND TRANSPORT (US DOT):

DOT Proper Shipping Name: Acetone

DOT Hazard Class: 3 FLAMMABLE LIQUID
UN/NA Number: UN1090 **Packing Group:** II

Additional Transport Information: The shipper/supplier may apply one of the following exceptions: Combustible Liquid, Consumer Commodity, Limited Quantity, Viscous Liquid, Does Not Sustain Combustion, or others, as allowed under 49CFR Hazmat Regulations. Please consult 49CFR Subchapter C to ensure that subsequent shipments comply with these exceptions.

15. REGULATORY INFORMATION

EPA SARA (Superfund Amendments and Reauthorization Act of 1986) Lists

CAS #	Hazardous Components (Chemical Name)	S. 302 (EHS)	S. 304 RQ	S. 313 (TRI)
67-64-1	Acetone {2-Propanone}	No	Yes 5000 LB	No

This material meets the EPA 'Hazard Categories' defined for SARA Title III Sections 311/312 as indicated:	[X] Yes [ ] No	Acute (immediate) Health Hazard
	[X] Yes [ ] No	Chronic (delayed) Health Hazard
	[X] Yes [ ] No	Fire Hazard
	[ ] Yes [X] No	Sudden Release of Pressure Hazard
	[ ] Yes [X] No	Reactive Hazard

CAS #	Hazardous Components (Chemical Name)	Other US EPA or State Lists
67-64-1	Acetone {2-Propanone}	CAA HAP,ODC: No; CWA NPDES: No; TSCA: Yes - Inventory; CA PROP.65: No

Regulatory Information: This product is regulated by the United States Consumer Product Safety Commission and is subject to certain labeling requirements under the Federal Hazardous Substances Act. These requirements differ from the classification criteria and hazard information required for safety data sheets (SDS). The product label also includes other important information, including directions for use, and should always be read in its entirety prior to using the product.

16. OTHER INFORMATION

Revision Date: 05/24/2017
Preparer Name: W.M. Barr EHS Department (901)775-0100
Additional Information About This Product: No data available.
Company Policy or Disclaimer: The information contained herein is presented in good faith and believed to be accurate as of the effective date shown above. This information is furnished without warranty of any kind. Employers should use this information only as a supplement to other information gathered by them and must make independent determination of suitability and completeness of information from all sources to assure proper use of these materials and the safety and health of employees. Any use of this data and information must be determined by the user to be in accordance with applicable federal, state and

local laws and regulations.

Paragon Building Products

Safety Data Sheet

SECTION 1: PRODUCT IDENTIFICATION

Material Name:
94# - PARAGON PLASTIC CEMENT

Synonyms:
Portland cement, Cement or Hydraulic Cement, Mortar, Class G

Manufacturer Information:
Paragon Aggregate Products, Inc.
2305 S Roof Tile Rd
Casa Grande, AZ 85193
Phone: 520-836-6454
www.paragonbp.us

SECTION 2 – HAZARDS IDENTIFICATION

GHS CLASSIFICTION:

Acute Toxicity Oral – Category 4
Acute Toxicity Dermal – Category 4
Acute Toxicity Inhalation – Category 3
Skin Corrosion/Irritation – Category 1B
Eye Damage – Category 1
Respiratory Sensitization – Category 1
Skin Sensitization – Category 1
Carcinogenicity – Category 1A
Specific Target Organ Toxicity Repeat Exposure – Category 1

GHS LABELS ELEMENTS:

Symbols(s)

Signal Word

Danger

Hazard Statements:

Harmful if swallowed
Harmful in contact with skin
Toxic if inhaled
Causes severe skin burns and eye damage
Causes serious eye damage
May cause allergy or asthma symptoms or breathing difficulties if inhaled
May cause an allergic skin reaction
May cause cancer
Causes damage to organs through prolonged or repeated exposure (lungs)

Precautionary Statements:

Prevention:

Wash thoroughly after handling
Do not eat, drink or smoke when using this product
Wear protective gloves/protective clothing/eye protection/face protection
Contaminated work clothing must not be allowed out of the workplace
Obtain special instructions before use
Do Not handle until all safety precautions have been read and understood
Do Not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
In case of inadequate ventilation wear respiratory protection

Material Name: PARAGON ~ SUPERMIX / MASONRY TYPE-S, PLASTIC CEMENT

SECTION 2 – HAZARDS IDENTIFICATION (CONT.)

Precautionary Statements:

Response:

If swallowed: Rinse mouth, **DO NOT** induce vomiting. Immediately call a poison center/doctor.

If on skin (or hair: Take off immediately all contaminated clothing. Rinse skin with water/shower. Immediately call a poison center or doctor/physician. Wash contaminated clothing before reuse.

If inhaled: Remove victim to fresh air and keep at rest in a position comfortable for breathing. If experiencing respiratory symptoms, call a poison center or doctor/physician.

If in eye: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do, continue rinsing, immediately call a poison center/doctor.

Storage:

Store in a well-ventilated place

Store in an appropriate container or containment structure

Disposal:

Dispose of contents/container in accordance with local/regional/international regulations

SECTION 3 – COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name and Synonyms:

Component	CAS #	Percent
Cement, Portland Chemicals	65997-15-1	78-95
Limestone	1317-65-3	0-15
Gypsum(Ca(So4)2H2O)	13397-24-5	5-7
Quartz	14808-60-7	0-0.3

Component Information/Information on Non-Hazardous Components General Product Information:

Trace Elements: Masonry Type-S, Plastic cement is made from materials mined from earth and is processed using energy provided by fuels. Trace amounts of naturally occurring, potentially harmful chemical might be detected during chemicals analysis. For example, Portland cement may contain up to 1.50% insoluble residue, some of which may be free crystalline silica. Other trace constituents may include calcium oxide, free magnesium oxide, potassium and sodium sulfate compounds, and trace metal compounds.

SECTION 4 – FIRST AID MEASURES

First Aid Eyes:

Immediately flush eye thoroughly with water. Continue flushing eye for a least 15 minutes, including under lids, to remove all particles. Call a physician immediately.

First Aid Skin:

Wash skin with cool water and pH-neutral soap or mild detergent. Seek medical treatment if irritation or inflammation develops or persist. Seek medical treatment in the event of burns.

First Aid Inhalation:

Remove person to fresh air. If breathing is difficult, administer oxygen. If not breathing, give artificial respiration. Seek medical help if coughing and other symptoms do subside. Inhalation of large amounts of Masonry Type-S, Plastic cement requires immediate medical attention.

First Aid Ingestion:

Do not induce vomiting. If conscious, have the victim drink plenty of water and call physician.

Paragon Building Products

Material Name: PARAGON ~ SUPERMIX / MASONRY TYPE-S, PLASTIC CEMENT

SECTION 5 – FIRE FIGHTING MEASURES

General Fire Hazards:

See Section 9 for Flammability Properties
Non combustible

Hazardous Combustion Products:

NONE

Extinguishing Media:

Use appropriate extinguishing media for surrounding fire

Unsuitable Extinguishing Media:

NONE

Fire Fighting Equipment/Instructions:

Firefighters should wear full protective gear

SECTION 6 – ACCIDENTAL RELEASE MEASURES

Recovery and Neutralization:

Stop the flow of material, if this is without risk

Personal Precautions, Protective Equipment and Emergency Procedures:

Use personal protection recommended in Section 8. Isolate the hazard area and deny entry to unnecessary and unprotected personal.

Emergency Measures:

Isolate area, keep unnecessary personal away

Environmental Precautions:

Do not attempt to wash Masonry Type-S, Plastic cement down sewers or storm drains

Methods for Containment and Clean-up:

Collect dry material using a scoop. Avoid actions that cause dust to become airborne. Avoid inhalation of dust and contact with skin. Scrape up wet material and place on an appropriate container. Allow the material to dry before disposal.

Prevention of Secondary Hazards:

NONE

SECTION 7 – HANDLING AND STORAGE

Handling Procedures:

Avoid prolonged or repeated breathing of dust. Avoid contact with eyes and skin. Promptly remove dusty clothing or clothing which is wet with Masonry Type-S, Plastic cement fluids and launder before reuse. Wash thoroughly after exposure to dust or wet Masonry Type-S, Plastic cement.

Storage Procedures:

Store product in a cool, dry, ventilated area. Protect against physical damage and moisture. Keep Masonry Type-S, Plastic cement dry until used. Normal temperature and pressures do not affect the material.

Incompatibilities:

Wet Masonry Type-S, Plastic cement is alkaline, as such it is incompatible with acids, ammonium salts and metal.

Paragon Building Products

Material Name: PARAGON ~ SUPERMIX / MASONRY TYPE-S, PLASTIC CEMENT

SECTION 8 – EXPOSURE CONTROL / PERSONAL PROTECTION

Component Exposure Limits:

Cement, Portland, chemicals (65997-15-1)

ACGIH: 1m/m3 TWA (particulate matter containing no asbestos and<1% crystalline silica, respirable fraction)
OSHA: 15 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable fraction)
NIOSH: 10 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable dust)

Limestone (1317-65-3)

OSHA: 15 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable fraction)
NIOSH: 10 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable dust)

Gypsum (Ca(SO4).2H2O) (13397-24-5)

ACGIH: 10 mg/m3 TWA (inhalable fraction, listed under Calcium Sulfate)
OSHA: 15 mg/m3 TWA (total dust); 5mg/m3 TWA (respirable fraction)
NIOSH: 10 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable dust)

Quartz: (14808-60-7)

ACGIH: 0.25 mg/m3 TWA (respirable fraction)
NIOSH: 0.05 mg/m3 TWA (respirable dust)

Engineering Measures:

Periodically wash areas contacted by dry Masonry Type-S, Plastic cement or by wet cement fluids with a Ph neutral soap. Wash again at the end of work. If irritation occurs immediately wash affected areas and seek treatment. If clothing becomes saturated with wet cement, it should be removed and replaced with clean clothing.

Personal Protective Equipment:

Respiratory:

Use local or general ventilation to control exposures below applicable exposure limits, NIOSH or MSHA approved particulate filter respirators should be used in the context of respiratory protection program meeting the requirements of the OSHA respiratory protection standard [29 CFR 1910.134] to control exposures when ventilation or other controls are inadequate or discomfort or irritation is experienced. Respirator and/or filter cartridge selection should be based on American National Standards Institute (ANSI) Standards Z88.2 Practices for Respiratory Protection.

Hands:

Where prolonged exposure to unhardened cement products might occur, wear impervious gloves to eliminate skin contact. Do not rely on barrier creams; barrier creams should not be used in place of gloves. Periodically wash areas contacted by wet cement or its dry ingredients with pH neutral soap and water. Wash again at the end of the work. If irritation occurs, immediately wash the affected area and seek treatment.

Eyes:

Where potentially subject to splashes or puffs of cement, wear safety glasses with side shields or goggles. In extremely dusty environments and unpredictable environments wear unvented or indirectly vented goggles to avoid eye irritation or injury. Contact lenses should not be worn when working with Masonry Type-S, Plastic cement or fresh products.

Skin and Body:

Protection is essential to avoiding potentially severe skin injury. Avoid contact with unhardened Masonry Type-S, Plastic cement. If contact occurs, promptly wash affected area with soap and water. Where prolonged exposure to unhardened cement products might occur, wear impervious clothing and gloves to eliminate skin contact. Wear sturdy boots that are impervious to water, to eliminate foot and ankle exposure.

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Gray Powder	**Odor:**	None
Physical State:	Solid	**pH (in water):**	12-13
Vapor Pressure:	Not Applicable	**Vapor Density:**	Not applicable
Boiling Point:	Not Applicable	**Melting Point:**	Not Applicable
Solubility (H2O):	Slightly Soluble	**Specific Gravity:**	3.15
Evaporation Rate:	Not Applicable	**VOC:**	Not Determined
Octanol/H2O Coeff:	Not Applicable	**Flash Point:**	None
Flash Point Method:	None	**Upper Flammability Limit (UFL):**	None
Lower Flammability Limit (LFL):	None	**Burning Rate:**	None
Auto Ignition:	Not Applicable		

Material Name: PARAGON ~ SUPERMIX / MASONRY TYPE-S, PLASTIC CEMENT

SECTION 10 – CHEMICAL STABILITY AND REACTIVITY INFORMATION

Chemical Stability:
This is a stable material

Hazardous Reaction Potential:
Will not occur

Conditions to Avoid:
Unintentional contact with water

Incompatibility Products:
Wet Masonry Type-S, Plastic cement is alkaline, As such it is incompatible with acids, ammonium salts and phosphorous

Hazardous decomposition: Will not spontaneously occur. Adding water produces (caustic) calcium hydroxide

SECTION 11– TOXICOLOGICAL INFORMATION

Acute Toxicity: Component Analysis – LD50/LC50

Quartz (14808-60-7)
Oral LD50 Rat 500 mg/kg

Potential Health Effects:

Skin Corrosion Property/Stimulativeness

Discomfort or pain cannot be relied upon to alert a person to a hazardous skin exposure. Consequently, the only effective means of avoiding skin injury or illness involves minimizing skin contact, particularly contact with wet cement. Exposed persons may not feel discomfort until hours after the exposure has ended and significant injury has occurred. Exposure during the handling or mixing of the dry ingredients in Masonry Type-S, Plastic cement may cause drying of the skin with consequent mild irritation or more significant effects attributable to aggravation of other conditions. Exposure to wet cement may cause more skin effects including thickening, cracking or fissuring of the skin. Prolonged exposure can cause severe damage in the form of (caustic) chemical burn.

Eye Critical Damage/Stimulativeness

Exposure to airborne dust during the handling or mixing of the dry ingredients in Masonry Type-S, Plastic cement may cause immediate or delayed irritation or inflammation. Eye contact by splashes of wet cement may cause effects ranging from moderate eye irritation to chemical burns and blindness. Such exposures require immediate first aid (see Section 4) and medical attention to prevent significant damage to the eye.

Ingestion

Although inadvertent ingestion of small quantities of wet cement or its dry ingredients are not known to be harmful, accidental ingestion of larger quantities can be harmful and requires immediate medical attention.

Inhalation

Exposure to Masonry Type-S, Plastic cement in excess of the applicable TLV or PEL (see section 2) may cause or aggravate other lung conditions. The ingredients in Masonry Type-S, Plastic cement may contain trace amounts of crystalline silica. Exposure to these ingredients in excess of the applicable TLV or PEL (see Section 2) may cause or aggravate other lung conditions. Exposure to Masonry Type-S, Plastic cement may cause irritation to the moist mucous membranes of the nose, throat, and upper respiratory system. It may also leave unpleasant deposits in the nose.

Respiratory Organs Sensitization/Skin Sensitization:

May cause allergy or asthma symptoms or breathing difficulties if inhaled, some individuals may exhibit an allergic response upon exposure to wet cement. The response may appear in a variety of forms ranging from a mild rash to severe skin ulcers. Persons already sensitized mat react to their first contact with the product. Other persons may first experience this effect after years of contact with Masonry Type-S, Plastic cement products.

Material Name: PARAGON ~ SUPERMIX / MASONRY TYPE-S, PLASTIC CEMENT

SECTION 11– TOXICOLOGICAL INFORMATION CONT.

Generative Cell Mutagenicity

This product is not reported to have any mutagenic effects

Carcinogenicity

A: General Product Information

May cause cancer: Prolonged and repeated exposure to airborne free respirable crystalline silica can result in lung disease and/or lung cancer! IARC states that crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1).

B: Component Carcinogenicity

ACGIH: A4 – Not Classified as a Human Carcinogen

Quartz (14808-60-7)

ACGIH:	A2 – Suspected Human Carcinogen
NIOSH:	potential occupational carcinogen
NTP:	Known Human Carcinogen (respirable size) (Select Carcinogen)
IARC:	Monograph 100C [2012] (listed under Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources); Monograph 68 [1997] (Group 1 (carcinogenic to humans)

Reproductive Toxicity

This product is not reported to have any reproductive toxicity effects

Specified Target Organ General Toxicity:

Single Exposure

This product is not reported to have any single exposure specific target organ toxicity effects

Specified Target Organ General

Causes damage to organs through prolonged or repeated exposure (lungs)

Aspiration Respiratory Organs Hazard

This product is not reported to have any aspiration hazards

SECTION 12 – ECOLOGICAL INFORMATION

Ecotoxicity

A: General Product Information

This product is not reported to have any ecotoxicity effects

B: Component Analysis – Ecotoxicity – Aquatic Toxicity

No ecotoxicity data are available for this product's components

Persistence/Degradability

No information available for the product

Bioaccumulation

No information available for the product

Mobility in Soil

No information available for the product

SECTION 13 – DISPOSAL CONSIDERATIONS

Waste Disposal Instructions

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment recommendations

Disposal of Contaminated Containers or Packaging

Dispose information available for the product

SECTION 14 – TRANSPORTATION INFORMATION

DOT Information

Hazardous materials description proper shipping name:

Hazard Class……Not applicable
Identification number……Not applicable
Required label text……Not applicable
Hazardous substance / reportable quantities (RO)……Not applicable

Material Name: PARAGON ~ SUPERMIX / MASONRY TYPE-S, PLASTIC CEMENT

SECTION 15 – REGULATORY INFORMATION

Regulatory Information

US Federal Regulations

Component Analysis

None of this products components are listed under SARA Section 302 (40 CFR 355 Appendix A). SARS Section 313 (40 CFR 372.65), or CERCLA (40 CFR 302.4)

State Regulations

Component Analysis – State

The following components appear on one or more of the following state hazardous substances lists;

Components	CAS	CA	MA	MN	NJ	PA	RI
Cement, Portland, Chemicals	65997-15-1	No	Yes	Yes	Yes	Yes	No
Limestone	1317-65-3	No	Yes	Yes	Yes	Yes	No
Gypsum (Ca(SO4).2H2O)	13397-24-5	No	No	Yes	Yes	Yes	No
Quartz	1408-60-7	No	Yes	Yes	Yes	Yes	No

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains chemicals known to the state of California to cause cancer, birth defects, or other reproductive harm.

Component Analysis – WHMIS IDL

No components are listed in the WHMIS IDL

Additional Regulatory Information

Component Analysis – Inventory

Component	CAS #	TSCA	CAN	EEC
Cement, Portland. Chemicals	65997-15-1	Yes	DSL	EINECS
Limestone	1317-65-3	Yes	NDSL	EINECS
Gypsum (Ca(SO4).2H2O)	13397-24-5	No	DSL	No
Quartz	14808-60-7	Yes	DSL	EINECS

1 **SAFETY DATA SHEET-BLACK POWDER**

Section 1: Identification

Product Identifier: Black Powder (includes all grades)

Manufacturer's Name: GOEX Powder, Inc. **Informational Telephone Number**:1-(318) 382-9300

Address: P.O. Box 659 **Emerg. Phone Number**: 1-(800) 255-3924 (Chem Tel)

Doyline, LA 71023-0659

Recommended Use: for use in competitive and recreational shooting, muzzleloading hunting and the U.S. Military .

Section 2: Hazard(s) Identification

Hazard category:	Signal Word	Hazard statement	Pictogram
Division 1.1	Danger	Explosive; mass explosion hazard	

Target Organ Warning: Above OSHA levels, chronic exposure may cause skin irritation and damage to the respiratory system, and acute exposure can cause skin, eye, and respiratory irritation.

Section 3: Composition/information on ingredients

Component	CAS-Number	Weight %
Charcoal	16291-96-6	8-18%
Sulfur	7704-34-9	9-20%
Potassium Nitrate	7757-79-1	70-76%
Graphite (note: not contained in all grades of black powder)	7782-42-5	<1%

Section 4: First-aid measures

Ingestion: * Not a likely route of exposure. If ingested, dilute by giving two glasses of water and induce vomiting. Avoid, when possible and contact a Poison control center for advice on treatment, if unsure.

Eye Contact: * Not a likely route of exposure. Flush eyes with water.

Inhalation: * Remove patient from area to fresh air. If not breathing, give artificial respiration, preferably by mouth to mouth. If breathing is difficult, give oxygen. Seek prompt medical attention. Avoid when possible.

Skin Contact: * wash the affected area with copious amounts of water. Some persons may be sensitive to product.

Injury from detonation: * Seek prompt medical attention immediately.

Note to Physician: * Treat symptomatically.

Section 5: Fire-fighting measures

Extinguishing media: * Water may be used as the extinguishing method. DO NOT FIGHT EXPLOSIVES FIRES. Evacuate the area according to Emergency Response Guide 112 guidelines. Isolate the area and guard against any intruders.

Special Procedures: * Black Powder is extremely flammable and may deflagrate. Get away and evacuate the area.

Unusual Hazards: * As with any pyrotechnic, if under confinement or piled in slight confinement, Black Powder can explode. No known toxic fumes are emitted, but good ventilation should still be present.

Flash Point: not applicable.

Auto ignition Temp: Approximate range: 392° -867^{0}F /(200°-464°C)

NFPA Ratings: **Health=1** **Flammability=3** **Reactivity=1**

Advice and PPE for Firefighters: * Fires involving Black Powder should not be fought unless extinguishing media can be applied from a well protected and distant location from the point of fire. Self-contained breathing apparatus (SCBA) and protective clothing must be worn. Follow Emergency Response Guide 112. Wash all clothes prior to reuse.

Material Name: PARAGON ~ SUPERMIX / MASONRY TYPE-S, PLASTIC CEMENT

SECTION 16 – OTHER INFORMATION

Hazardous Material Information System (HMIS):	**Health**	**1**
	Flammability	**0**
	Physical Hazard	**0**
	Personal Protection	**B**

Revision: April 2015
Prepared by; R. Radel / A. Gallegos

NFPA/HMIS Definitions:
0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme

Protective Equipment:
Safety glasses, gloves

Key/Legend
EPA = Environmental Protection Agency
TSCA = Toxic Substance Control Act
ACGIH = American Conference of Governmental Industrial Hygienists
IARC = International Agency for Research on Cancer
NIOSH = National Institute for Occupational Safety and Health
NTP = National Toxicology Program
OSHA = Occupational Safety and Health Administration
NJTSR = New Jersey Trade Secret Registry

Literature Reference
None

Other Information

NOTE: SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT OR THE MERCHANTABILITY OT FITNESS THEREOF FOR ANY PURPOSE OR CONCERNING THE ACCURACY OF ANY INFORMATION PROVIDED BY PARAGON CONCRETE PRODUCTS, except the product shall conform to contracted specifications. The information provided herein was believed by Paragon Concrete Products Inc. to be accurate at the time of preparation or prepared from sources believed to be reliable, but it is the responsibility of the user to investigate and understand other pertinent sources of information to comply with all laws and procedures applicable to the safe handling and use of the product and to determine the suitability of the product for its intended use. Buyer's exclusive remedy shall be for damages and no claim of any kind, whether as to product delivered or for non-delivery of product, and whether based on contract, breach of warranty, negligence , or otherwise shall be greater in amount than the purchase price of the quantity of product in respect of which damages are claimed. In no event shall Seller be liable for incidental or consequential damages, whether Buyer's claim is based on contract, breach of warranty, negligence or otherwise.

***NOTE: Since other Agencies regulate this information, OSHA will not be enforcing SECTIONS 12 through 15 (29 CFR 1910.1200 (g) (2)).**