2019 First Nation Launch

Preliminary Design Report

For Wisconsin Space Grant Consortium

University of California, Los Angeles

1-22-2019

Table of Contents

1 Team Summary

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NAR/TRA Certification:	Level 3

2 Summary of Preliminary Design Report

2.1 Launch Vehicle Summary

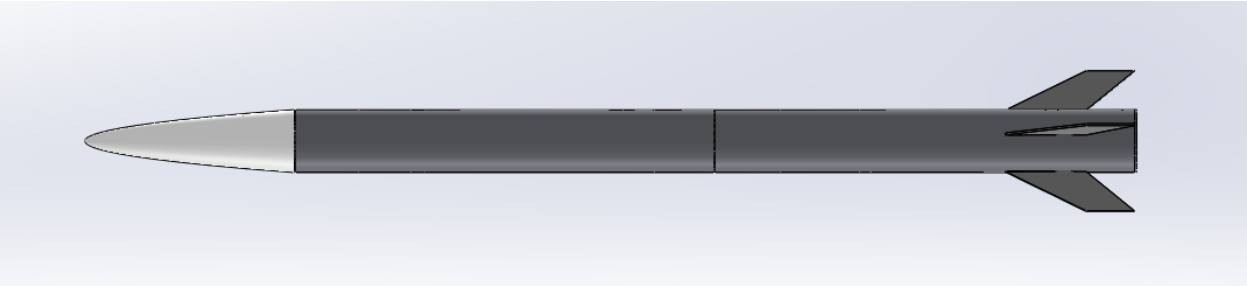


Figure 2.1.1 *Solidworks Model of Rocket Structure*

Part	Material	Dimensions	
Lower Body Tube	Carbon Fiber	Inner Diameter	3.82”
		Wall Thickness	0.040”
		Length	26”
Upper Body Tube	Carbon Fiber	Inner Diameter	3.82”
		Wall Thickness	0.040”
		Length	26”
Nose Cone	3D-Printed PLA/ABS	Shoulder	3.82”
		Wall Thickness	0.040”
		Length	26”
Fins	Fiberglass	Thickness	0.134”
Coupler	Carbon Fiber	Outer Diameter	3.82”
		Wall Thickness	0.040”
		Length	7.8”
Fin Securing Mechanism	Pine	Outer Diameter	3.82”
		Wall Thickness	0.040”
		Slits	3.0” x 0.5”

Centering Rings	Pine	Outer Diameter	3.82”
		Inner Diameter	2.165”
		Thickness	0.75”
Locking Mechanism	Pine	Outer Diameter	3.82”
		Thickness	1.5”
Bulkheads	Pine	Outer Diameter	3.82”
		Thickness	0.75”

***Figure 2.1.2**: Cross Section Side View of Rocket*

Specifications	
Total Length	65”
Center of Pressure	36.891” (from tip of nose cone)
Center of Gravity	41.519” (from tip of nose cone)
Stability Margin	1.19
Total Mass	~10.8 lb
Mass Without Motor	~8.1 lb

Motor Selection
The motor for this year, the Aerotech J450DM, was selected by our team between the two choices of motors given by the competition. The specifications of this motor are listed under Section 4.4 of this report.

Target Altitude
The preliminary target altitude is 4299 feet, which was given from the rocket simulation software OpenRocket.

Recovery System
Currently, our main method of slowing down the rocket to a safe landing speed is through a drogue chute deployed at apogee and the main chute deployed at a specified altitude.

2.2 Payload/Challenge Summary

B.A.M.S. (Barometric Pressure & Acceleration Microcontroller System)
for data recording of in-flight rockets

The payload this year is designed to solve the challenge presented by the competition. The payload will be incorporated into the avionics bay to centralize all electronics in the rocket. The payload will contain a microcontroller, a gyroscope/accelerometer module, a barometric pressure sensor, an SD card module, and a 9V battery. Data will be processed by the microcontroller and outputted to an SD card using the SD card module. The challenge requires that 3 data types are recorded during flight; however, the payload will record 5 data types (rotation, acceleration, pressure, altitude, and temperature) in case of component failure in individual modules. The avionics bay and payload will be housed by a 3D printed PLA/ABS locking mechanism and a 3D printed sled. The sled will be designed to snugly house the individual electronic modules. Both the barometric pressure sensor and gyroscope/accelerometer module will be surrounded by an insulating piece of foam to reduce direct contact with the 3D printed sled. This will also reduce vibrations experienced by the electronic components and provide more accurate data.

3 Changes Made Since Proposal

Vehicle Criteria
The vehicle has been modified to provide the most internal space available to the avionics bay, to account for actual masses of the rocket components, and to add in extra components that were not included in the proposal. This includes: changing the packed length of the main parachute, placing a locking mechanism in place of a bulkhead above the coupler in the upper body tube in order for easy access to the avionics bay, and the addition of a wooden centering above the aluminum centering ring on the bottom of the motor mount. Our construction methods have also changed as we do not plan to utilize a Dremel to cut out our bulkheads and centering rings; we plan to use a laser cutter to ensure that the components are precise and accurate to the simulation dimensions.

Payload Criteria
The payload has been modified to solve the challenge. Previously, the altimeter (RRC3 Sports Altimeter) was planned to be used to not only set off the ejection charges, but to also record pressure, altitude, and temperature as three of the required data types to satisfy the challenge problem. This has been changed since the challenge requires a microcontroller to record the data, not the altimeter already used in the recovery system. To compensate for this, a barometric pressure sensor (BMP180) will be used to record pressure, altitude, and temperature instead of the altimeter. The altimeter will be used to compare pressure, altitude, and temperature values with the BMP180 if needed, however, only values from the BMP180 will be used to solve the challenge. Battery types have also been changed from 3V Lithium Coin Cell Batteries to 9V Alkaline Batteries since these batteries have been used in previous rockets and are known to work during flight.

Project Plan
Our schedule has not changed, with the exception that testing of the payload components may proceed sooner than anticipated due to early possession of the electronic components. This will allow more time for thorough testing of the overall rocket.

4 Vehicle Criteria

4.1 Selection, Design and Rationale of Launch Vehicle

Mission Statement & Mission Success Criteria
The objective is to design and build a high-power rocket that can fly safely in order for the microcontroller system to gather crucial data. Requirements we must meet include the following: a non-metallic nose cone that needs to be designed and fabricated, reaching an altitude of 3500 ft - 5000 ft AGL, having an aerodynamic design and enable motor deployment charge, and having an altimeter to record altitude of apogee. In order to maximize our score, we need to perform well in the following two categories: flight performance and payload performance. First, we must ensure that the rocket successfully deploys with its recovery system and payload integration. Second, we must ensure that the payload, with its microcontroller system, accurately captures the crucial data while in flight.

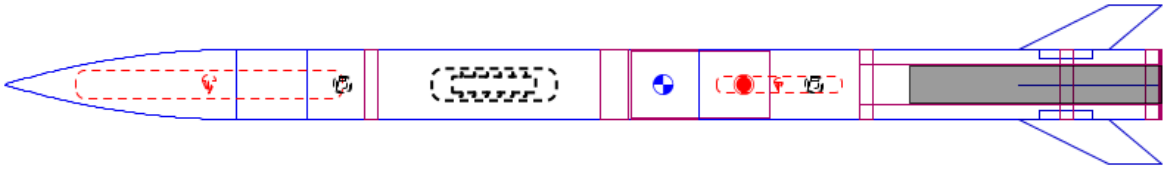


***Figure 4.1.1**: Cross Section Side View of Rocket from OpenRocket simulation*

Overview & Description
The vehicle design allows for a simple recovery system design that is ensured to work multiple times and in case of failure. The recovery electronics include a pair of altimeters that monitor and record the altitude of the rocket so that if one altimeter should fail, a second altimeter will continue functioning and the risk of failing to deploy the recovery system is reduced. At certain preprogrammed altitudes at apogee and during descent, the altimeters in the recovery electrical system will send electrical signals to the black powder ejection charges belonging to the recovery system. This will break the shear pins, releasing the most critical parts of the recovery system, the drogue chute and main parachute, which will, in turn, slow the rocket enough for a safe landing.

Though the option to have only one altimeter always exists and serves to lessen the weight of the rocket, we determined having the redundancy in spite of the loss in weight freedom was well worth the risk if it meant reducing the possibility of the rocket not surviving the landing.

The design also allows for the most space available for the electrical system to achieve mission success. As there will be quite a few data-capturing devices (described in section 4.3) within the rocket, the availability of space for each device was in high demand. This availability of space also allows for the wiring for both the recovery electrical system and the payload electrical system to be neat and separate from each other, fulfilling the competition guidelines.

The altimeters will be tested by running through their test functions prior to launch. The parachute will be tested by having a team member grab the properly folded parachute from the shock cords and run as fast as possible while throwing the parachute out behind them to see if it deploys appropriately, causing them to slow down.

Leading Design Diagrams

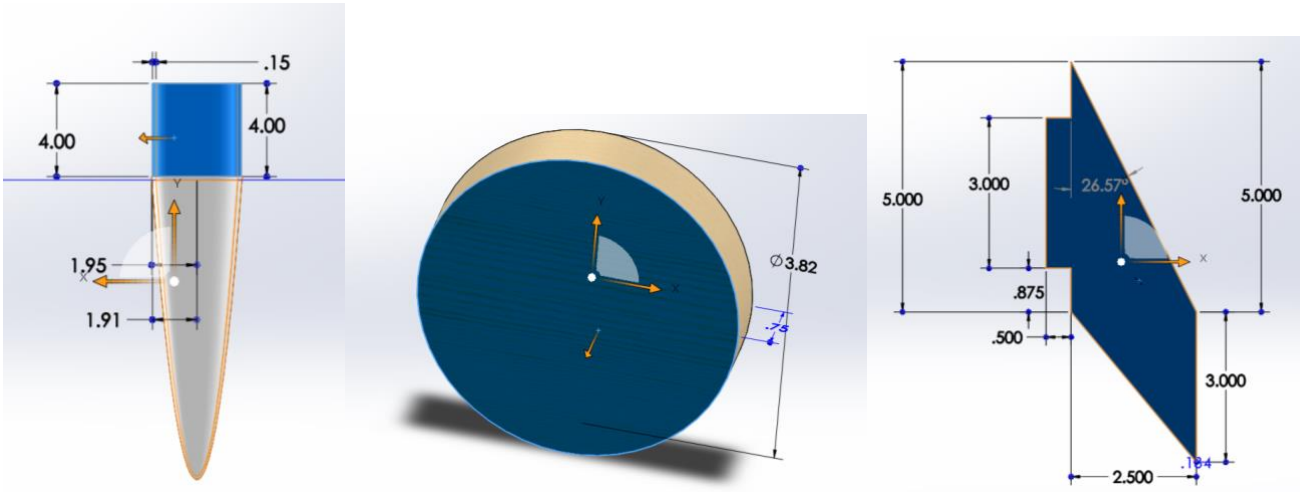


Figure 4.1.2: *3D Printed Nosecone (left). 0.75 in thick pine bulkhead to be used to separate the main parachute from the avionics bay (center). The locking mechanism (described in section 4.3) will utilize the same dimensions as the bulkhead, but it will be double the thickness and contain the described cuts (as said in Section 4.3). Fin Dimensions (right)*

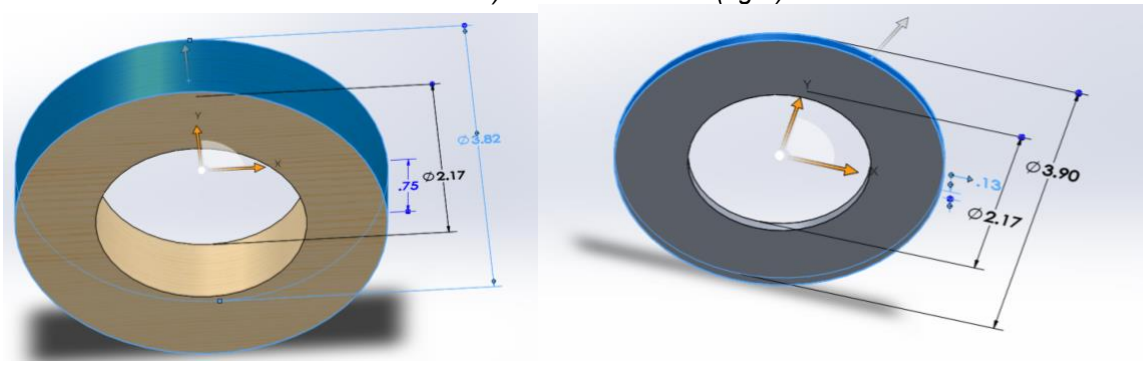


Figure 4.1.3: *0.75 in. thick pine centering ring to be used on top and bottom end of motor mount(left). 0.134 in thick aluminum centering ring used on bottom end of the motor mount after the wooden centering ring (right)*

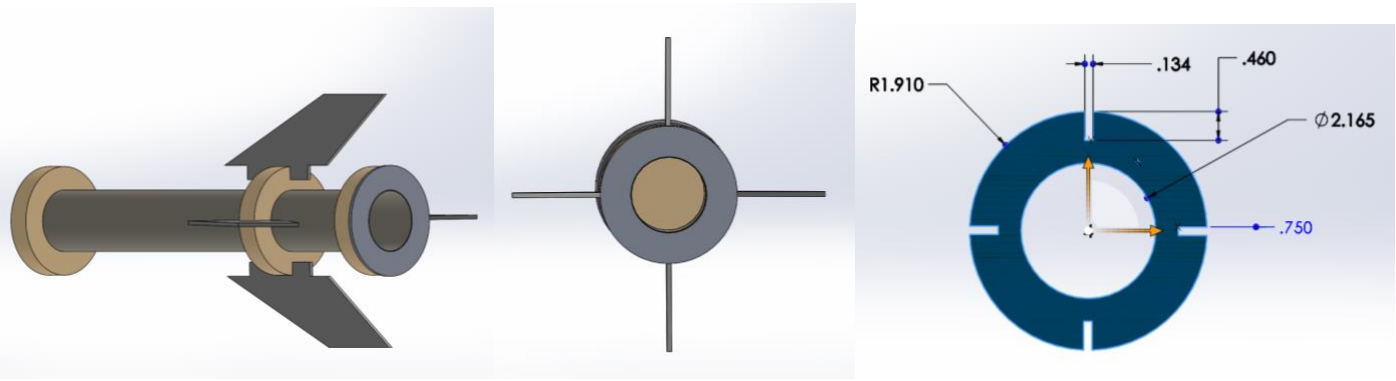


Figure 4.1.4: *Internal view of fin securement mechanism (left). Front view of fins attached at 90 degrees to each other on the centering ring (center). 0.75 in. thick pine fin centering ring (right)*

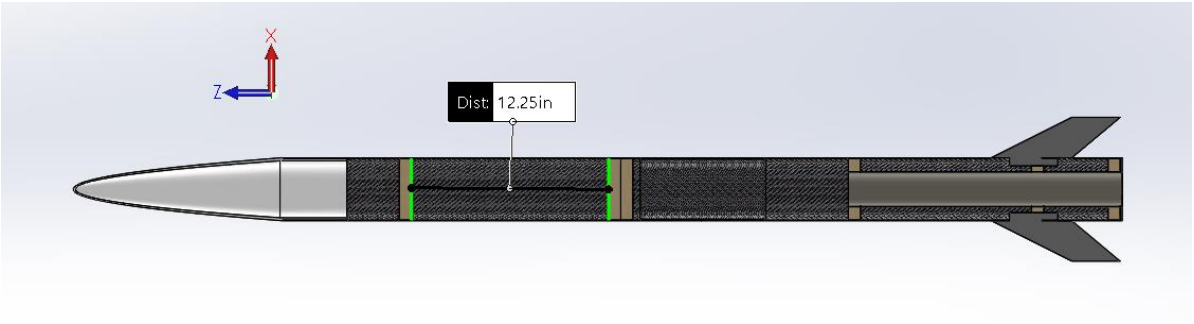


Figure 4.1.5: *The electronics bay will have a total of 12.25" of length within the body tube. This space begins above the top edge of the locking mechanism, which is above the coupler, in the upper body tube. Internal space was maximized here in order to house the avionics bay. Components of electronics bay discussed in Section 4.3 will be placed here.*

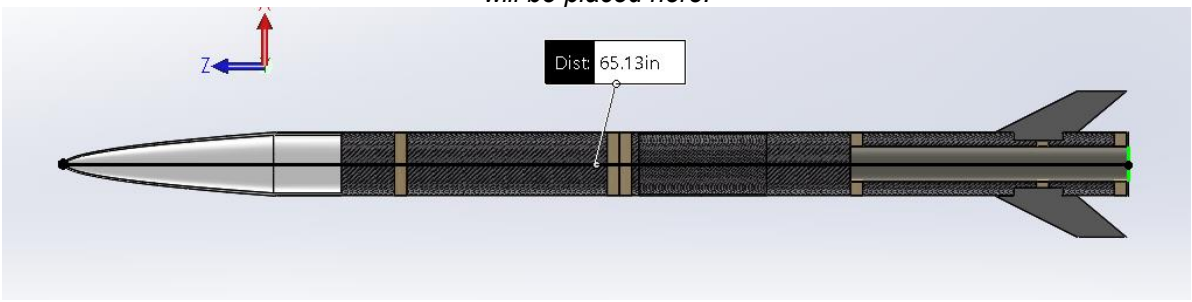


Figure 4.1.6: *Completely assembled the rocket will stand at ~65".*

Subsytem Masses

Item	Mass (oz)	Item	Mass (oz)
Nose Cone	16.1	Bulkhead	2.63

Body Tube (top)	13	Locking Mechanism	5.27
Body Tube (bottom)	13	Main Parachute (w/ shock cords, quick links, and fire cloth)	38.6
Pine Centering ring (top of motor mount)	1.79	Pine Centering ring (bottom of motor mount)	1.79
Tube Coupler	5.11	Aluminum Centering Ring	1.63
Inner Tube	1.18	Fin Securing Mechanism	1.79
Trapezoidal Fin Set	6.93	Drogue Chute (w/ shock cords, quick links, and fire cloth)	10.83
Motor with Propellant	42.65	Electronics Bay	9.1
Unspecified (screws, bolts, etc.)	~15	Total Mass	172

The total mass of the rocket is approximately 172 oz, accounting for the motor and propellant. The bases of our mass estimates are Open Rocket, RockSim, and Aerotech with accuracies of +/- 1 oz (Openrocket, RockSim) and +/- 0.05 oz (Aerotech). We estimate we have at the most 15 oz to spare before the rocket is too heavy to remain stable in flight. Knowing that these are all ideal estimates and that real world components are somewhat less than ideal, besides those 15 oz, we have set aside ~22 oz for components that aren't included in the software simulator applications, such as screws, epoxy, etc, as well as uncertainties and differences between simulated mass and actual mass. This additional 22 oz will allow the rocket to reach the minimum apogee requirement (3500 ft AGL) but cause the rocket to be slightly over stable. This corresponds to an allowable 22% increase in mass between the rocket presented in the Preliminary Design Report and the actual rocket presented and launched in Wisconsin.

4.2 Recovery Subsystem

Parachute Sizing

When choosing a parachute design, we had to take into account three major characteristics of our rocket: mass, velocity on descent, and space available in the body for both the main and drogue chutes. Taking these into consideration, and the availability of the parachutes, we have decided to use a 96 inch diameter main chute and 16 inch diameter drogue chute. This will give us an approximate descent rate of about 15 ft/s. These parachutes are small enough to fit into the rocket easily so they can still deploy when the ejection black powder charges are detonated, while still providing enough drag to drastically slow down the rocket.

Leading Components
Given our available resources, our choice of main parachute was set from the beginning. The next best option was smaller (56 inch diameter) and would have cut down on the weight of the rocket, but given the smaller area, would have made the descent velocity much faster. This could have made the rocket dangerous and the chance of recovery would decrease given the more powerful impact with the ground. Because of these reasons, we chose the 96 inch diameter main parachute. For the drogue chute, we had the opposite occur. Because we chose a large main parachute, we felt as though we could choose the smaller option we had (16 inch diameter) as the drogue chute would only slow the rocket down slightly and we did not want to add unnecessary weight.

4.3 Avionics Bay

Avionics Bay Overview

- MissileWorks RRC3 Altimeter
    - Tasked with releasing the parachutes at the proper heights and recording the rocket altitude every few milliseconds to produce altitude and velocity charts post-landing.
    - Powered by one 9V battery
    - Dimensions: 3.92” x 0.925”
    - Weight: approximately 0.60 oz
- StratoLogger SL100 Altimeter
    - Has same functions as the MissileWorks altimeter, but is being used for redundancy.
    - Powered by one 9V battery
    - Dimensions: 2.75” x 0.9”
    - Weight: approximately 0.45 oz
- Arduino Uno
    - Retains code for sampling data from other modules during flight
    - Will record data from other modules and write data onto an SD card for post-landing analysis
    - Powered by one 9V battery
    - Dimensions: 2.7” x 2.1”
    - Weight: approximately 0.88 oz
- Barometric Pressure Sensor (BMP180)
    - Records static pressure, altitude, and temperature
    - Powered by Arduino Uno
    - Dimensions: 0.
    - Weight: approximately

- Accelerometer/Gyroscope (MPU6050
    - Records acceleration and rotation in 3 axis
    - Powered by Arduino Uno
    - Dimensions: 0.
    - Weight: approximately
- Sled
    - 3D-printed using PLA filament
    - Holds the altimeters, Arduino Uno and its components, and three batteries in dedicated areas
    - Permanently attached to the top of the bulkhead center ring

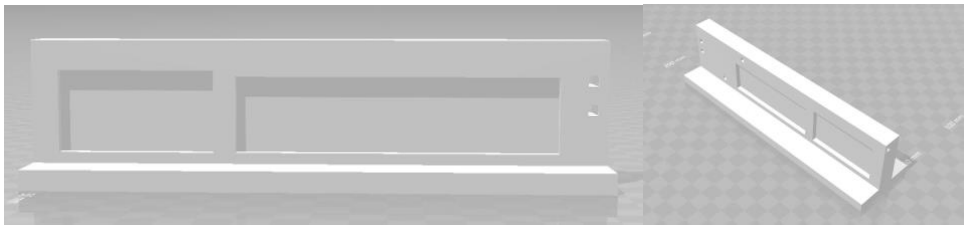


Figure 4.3.2: *(Right) Angled view of the prototype electronics sled, showing T-shape. (Left) Side view, showing impressions for placing the electronics.*

- Bulkhead Center Ring
    - Material: Wood
    - A part of the Bulkhead Locking Mechanism which facilitates access to the Avionics Bay without damaging the airframe
- Vent Holes
    - The size of the vent holes were calculated using the equations given in the MissileWorks manual
    - $MultiPort\ Diameter = 2 \cdot \sqrt{(single\ vent\ area/\#\ of\ holes)/\pi)}$
    - $MultiPort\ Diameter = 2 \cdot \sqrt{(0.042/4)/\pi)} = 0.115in$
    - They will be located 30 inches from the bottom of the rocket.
- Safety Switch
    - Powerpole Connector Pins will be used to quickly engage the safety switch. This will help with meeting the timed challenge requirement
    - Excess cable will be taped to the outside

Locking Mechanism

- The lower bulkhead of the electronics bay forms the locking mechanism, comprised of one outer ring and one inner ring

    - Outer Ring: permanently attached to the airframe
    - Inner Ring: attached to avionics sled; slides into a locking position with the outer ring and stays in place due to magnets on both the outer and inner ring
- Facilitates access to the avionics bay without requiring the removal of the entire avionics bulkhead. The body tube's outer design remains unaffected since the bulkhead would not require unscrewing from the outer surface

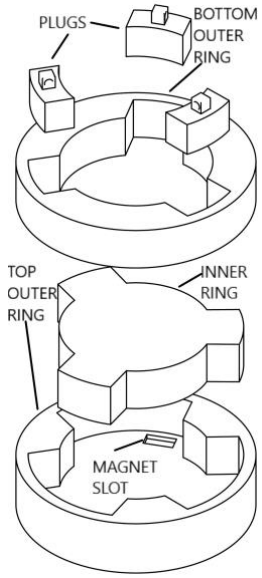


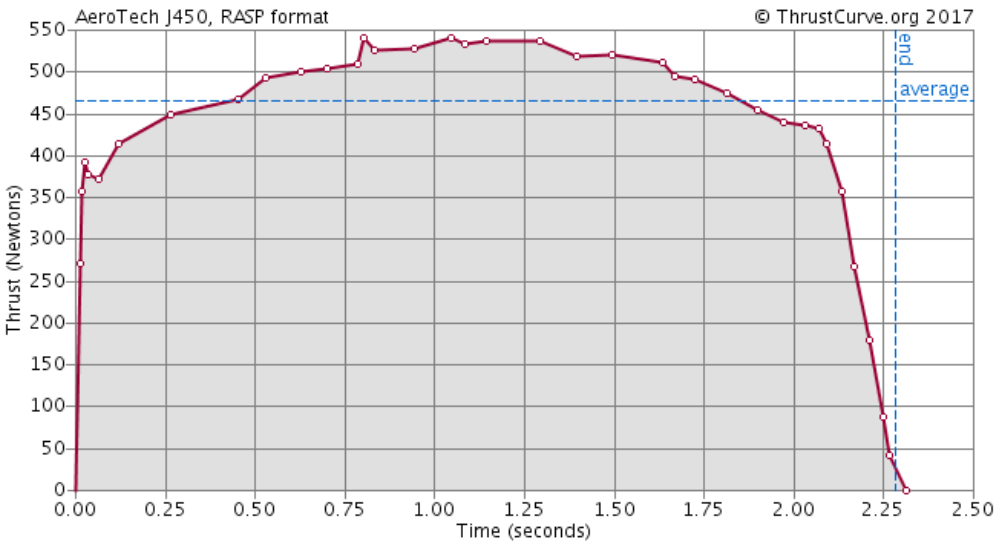
Figure 3.1 Exploded view of the locking mechanism with relevant parts labelled.

4.4 Motor Selection

The motor our team has selected for this year's competition is the **AEROTECH 54mm HP SU DMS MOTOR - J450DM - 14A.** The competition has dictated each team to choose between the Aerotech 54mm J450DM-14A motor and the Aerotech 54mm K550W-14A motor. The important aspects of each motor are listed below.

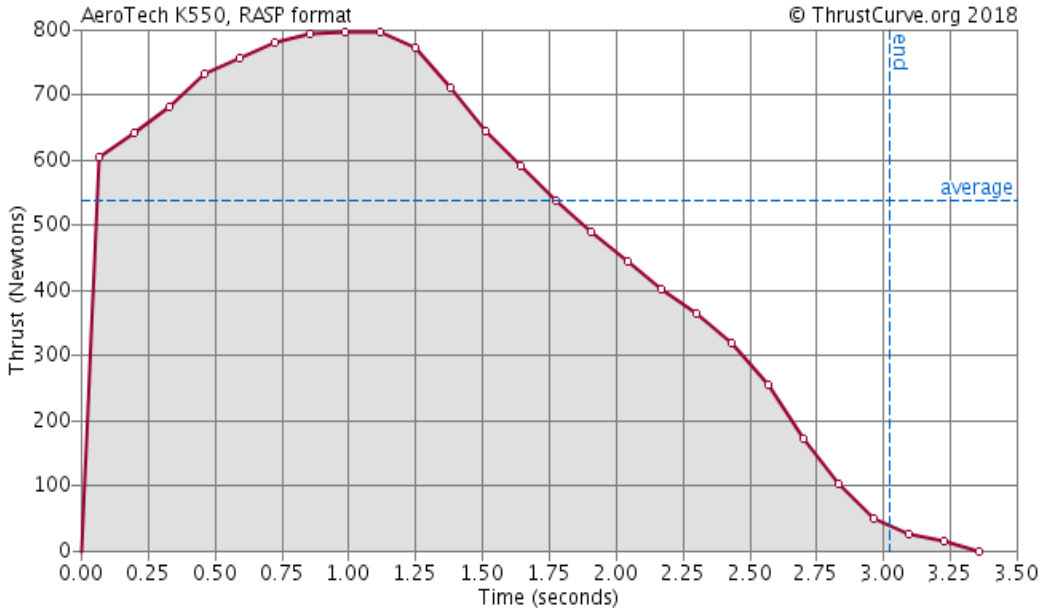
AEROTECH 54mm HP SU DMS MOTOR - J450DM - 14A Specifications

Size: 54mm Single Use	**Motor Length:** 358 mm
Delay: 14 sec	**Max Thrust:** 125.0 Newtons
Burn Time: 2.4 sec	**Total Mass:** 1209.0 g
Total Impulse: 1097.0 Newton-seconds	**Propellant Mass:** 662.0 g
Thrust to Weight ratio: 10.550	



AEROTECH 54mm MOTOR - K550W - 14A Specifications

Size: 54mm Reloadable	**Motor Length:** 410 mm
Delay: 14 sec	**Max Thrust:** 655.0 Newtons
Burn Time: 3.9 sec	**Total Mass:** 1515.1 g
Total Impulse: 1700.0 Newton-seconds	**Propellant Mass:** 880.4 g
Thrust to Weight ratio: 44.113	



Using OpenRocket as well as the most updated model of our rocket, our team was able to run two simulations and flight trajectories, each for a respective motor used in our rocket. We found that the J-Class motor gave a stability well within the safe range, as well as an altitude within the competition requirements. Neither of these conditions were met with the K-Class motor.

Considering the design process is close to over and our manufacturing process is underway, it is unlikely that any major design changes will occur. That being said the only way the K-Class Motor would become the team's preference over the J-Class Motor would be if the rocket's weight and overall layout were completely altered.

The potential for such a drastic change in design was controlled by modeling the rocket plan in OpenRocket and Solidworks as well as measuring the dimensions of all components that will be used before selecting a motor that would work well. Through doing this, it is expected that no changes made to the design after this point will be drastic enough for the preference of motor to be changed.

For the motor retention plan, a motor retainer will be attached via screws through the aluminum centering ring and into the wooden centering at the bottom of the motor mount. The aluminum centering ring was chosen because a metal bottom ensures that the motor mount does not misalign or warp during landing and helps to ensure a stable second launch. These centering rings will then be epoxied to the carbon fiber bottom body tube, which lends to the motor retainer having two mechanical connections to the rocket; one would be between the motor retainer and the centering rings, and the other would be between the centering rings and the bottom body tube. The motor we have selected, the Aerotech 54mm HP SU DMS Motor - J450DM - 14A, will be able to slide into the motor mount easily and the cap of the motor retainer will be screwed on once the motor is inside the rocket. This ensures that the motor will not fall out of the rocket upon launch, which not only ensures that our rocket will be in flight but also that it can fly safely.

4.5 Mission Performance Predictions

Simulated Vehicle Data, Motor Thrust Curve and Component Weights
For our simulations we set three windspeeds of 0, 10, and 20 MPH, with a 60" launch rail oriented straight up. Below are shown the simulated vehicle data, component weights and motor thrust curve from the 0 MPH windspeed calculation. The information presented in simulations is not affected by windspeed therefore only one set will be shown.

Windspeed	**0 MPH**	**10 MPH**	**20 MPH**
Motor Configuration	J450DM-14	J450DM-14	J450DM-14
Velocity off Rod	50.7 ft/s	50.6 ft/s	50.6 ft/s
Apogee	4301 ft	4277 ft	4229 ft
Velocity at Main Chute Deployment	115 ft/s	115 ft/s	115 ft/s
Optimum Delay for Ejection Charge	13.7 s	13.7 s	13.6 s
Max Velocity	632 ft/s	631 ft/s	629 ft/s
Max Acceleration	335 ft/s^2	335 ft/s^2	335 ft/s^2
Time to Apogee	15.9 s	15.9 s	15.8 s
Flight Time	69.7 s	70.4 s	69.9 s
Ground Hit Velocity	22.3 ft/s	22.3 ft/s	22.3 ft/s

Table 4.5.1 Vehicle Data *Vehicle data for three simulations of 0, 10 and 20 MPH, it can be observed that the apogee is decreased with increasing windspeed, indicating increased stress on the rocket*

Motor Mount Body Tube	13 oz	*Avionics Body Tube*	13 oz
Fins	6.93 oz	Coupler	5.11 oz
Pine Centering rings (2)	4.58 oz	*Locking Mechnaism*	5.27 oz
Drogue Chute + Recovery Hardware	10. 83 oz	*Pine Bulkhead*	2.63 oz
Phenolic Tubing	1.18 oz	Main Parachute	20 oz
Aluminum Centering Ring	1.63 oz	Avionics Bay	8.68 oz
Fin Securement Mechanism	1.79 oz	Recovery Hardware	18.6 oz
Subtotal (Motor Mount B.T.)	39.94 oz	Subtotal (Avionics B.T.)	73.29 oz
Nosecone	16.1 oz	Motor	43 oz
		Grand Total	172 oz

Table 4.5.2 Component Weights*. Italicized values are simulated with OpenRocket material data and component dimensions*

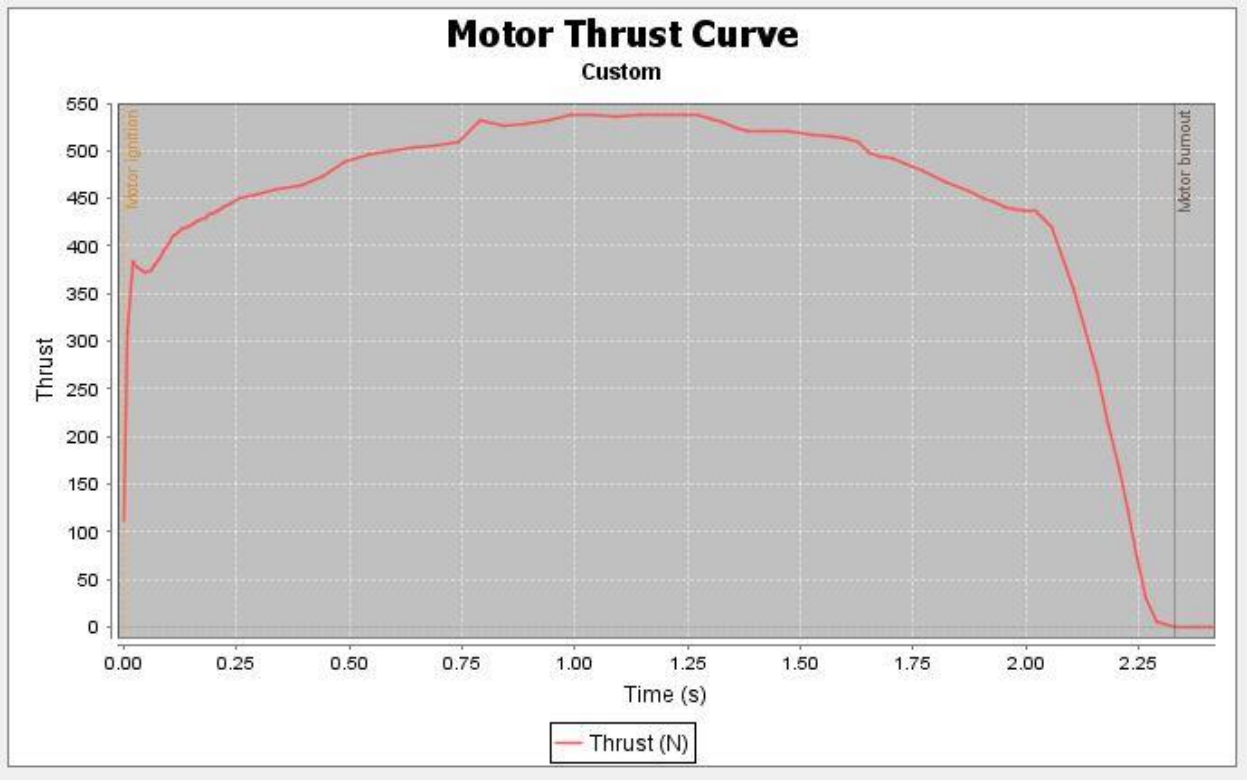


Figure 4.5.1 Simulated Motor Thrust Curve Plot

Flight Profiles

Next are the flight profiles for the three different windspeed cases: 0 MPH, 10 MPH, and 20 MPH.

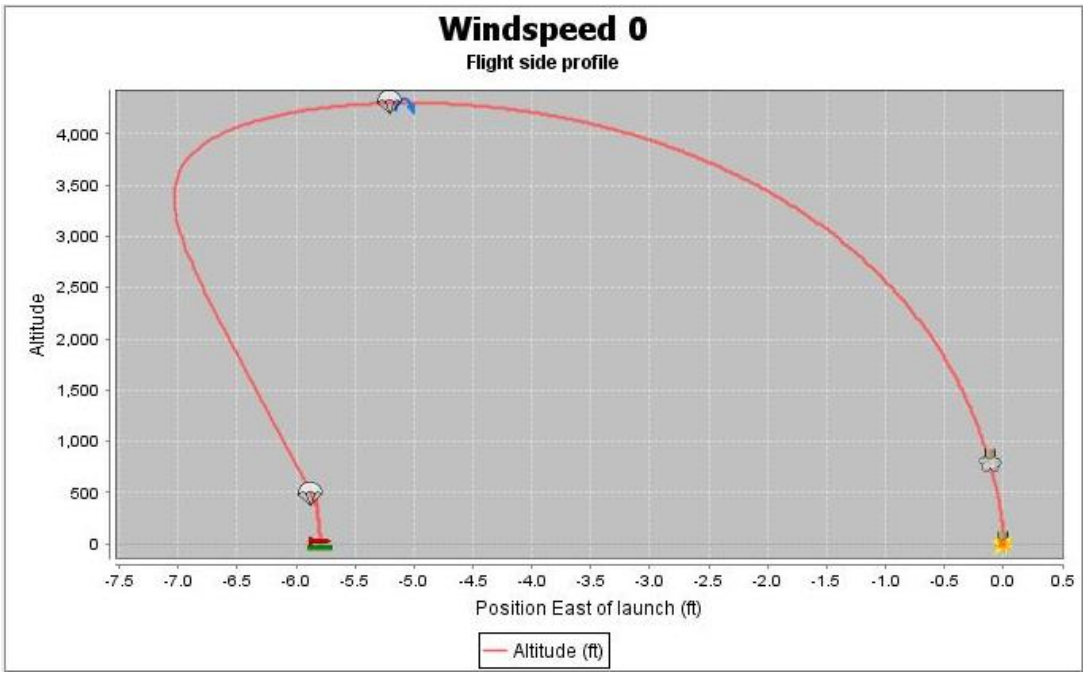


Figure 4.5.2 No Wind Simulation Plot Flight profile of a no wind simulation

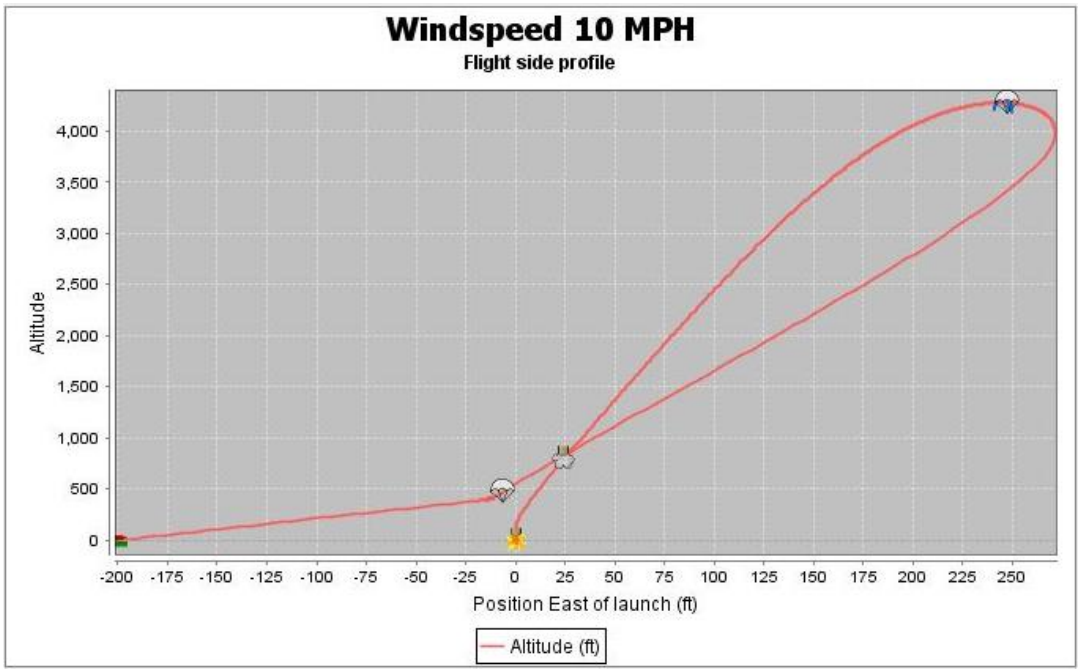


Figure 4.5.3 10 MPH Wind Simulation Plot Flight profile of a 10 MPH south eastern wind simulation with rocket position indicated in ft east of launch

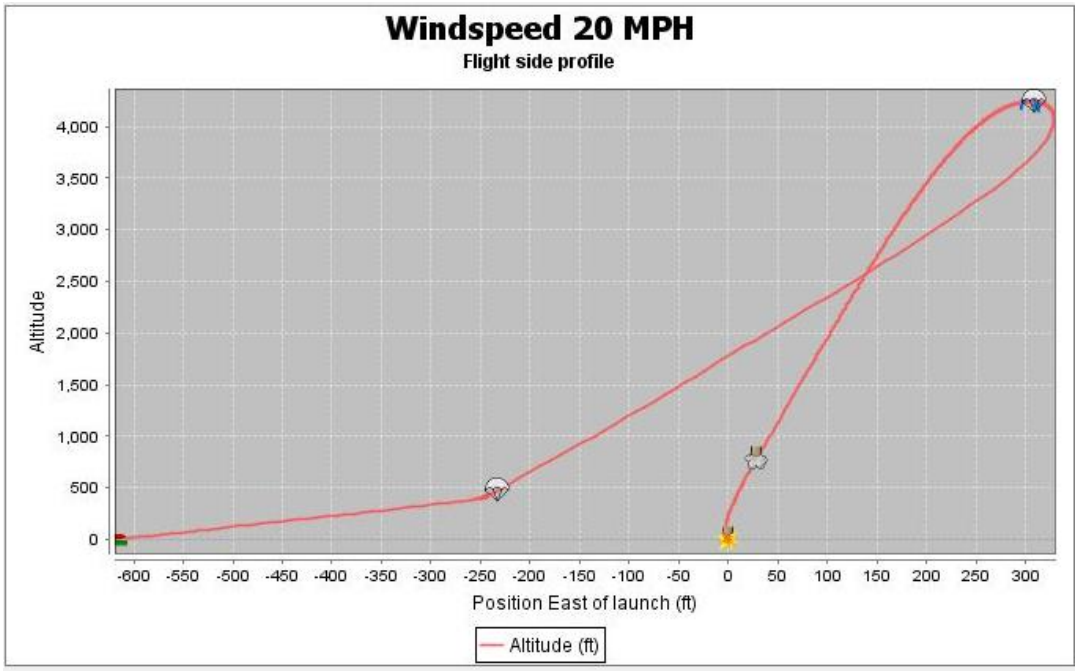


Figure 4.5.4 20 MPH Wind Simulation Plot Flight profile of a 10 MPH south eastern wind simulation with rocket position indicated in ft east of launch

Stability, CP and CG

Stability is the ratio of the center of Gravity (CG) by the Center of Pressure (CP), with both quantities measured in inches from the tip of the nosecone.

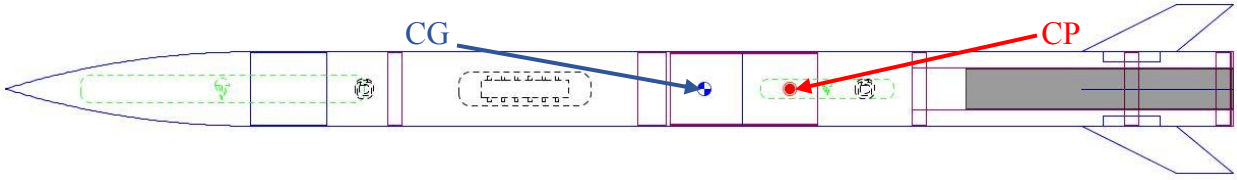


Figure 4.5.5 Simulated Stability, CP, and CG on OpenRocket Both the CG and CP are shown on the area of the coupler, indicated with a blue and red arrow respectively

Descent Rate and Time

From simulation data, descent rate is 115 ft/s under the drogue parachute until the main parachute deploys at 500 ft AGL and reduces the rate to approximately 22.3 ft/s. Subtracting flight time (69.7) from time to apogee (15.9) we can calculate total descent time to be **53.8 s**.

Kinetic Energy at Landing

With the ground hit velocity of 22.3 ft/s we can calculate the kinetic energy of the rocket:

$$KE = \frac{1}{2}mv^2$$

For the mass we will assume complete motor burn and take the mass of the rocket with a motor (172.33 oz) and subtract the propellant mass (23.35 oz).

$$KE = \frac{1}{2}(148.98\ oz)\left(\frac{.0625\ lb}{1\ oz}\right)\left(22.3\ \frac{ft}{s}\right)^2 = 6119.5\ \text{ft} \cdot \text{lbf}$$

Drift

From the flight profiles above, we can determine the drift from the launch pad with the assumption that the apogee is directly above it by adding the drift from the launch pad to apogee to the final drift location.

Table 4.5.2 Drift from Launchpad *Assume apogee occurs directly over launchpad

Windspeed (MPH)	Drift from launchpad* (ft)
0	0.5
10	450
20	900

5 Safety

Personnel Hazard Analysis

In anticipation of the manufacturing season, the personnel hazards for the construction of our rocket are outlined below in table format. The Safety Officer, Joshua Diaz, is responsible for ensuring that all mitigations and controls listed are carried out when they can be. The MSDS for all potentially hazardous materials that we will be working with are provided in the Appendix.

Hazard	Carbon Fiber / Fiberglass Dust Inhalation	Inhalation of Lead Fumes	Use of Machining Equipment (Lathe, Drill Press, Dremel)
Effects	Both materials are known to cause health problems given long enough exposure	Lead has been known to cause mental health problems when ingested or inhaled	Potential team member injury if used improperly
Cause	Cutting Carbon Fiber or Fiberglass material with a Dremel in a dry environment	Using lead-based solder	Inexperienced team member improperly using machining equipment
Severity	Medium	High	High
Chance	Low	Low	Low
Controls	P100 rated respirator masks and filters, a lab coat, gloves, and goggles will be worn when working with these materials. The materials will only be cut in a safe workspace in accordance with UCLA EH&S policy.	Lead based solder will not be used.	All team members will be trained on equipment before use by UCLA staff or experienced members and supervised when machining.
Impact of Controls	The workspace that the materials must be cut at has to be notified 48 hours in advance and may not always be available. Disposable PPE stock must be maintained, which affects the budget.	Instead of lead-based solder the team must buy solder wire that does not contain lead, which may impact budget.	Team members will have knowledge and guidance, but schedules of team members must be coordinated.

Failure Modes and Effects Analysis
According to the rocket design, payload, payload integration, and launch operations established in this report, a preliminary Failure Modes and Effects Analysis is provided in the chart below.

Potential Failure Mode	Potential Effects	Potential Causes	Severity	Chance	Controls
Motor Ignition Failure	Rocket is grounded	Improper motor prep or defective motor	Low	Low	Attending a motor wiring workshop and checking security of wiring
Motor Delayed Ignition	Injury from unsafe personnel approach	Improper motor prep or defective motor	Medium	Low	Attending a motor wiring workshop and checking security of wiring
Motor Premature Ignition	Injury to nearby personnel	Improper motor prep or defective motor	High	Low	Attending a motor wiring workshop and checking security of wiring
Nose Cone fails to detach at apogee	Parachute does not deploy and damage to the interior of the rocket	Improper fitting and/or construction of the nose cone	High	Low	Ensuring a tight friction fit by sanding the 3D printed nose cone to the correct dimensions
Altimeter Malfunction	Failure to deploy parachute	Coding error or defective equipment	High	Low	Thorough testing of the code and altimeter
Fins break off during flight	Instability in the rocket and changing its trajectory	Improper alignment with the body tube when attached during construction	High	Low	Proper implementation of the fin securement mechanism

Microcontroller Malfunction	Critical data may not be captured or captured incorrectly	Coding error or defective equipment	Medium	Medium	Thorough testing of the code, microcontroller, and any attached sensors

Project Risk Assessment

Risk	Likelihood	Impact	Mitigation
Time	Low	High	Carefully following the timeline presented in section 7.3 will assure that the rocket is completed on time. This timeline includes sufficient time for manufacturing and testing, which should be completed well before the competition. This gives about 1 month of buffer time to recover in the case that time is lost due to malfunctions or personnel injury.
Budget	Low	High	Following safety guidelines set by UCLA and Safety Officer Joshua Diaz will ensure that no more than what has been allocated to safety will be spent. Meticulousness when manufacturing and following vendor protocols will ensure that tools and parts purchased will not need to be replaced.
Scope/functionality	Low	High	Scope/functionality of the rocket should not be affected if the timeline is followed. Enough time has been assigned to manufacture and test the rocket to ensure all requirements are met. In the event of a malfunction or injury, buffer time has been given to ensure functionality of the rocket.

6 Payload Criteria

6.1 Selection, Design and Rationale of Payload/Challenge

Payload Objective
The payload will capture and store flight data throughout the duration of the flight. The selected types of data are acceleration and rotation of the rocket, internal pressure, internal temperature, and altitude. A successful experiment will print at least 3 of the 5 types of data onto an SD card for post-flight analysis.

Overview

Task	Used Product	Alternative
Microcontroller	**Arduino Uno**- chosen for its relatively small size and greater number of pins. More universally known than Raspberry Pi or other Arduino module types. Greater processing power than Arduino Nano. Contains a DC adapter plug which is more secure than soldering wires onto pins. More expensive than Nano.	**Arduino Nano**- was our 2nd option due to it having the same functionality as the Arduino Uno but smaller. However, space is currently not a concern. The Nano has less pins, less processing power, and does not directly connect to the battery (would require soldering). Cheaper than Arduino Uno.
Data Module 1	**MPU6050**- very cheap module. Made by InvenSense. Not a knock off product. Easy module to program. Known documentation of this module. Easy to capture data. Provides 2 data types across 3 axis. Small sized module.	**GT-U7 GPS**-records position instead. Relatively expensive. Made by MakerFocus. Records only position in 3 axis, which is only 1 data type. Requires 2 other libraries. Relatively easy to code. Small sized module, but also requires another antenna module.
Data Module 2	**Onyehn BMP180**- is not only a pressure sensor, but also records pressure and altitude. Made by Onyehn, a reliable provider. Even easier to program than the MPU6050. There are Arduino libraries made specifically for this module. Very small sized module.	JBtek BMP180- exactly the same as the Onyehn BMP180, just twice as expensive. Made by JBtek, a reliable provider.

SD Card Module	**GikFun SD Card Module**- slightly more expensive, but came in a pack of one. Have worked in past personal projects. Easy to incorporate and use. Reliable manufacturer.	**SenMod SD Card Module**- way cheaper, but comes in a pack of 5. Made by SenMod, which does not have a website, which suggests it may be a knockoff version of the GikFun. Easy to incorporate and use.

Payload Design Description

The current payload design will consist of an Arduino Uno that interacts with the accelerometer/gyroscope unit (MPU6050), Onyehn BMP180, and GikFun SD Card Module. The Arduino Uno was chosen for its robustness, faster processing speed, and DC power supply. The MPU6050 and BMP180 were chosen since they both act as I2C slaves and are easier to monitor within the code. I2C slaves require only 2 pins for receiving and transmitting data, so technically more data capturing devices could be added without needing more pins. The GikFun SD Card module was chosen over the SenMod version because of the possibility it is a knock version of the GikFun module.

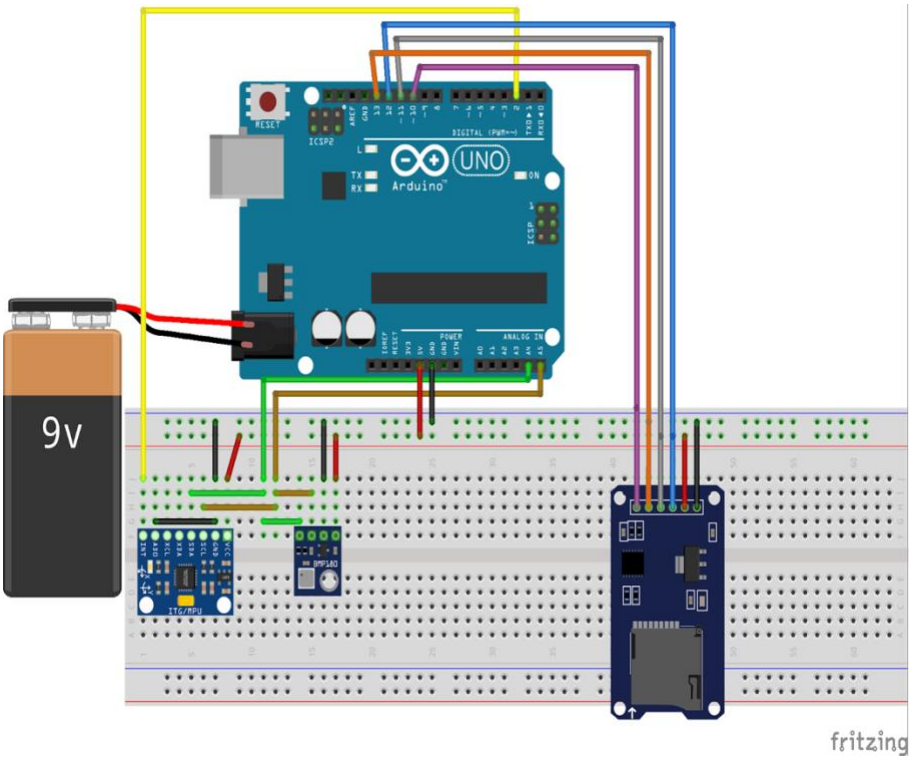


Figure 6.1: Wiring of the payload. Shown here is the Arduino Uno hooked up to the MPU6050 (bottom left), BMP180 (bottom middle), and SD Card module (bottom right). The assembly is powered by a single 9V battery using a DC adapter plug.

Component Masses

Part	Mass	Part	Mass
Arduino Uno	0.88 oz	SD Card Module	0.18 oz
MPU6050	0.04 oz	9V Battery	1.59 oz
BMP180	0.02 oz		

Preliminary Interfaces Between Payload and Launch Vehicle
The payload will be placed with the avionics bay. This sled will be epoxied onto a locking mechanism that will close off that section of the rocket. There are no direct interfaces between the payload and the rocket, but this placement will ensure that accurate data is collected when the rocket is launched with the payload within it.

7 Project Plan

7.1 Requirements Verification**

The following table lists the five requirements needed by the project and the method by which they are to be verified. Please refer to the appendix for detailed verification plans.

Requirements	Verification Method
General	Analysis, demonstration
Vehicle	Test, analysis, inspection
Recovery System	Test, analysis, inspection
Payload/Experiment	Test, analysis, inspection
Safety	Analysis, demonstration, inspection

7.2 Project Budget

Below is our current 2018-2019 budget, which outlines components needed by subteams with respective totals, adding up to the full budget total. A more detailed budget plan specifying individual unit market prices and vendors can be found in the appendix.

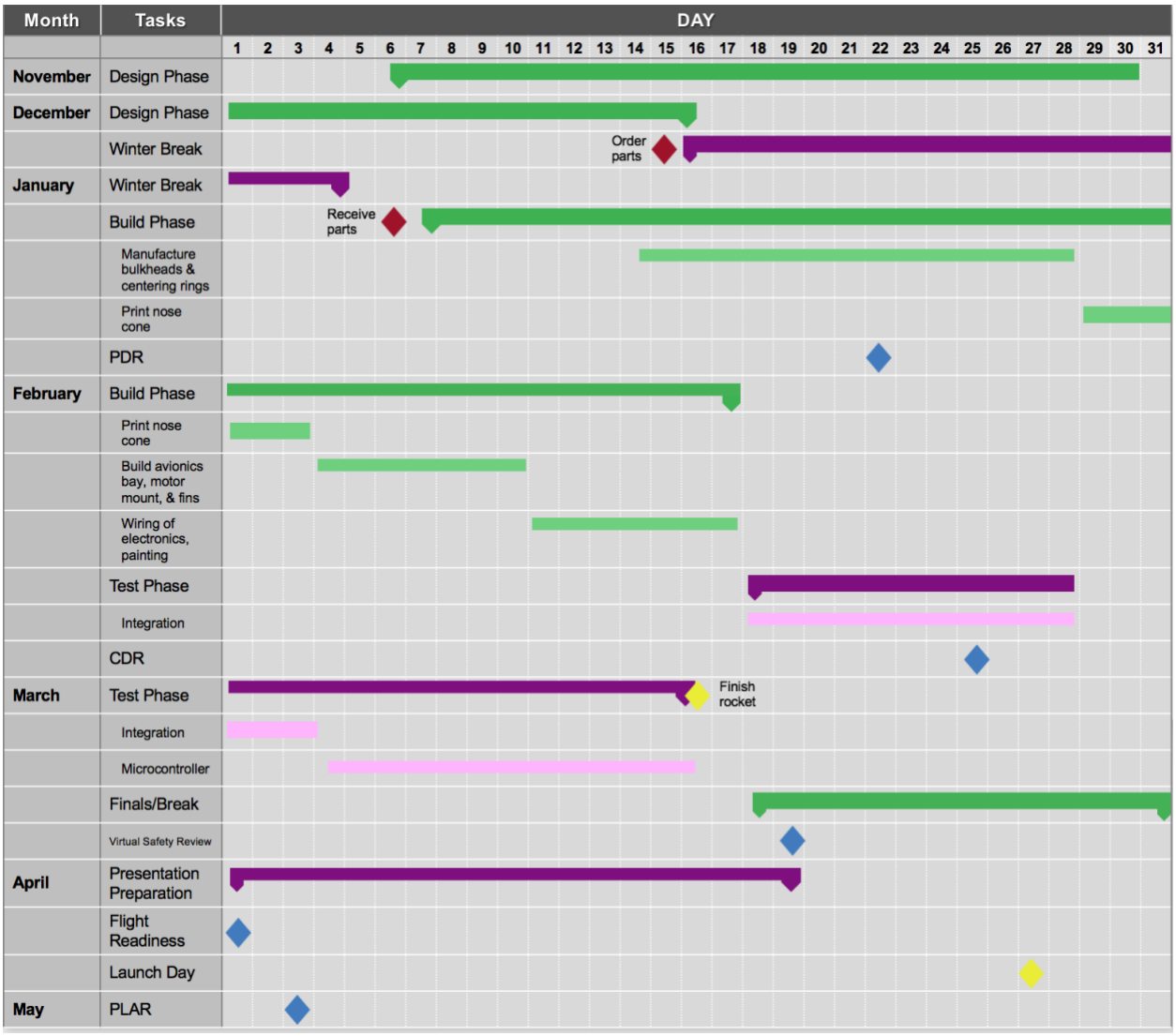
Expenses	Funding Allocated Towards	Amount
Structures	Body Tube, Coupler, Motor Mount, Epoxy, Screws	$431
Electrical	RRC3 Sport Altimeter, SR44 Silver Oxide Battery, Battery Cell Holders, Accelerometer, SD Card Module (x5), Arduino Uno	$112
Tools	Dremel Tool & Kit, Dremel Blades	$137
Travel	Plane and Bus Tickets, Uber Charges, Toolbox, Shipping Box	$1785
Safety	Gloves, Masks, Goggles	$108
Total		**$2573**

Below is our current list of funding sources, with respective means of access and fiscal amounts. This listing accounts for both past sources and more recent acquisitions.

Funding Source	**Funding Access**	**Amount**
Wisconsin Space Grant Consortium	Reimbursements for Materials and Supplies	$3000
Previous Award Money	Purchase Orders Through the UCLA Engineering Department	$575
UCLA Engineering Alumni Association	Purchase Orders Through the UCLA Engineering Department	$650
Total		**$4225**

7.3 Project Timeline

This Gantt chart contains our projected dates for manufacturing and testing of our rocket, as well as important deadlines.



8 Appendix

Material Safety Data Sheets…31

- Clear Epoxy Resin
- Graphite Powder
- Klean-Strip Acetone
- STRUST +SSPR 6PK GLOSS BLACK
- TAP Super Hard Epoxy Hardener
- TAP Super Hard Epoxy Resin
- WD-40

Requirements Verification…86

2018 – 2019 Budget…87

SAFETY DATA SHEET

Issuing Date 28-Oct 2014 **Revision Date** 17-Oct-2014 **Revision Number** 1

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product identifier

Product SDS Name **Clear Epoxy Resin – Syringe – Part A**

J-B Weld FG SKU Part Numbers Covered

50112, 50101, 50132, 50112-F, 50101-F, 50132-F, 80112, 40002

J-B Weld Product Names Covered

ClearWeld™ (all), PlasticWeld™ Syringe, MinuteWeld™ Syringe, Wood Restore™ Liquid Epoxy

J-B Weld Product Type

Epoxy

Recommended use of the chemical and restrictions on use

Recommended Use	General Purpose Adhesive
Uses advised against	No information available

Details of the supplier of the safety data sheet

Supplier Name	J-B WELD COMPANY,LLC
Supplier Address	1130 COMO ST SULPHUR SPRINGS, TX 75482 USA
Emergency Telephone Numbers	Transportation Emergencies: Chemtrec (24 hour transportation emergency response info): 800-424-9300 or 703-527-3887 Poison/Medical Emergencies: Poison Control Centers (24 hour emergency poison / medical response info): 800-222-1222
Supplier Email	info@jbweld.com
Supplier Phone Number	903-885-7696

2. HAZARDS IDENTIFICATION

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 1
Skin sensitization	Category 1

GHS Label elements, including precautionary statements

Emergency Overview

Signal word **Warning**

Hazard Statements

Causes severe skin irritation

May cause an allergic skin reaction

May cause serious eye damage / eye irritation

Appearance Clear **Physical State** Gel Liquid **Odor** Ammoniacal

Precautionary Statements - Prevention

Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Use only outdoors or in a well-ventilated area
Do not breathe dust/fume/gas/mist/vapors/spray
Contaminated work clothing should not be allowed out of the workplace
Wear protective gloves

Precautionary Statements - Response

Immediately call a doctor/physician or poison control center.
Specific treatment (see supplemental first aid instructions on this label)

Eyes

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Immediately call a doctor/physician

Skin

Call a POISON CENTER or doctor/physician if you feel unwell
Wash contaminated clothing before reuse
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation or rash occurs: Get medical advice/attention

Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician if you feel unwell

Ingestion
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth
Do NOT induce vomiting
Precautionary Statements - Storage
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

Not applicable

Unknown Toxicity
75% of the mixture consists of ingredient(s) of unknown toxicity

Other information

Harmful to aquatic life with long lasting effects
Repeated or prolonged skin contact may cause allergic reactions with susceptible persons

Interactions with Other Chemicals
Use of alcoholic beverages may enhance toxic effects.

3. COMPOSITION/INFORMATION ON INGREDIENTS

.

Chemical Name	CAS No	Weight-%
Diglycidyl bisphenol A resin	25085-99-8	95
Oxirane, [[4-(1,1-dimethylethyl)phenoxy]methyl]-	3101-60-8	5

4. FIRST AID MEASURES

· **4.1 Description of first aid measures**
· **After inhalation:**
Supply fresh air. If required, provide artificial respiration. Keep patient warm. Consult doctor if symptoms persist.
In case of unconsciousness place patient stably in side position for transportation.
· **After skin contact:**
Immediately wash with water and soap and rinse thoroughly.
Immediately remove any clothing soiled by the product. If skin irritation continues, consult a doctor.
· **After eye contact:**
Protect unharmed eye.
Rinse opened eye for several minutes under running water. Then consult a doctor. Do not remove contact lenses if worn.

· **After swallowing:**
Rinse out mouth and then drink plenty of water.
Do not induce vomiting; call for medical help immediately.
· **4.2 Most important symptoms and effects, both acute and delayed** Allergic reactions
Nausea
Dizziness
· **Hazards** Danger of impaired breathing.
· **4.3 Indication of any immediate medical attention and special treatment needed**
Treat skin and mucous membrame with antihistamine and corticoid preparations.
Monitor circulation.

5. FIRE-FIGHTING MEASURES

· **5.1 Extinguishing media**
· **Suitable extinguishing agents:** Use fire extinguishing methods suitable to surrounding conditions.
· **5.2 Special hazards arising from the substance or mixture**
Formation of toxic gases is possible during heating or in case of fire.
· **5.3 Advice for firefighters**
· **Protective equipment:**
Wear self-contained respiratory protective device.
Wear fully protective suit.
· **Additional information** Cool endangered receptacles with water spray.

6. ACCIDENTAL RELEASE MEASURES

· **6.1 Personal precautions, protective equipment and emergency procedures**
Use respiratory protective device against the effects of fumes/dust/aerosol.
Remove persons from danger area.
Ensure adequate ventilation
Wear protective equipment. Keep unprotected persons away.
· **6.2 Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **6.3 Methods and material for containment and cleaning up:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Dispose contaminated material as waste according to item 13.
Clean the affected area carefully; suitable cleaners are:
Warm water and cleansing agent
· **6.4 Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment. See Section 13 for disposal information.

7. HANDLING AND STORAGE

· **7.1 Precautions for safe handling**
Ensure good ventilation/exhaustion at the workplace.
Prevent formation of aerosols.
· **Information about fire - and explosion protection:** No special measures required.

· **7.2 Conditions for safe storage, including any incompatibilities**

· **Storage:**

· **Requirements to be met by storerooms and receptacles:** No special requirements.
· **Information about storage in one common storage facility:**
Store away from oxidizing agents.
Store away from foodstuffs.
Do not store together with acids.
· **Further information about storage conditions:** Store in cool, dry conditions in well sealed receptacles.
· **7.3 Specific end use(s)** No further relevant information available.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

· **Additional information about design of technical facilities:** No further data; see item 7.

· **8.1 Control parameters**
· **Ingredients with limit values that require monitoring at the workplace:**
The product does not contain any relevant quantities of materials with critical values that have to be monitored at the workplace.
· **Additional information:** The lists valid during the making were used as basis.

· **8.2 Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing
Wash hands before breaks and at the end of work.
Avoid contact with the eyes and skin.
· **Respiratory protection:**
Use suitable respiratory protective device in case of insufficient ventilation.
Use suitable respiratory protective device when aerosol or mist is formed.

· **Protection of hands:**


Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation. Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

· **Material of gloves**
Butyl rubber, BR
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material cannot be calculated in advance and has therefore to be checked prior to the application.

· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

· **Eye protection:**


Safety glasses

Goggles recommended during refilling

9. PHYSICAL AND CHEMICAL PROPERTIES

· **9.1 Information on basic physical and chemical properties** · **General Information**	
· **Appearance:**	
Form:	Liquid
Colour:	Light yellow
· **Odour:**	Characteristic
· **Odour threshold:**	Not determined.
· **pH-value:**	Not determined.
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	> 200°C (> 392 °F)
· **Flash point:**	> 93,3°C (> 200 °F)
· **Flammability (solid, gaseous):**	Not applicable.
· **Ignition temperature:**	
Decomposition temperature:	Not determined.
· **Self-igniting:**	Product is not selfigniting.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.

· **Vapour pressure:**	Not determined.
· **Density at 20°C:**	1,13 g/cm³
· **Relative density**	Not determined. ·
Vapour density	Not determined.
· **Evaporation rate**	Not determined.
· **Solubility in/Miscibility with water:**	Not miscible or difficult to mix.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not determined.
Kinematic:	Not determined.
· **VOC (% content)**	<1%
Dynamic:	Not determined.
· **9.2 Other information**	No further relevant information available.

10. STABILITY AND REACTIVITY

· **10.1 Reactivity**
· **10.2 Chemical stability**
· **Thermal decomposition / conditions to be avoided:**
No decomposition if used according to specifications.
· **10.3 Possibility of hazardous reactions**
Reacts with oxidizing agents.
Reacts with amines.
Exothermic polymerization.
· **10.4 Conditions to avoid** No further relevant information available.
· **10.5 Incompatible materials:** No further relevant information available.
· **10.6 Hazardous decomposition products:** Carbon monoxide and carbon dioxide

11. TOXICOLOGY INFORMATION

· **11.1 Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** Irritant to skin and mucous membranes.
· **on the eye:** Irritating effect.
· **Sensitization:**
Sensitization possible through skin contact.
Sensitizing effect through inhalation is possible by prolonged exposure.

· **Additional toxicological information:**

The product shows the following dangers according to the calculation method of the General EU Classification Guidelines for Preparations as issued in the latest version: Irritant

12. ECOLOGICAL INFORMATION

· **12.1 Toxicity**

· **Aquatic toxicity:** The product contains materials that are harmful to the environment.

· **12.2 Persistence and degradability:** The product is not easily, but potentially degradable.

· **12.3 Bioaccumulative potential**

Due to the distribution coefficient n-octanol/water an accumulation in organisms is possible.

· **12.4 Mobility in soil** No further relevant information available.

· **Additional ecological information:**

· **General notes:**

Water hazard class 2 (German Regulation) (Self-assessment): hazardous for water
Do not allow product to reach ground water, water course or sewage system.
Danger to drinking water if even small quantities leak into the ground.

· **12.5 Results of PBT and vPvB assessment**

· **PBT:** Not applicable.

· **vPvB:** Not applicable.

· **12.6 Other adverse effects:** No further relevant information available.

13. DISPOSAL CONSIDERATIONS

· **13.1 Waste treatment methods**

· **Recommendation**

Must not be disposed together with household garbage. Do not allow product to reach sewage system.
Can be burned with household garbage after consulting with the waste disposal facility operator and the pertinent authorities and adhering to the necessary technical regulations.

· **Uncleaned packaging:**

· **Recommendation:** Disposal must be made according to official regulations.

14. TRANSPORT INFORMATION

· **14.1 UN-Number**	
· **DOT, ADR, ADN, IMDG, IATA**	Not Regulated
· **14.2 UN proper shipping name**	
· **DOT, ADR, ADN, IMDG, IATA**	Not Regulated
· **14.3 Transport hazard class(es)**	
· **DOT, ADR, ADN**	
· **Class**	Not Regulated

· **IMDG, IATA** 	
· **Class**	Not Regulated
· **14.4 Packing group**	
· **DOT, ADR, IMDG, IATA**	Not Regulated
· **14.5 Environmental hazards:**	
· **Marine pollutant:**	Not Regulated
· **Special marking (IATA):**	Not applicable.
· **14.6 Special precautions for user**	Not applicable.
· **14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	-

15. REGULATORY INFORMATION

· **15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **United States (USA)**
· **SARA**

· **Section 355 (extremely hazardous substances):**
None of the ingredients is listed.
· **Section 313 (Specific toxic chemical listings):**
None of the ingredients is listed.
· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

· **Proposition 65 (California):**

· **Chemicals known to cause cancer:**	
None of the ingredients is listed.	
· **Chemicals known to cause reproductive toxicity for females:**	
None of the ingredients is listed.	
· **Chemicals known to cause reproductive toxicity for males:**	
None of the ingredients is listed.	

· **Chemicals known to cause developmental toxicity:**
None of the ingredients is listed.

· **Carcinogenic Categories**

· **EPA (Environmental Protection Agency)**
None of the ingredients is listed.

· **IARC (International Agency for Research on Cancer)**
None of the ingredients is listed.
· **TLV (Threshold Limit Value established by ACGIH)**
None of the ingredients is listed.
· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients is listed.
· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

· **Canada**

· **Canadian Domestic Substances List (DSL)**
All ingredients are listed.
· **Canadian Ingredient Disclosure list (limit 0.1%)**
None of the ingredients is listed.
· **Canadian Ingredient Disclosure list (limit 1%)**
None of the ingredients is listed.

· **15.2 Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16. OTHER INFORMATION

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Relevant phrases**

H315: Causes skin irritation.
H317: May cause an allergic skin reaction.
H319: Causes serious eye irritation.
H341: Suspected of causing genetic defects.
H411: Toxic to aquatic life with long lasting effects.

R36/38: Irritating to eyes and skin.
R38: Irritating to skin.
R43: May cause sensitisation by skin contact.
R46: May cause heritable genetic damage. R51: Toxic to aquatic organisms.

· **Abbreviations and acronyms:**

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods DOT: US Department of Transportation
IATA: International Air Transport Association
GHS: Globally Harmonized System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
WHMIS: Workplace Hazardous Materials Information System (Canada)

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of Safety Data Sheet

SAFETY DATA SHEET

Issuing Date 27-Oct 2014 **Revision Date** 17-Oct-2014 **Revision Number** 1

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product identifier

Product SDS Name **Clear Epoxy Hardener - Syringe - Part B**

J-B Weld FG SKU Part Numbers Covered

50112, 80112, 50112-F

J-B Weld Product Names Covered

ClearWeld™ (all)

J-B Weld Product Type

Epoxy

Recommended use of the chemical and restrictions on use

Recommended Use	General Purpose Adhesive
Uses advised against	No information available

Details of the supplier of the safety data sheet

Supplier Name	J-B WELD COMPANY,LLC
Supplier Address	1130 COMO ST SULPHUR SPRINGS, TX 75482 USA
Emergency Telephone Numbers	Transportation Emergencies: Chemtrec (24 hour transportation emergency response info): 800-424-9300 or 703-527-3887 Poison/Medical Emergencies: Poison Control Centers (24 hour emergency poison / medical response info): 800-222-1222
Supplier Email	info@jbweld.com
Supplier Phone Number	903-885-7696

2. HAZARDS IDENTIFICATION

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin corrosion/irritation	Category 1B
Serious eye damage/eye irritation	Category 1
Skin sensitization	Category 1

GHS Label elements, including precautionary statements

Emergency Overview

Signal word **Warning**

Hazard Statements

Causes severe skin irritation

May cause serious eye damage / eye irritation

May cause an allergic skin reaction

Appearance Pale yellow **Physical State** Gel Liquid **Odor** Ammoniacal

Precautionary Statements - Prevention

Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Use only outdoors or in a well-ventilated area
Do not breathe dust/fume/gas/mist/vapors/spray
Contaminated work clothing should not be allowed out of the workplace
Wear protective gloves

Precautionary Statements - Response

Immediately call a POISON CENTER or doctor/physician
Specific treatment (see supplemental first aid instructions on this label)

Eyes

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Immediately call a POISON CENTER or doctor/physician

Skin

Call a POISON CENTER or doctor/physician if you feel unwell
Wash contaminated clothing before reuse
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation or rash occurs: Get medical advice/attention

Inhalation

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician if you feel unwell

Ingestion
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth
Do NOT induce vomiting
Precautionary Statements - Storage
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

Not applicable

Unknown Toxicity
75% of the mixture consists of ingredient(s) of unknown toxicity

Other information

Harmful to aquatic life with long lasting effects
Repeated or prolonged skin contact may cause allergic reactions with susceptible persons

Interactions with Other Chemicals
Use of alcoholic beverages may enhance toxic effects.

3. COMPOSITION/INFORMATION ON INGREDIENTS

.

Chemical Name	CAS No	Weight-%
2,4,6-Tri(dimethylaminomethyl)phenol	90-72-2	7 - 13
1-(2-Aminoethyl) piperazine	140-31-8	<5%
Benzyl alcohol	100-51-6	3 - 5
Ethylbenzene	100-41-4	<1%

4. FIRST AID MEASURES

First aid measures

General Advice

Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Eye Contact

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Keep eye wide open while rinsing. Do not rub affected area. Seek immediate medical attention/advice. Remove contact lenses, if present and easy to do. Continue rinsing.

Skin Contact

Immediate medical attention is required. Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. May cause an allergic skin reaction.

Inhalation

Remove to fresh air. Get medical attention immediately if symptoms occur. If breathing is difficult, (trained personnel should) give oxygen. If breathing has stopped, give artificial respiration. Get medical attention immediately. Avoid direct contact with skin. Use barrier to give mouth-to-mouth resuscitation.

Ingestion Do NOT induce vomiting. Rinse mouth immediately and drink plenty of water. Never give anything by mouth to an unconscious person. Call a physician or poison control center immediately.

Self-protection of the first aider Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Avoid direct contact with skin. Use barrier to give mouth-to-mouth resuscitation. Use personal protective equipment as required. Wear personal protective clothing (see section 8). Avoid breathing vapors or mists. Avoid contact with skin, eyes or clothing.

Most important symptoms and effects, both acute and delayed

Most Important Symptoms and Effects Burning sensation. Coughing and/ or wheezing. Difficulty in breathing. Itching. Rashes. Hives.

Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically. Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated. Do not give chemical antidotes. Asphyxia from glottal edema may occur. Marked decrease in blood pressure may occur with moist rales, frothy sputum, and high pulse pressure. May cause sensitization of susceptible persons.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media
CAUTION: Use of water spray when fighting fire may be inefficient.

Specific Hazards Arising from the Chemical
The product causes burns of eyes, skin and mucous membranes. Thermal decomposition can lead to release of irritating gases and vapors. Product is or contains a sensitizer. May cause sensitization by skin contact.

Uniform Fire Code Combustible Liquid: III-B
Sensitizer: Liquid

Hazardous Combustion Products
Carbon oxides.

Explosion Data
Sensitivity to Mechanical Impact No. **Sensitivity**

to Static Discharge No.

Protective equipment and precautions for firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal Precautions Attention! Corrosive material. Avoid contact with skin, eyes or clothing. Ensure adequate ventilation. Use personal protective equipment as required. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Avoid breathing vapors or mists. Avoid generation of dust.

Other Information Refer to protective measures listed in Sections 7 and 8.

Environmental Precautions

Environmental Precautions

Refer to protective measures listed in Sections 7 and 8. Prevent further leakage or spillage if safe to do so. Should not be released into the environment. Do not allow to enter into soil/subsoil. Prevent product from entering drains.

Methods and material for containment and cleaning up

Methods for Containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Soak up with inert absorbent material. Pick up and transfer to properly labeled containers.

7. HANDLING AND STORAGE

Precautions for safe handling

Handling

Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes or clothing. Avoid breathing vapors or mists. Use only with adequate ventilation and in closed systems. In case of insufficient ventilation, wear suitable respiratory equipment. Do not eat, drink or smoke when using this product. Take off contaminated clothing and wash before reuse.

Conditions for safe storage, including any incompatibilities

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from moisture. Store locked up. Keep out of the reach of children. Store away from other materials.

Incompatible Products Acids. Bases. Oxidizing agent.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Ethylbenzene 100-41-4	TWA: 20 ppm	TWA: 100 ppm TWA: 435 mg/m^3 (vacated) TWA: 100 ppm (vacated) TWA: 435 mg/m^3 (vacated) STEL: 125 ppm (vacated) STEL: 545 mg/m^3	IDLH: 800 ppm TWA: 100 ppm TWA: 435 mg/m^3 STEL: 125 ppm STEL: 545 mg/m^3

Other Exposure Guidelines See section 15 for national exposure control parameters

Appropriate engineering controls

Engineering Measures Showers
Eyewash stations

Ventilation systems

Individual protection measures, such as personal protective equipment

Eye/Face Protection	Tight sealing safety goggles. Face protection shield.
Skin and Body Protection	Wear protective gloves and protective clothing. Long sleeved clothing. Chemical resistant apron. Impervious gloves.
Respiratory Protection	No protective equipment is needed under normal use conditions. If exposure limits are exceeded or irritation is experienced, ventilation and evacuation may be required.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice. Do not eat, drink or smoke when using this product. Take off contaminated clothing and wash before reuse. Avoid contact with skin, eyes or clothing. Wear suitable gloves and eye/face protection. Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product. For environmental protection, remove and wash all contaminated protective equipment before re-use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical and Chemical Properties

Physical State	Gel Liquid		
Appearance	Pale yellow	**Odor**	Ammoniacal
Color	No information available	**Odor Threshold**	No information available

Property	**Values**	**Remarks/ Method**
pH	UNKNOWN	None known
Melting / freezing point	No data available	None known
Boiling point / boiling range	100 °C / 212 °F	None known
Flash Point	140 C / 284 F	None known
Evaporation Rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limit in Air		
Upper flammability limit	No data available	
Lower flammability limit	No data available	
Vapor pressure	No data available	None known
Vapor density	No data available	None known
Specific Gravity	No data available	None known
Water Solubility	Miscible in water	None known
Solubility in other solvents	No data available	None known
Partition coefficient: n-octanol/water	No data available	None known
Autoignition temperature	No data available	None known
Decomposition temperature	No data available	None known
Kinematic viscosity	No data available	None known
Dynamic viscosity	400	None known
Explosive properties	No data available	
Oxidizing Properties	No data available	

Other Information

Softening Point	No data available
VOC Content (%)	<1%
Particle Size	No data available
Particle Size Distribution	

10. STABILITY AND REACTIVITY

Reactivity

No data available.

Chemical stability
Stable under recommended storage conditions.

Possibility of Hazardous Reactions
None under normal processing.

Hazardous Polymerization
Hazardous polymerization does not occur.

Conditions to avoid
Exposure to air or moisture over prolonged periods. Excessive heat.

Incompatible materials
Acids. Bases. Oxidizing agent.

Hazardous Decomposition Products
Carbon oxides.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information .

Inhalation

Specific test data for the substance or mixture is not available. Corrosive by inhalation. (based on components). Inhalation of corrosive fumes/gases may cause coughing, choking, headache, dizziness, and weakness for several hours. Pulmonary edema may occur with tightness in the chest, shortness of breath, bluish skin, decreased blood pressure, and increased heart rate. Inhaled corrosive substances can lead to a toxic edema of the lungs. Pulmonary edema can be fatal. May cause irritation of respiratory tract. Harmful by inhalation.

Eye Contact

Specific test data for the substance or mixture is not available. Causes burns. (based on components). Corrosive to the eyes and may cause severe damage including blindness. Causes serious eye damage. May cause irreversible damage to eyes.

Skin Contact

Specific test data for the substance or mixture is not available. Corrosive. (based on components). Causes burns. May be absorbed through the skin in harmful amounts. Harmful in contact with skin.

Ingestion

Specific test data for the substance or mixture is not available. Causes burns. (based on components). Ingestion causes burns of the upper digestive and respiratory tracts. May cause severe burning pain in the mouth and stomach with vomiting and diarrhea of dark blood. Blood pressure may decrease. Brownish or yellowish stains may be seen around the mouth. Swelling of the throat may cause shortness of breath and choking. May cause lung damage if swallowed. May be fatal if swallowed and enters airways. Ingestion may cause irritation to mucous membranes. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea. May be harmful if swallowed.

Component Information

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50

2,4,6-Tri(dimethylaminomethyl)phen ol 90-72-2	= 1000 mg/kg (Rat)	= 1280 mg/kg (Rat)	-
1-(2-Aminoethyl) piperazine 140-31-8	= 2140 mg/kg (Rat)	= 880 µL/kg (Rabbit)	-
Benzyl alcohol 100-51-6	= 1230 mg/kg (Rat)	= 2 g/kg (Rabbit)	= 8.8 mg/L (Rat) 4 h
Ethylbenzene 100-41-4	= 3500 mg/kg (Rat)	= 15354 mg/kg (Rabbit)	= 17.2 mg/L (Rat) 4 h

Information on toxicological effects

Symptoms Erythema (skin redness). Burning. May cause blindness. Coughing and/ or wheezing. Itching. Rashes. Hives.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization May cause sensitization of susceptible persons. May cause sensitization by skin contact. May cause sensitization by inhalation.

Mutagenic Effects No information available.

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
Ethylbenzene 100-41-4	A3	Group 2B		X

ACGIH (American Conference of Governmental Industrial Hygienists)
A3 - Animal Carcinogen
IARC (International Agency for Research on Cancer)
Group 2B - Possibly Carcinogenic to Humans
OSHA (Occupational Safety and Health Administration of the US Department of Labor)
X - Present

Reproductive Toxicity No information available.

STOT - single exposure No information available.

STOT - repeated exposure No information available.

Chronic Toxicity Chronic exposure to corrosive fumes/gases may cause erosion of the teeth followed by jaw necrosis. Bronchial irritation with chronic cough and frequent attacks of pneumonia are common. Gastrointestinal disturbances may also be seen. Contains a known or suspected carcinogen.

Target Organ Effects Respiratory system. Eyes. Skin. Gastrointestinal tract (GI). Central Nervous System (CNS).

Aspiration Hazard No information available.

Numerical measures of toxicity Product Information

The following values are calculated based on chapter 3.1 of the GHS document

ATEmix (oral)
728.00 mg/kg
ATEmix (dermal)
1,140.00 mg/kg (ATE)
ATEmix (inhalation-gas)
18,750.00 ppm (4 hr)
ATEmix (inhalation-dust/mist)
6.20 mg/l
ATEmix (inhalation-vapor)
46.00 ATEmix

12. ECOLOGICAL INFORMATION

Ecotoxicity

Harmful to aquatic life with long lasting effects.

Chemical Name	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
1-(2-Aminoethyl) piperazine 140-31-8	72h EC50: = 495 mg/L (Pseudokirchneriella subcapitata)	96h LC50: > 1000 mg/L (Poecilia reticulata) 96h LC50: >= 100 mg/L (Oncorhynchus mykiss) 96h LC50: 1950 - 2460 mg/L (Pimephales promelas)	EC50 > 10000 mg/L 17 h	48h EC50: = 32 mg/L
Benzyl alcohol 100-51-6	3h EC50: = 35 mg/L (Anabaena variabilis)	96h LC50: = 10 mg/L (Lepomis macrochirus) 96h LC50: = 460 mg/L (Pimephales promelas)	EC50 = 50 mg/L 5 min EC50 = 63.7 mg/L 15 min EC50 = 63.7 mg/L 5 min EC50 = 71.4 mg/L 30 min	48h EC50: = 23 mg/L
Ethylbenzene 100-41-4	72h EC50: = 4.6 mg/L (Pseudokirchneriella subcapitata) 96h EC50: > 438 mg/L (Pseudokirchneriella subcapitata) 72h EC50: 2.6 - 11.3 mg/L (Pseudokirchneriella subcapitata) 96h EC50: 1.7 - 7.6 mg/L (Pseudokirchneriella subcapitata)	96h LC50: 11.0 - 18.0 mg/L (Oncorhynchus mykiss) 96h LC50: = 4.2 mg/L (Oncorhynchus mykiss) 96h LC50: 7.55 - 11 mg/L (Pimephales promelas) 96h LC50: = 32 mg/L (Lepomis macrochirus) 96h LC50: 9.1 - 15.6 mg/L (Pimephales promelas) 96h LC50: = 9.6 mg/L (Poecilia reticulata)	EC50 = 9.68 mg/L 30 min EC50 = 96 mg/L 24 h	48h EC50: 1.8 - 2.4 mg/L

Persistence and Degradability

No information available.

Bioaccumulation

No information available

Chemical Name	Log Pow
1-(2-Aminoethyl) piperazine 140-31-8	-1.48
Benzyl alcohol 100-51-6	1.1
Ethylbenzene 100-41-4	3.118

Other adverse effects

No information available.

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal methods

This material, as supplied, is not a hazardous waste according to Federal regulations (40 CFR 261). This material could become a hazardous waste if it is mixed with or otherwise comes in contact with a hazardous waste, if chemical additions are made to this material, or if the material is processed or otherwise altered. Consult 40 CFR 261 to determine whether the altered material is a hazardous waste. Consult the appropriate state, regional, or local regulations for additional requirements.

Contaminated Packaging

Dispose of contents/containers in accordance with local regulations.

Chemical Name	RCRA	RCRA - Basis for Listing	RCRA - D Series Wastes	RCRA - U Series Wastes
Ethylbenzene 100-41-4		Included in waste stream: F039		

California Hazardous Waste Codes 331

Chemical Name	California Hazardous Waste
Ethylbenzene 100-41-4	Toxic Ignitable

14. TRANSPORT INFORMATION

DOT NOT REGULATED
Proper Shipping Name NON REGULATED
Hazard Class N/A

TDG Not regulated

MEX Not regulated

ICAO Not regulated

IATA Not regulated
Proper Shipping Name NON REGULATED
Hazard Class N/A

IMDG/IMO Not regulated
Hazard Class N/A

RID Not regulated

ADR Not regulated

ADN Not regulated

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL	All components are listed either on the DSL or NDSL.

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

US Federal Regulations

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains a chemical or chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

Chemical Name	CAS No	Weight-%	SARA 313 - Threshold Values %
Ethylbenzene - 100-41-4	100-41-4	1 - 5	0.1

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden release of pressure hazard	No
Reactive Hazard	No

CWA (Clean Water Act)

This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

Chemical Name	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Ethylbenzene 100-41-4	1000 lb	X	X	X

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Chemical Name	Hazardous Substances RQs	Extremely Hazardous Substances RQs	RQ
Ethylbenzene 100-41-4	1000 lb		RQ 1000 lb final RQ RQ 454 kg final RQ

US State Regulations

California Proposition 65

This product contains the following Proposition 65 chemicals.

Chemical Name	California Proposition 65
Ethylbenzene - 100-41-4	Carcinogen

U.S. State Right-to-Know Regulations

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Chemical Name	New Jersey	Massachusetts	Pennsylvania	Rhode Island	Illinois
1-(2-Aminoethyl) piperazine 140-31-8	X	X	X		
Benzyl alcohol 100-51-6		X	X		
Ethylbenzene 100-41-4	X	X	X	X	X

International Regulations

Mexico National occupational exposure limits

Component	Carcinogen Status	Exposure Limits
Ethylbenzene 100-41-4 (1 - 5)		Mexico: TWA 100 ppm Mexico: TWA 435 mg/m^3 Mexico: STEL 125 ppm Mexico: STEL 545 mg/m^3

Mexico - Occupational Exposure Limits - Carcinogens

Canada

WHMIS Hazard Class

D2A - Very toxic materials

D2B - Toxic materials

16. OTHER INFORMATION

NFPA	**Health Hazards** 3	**Flammability** 1	**Instability** 0	**Physical and Chemical Hazards** -
HMIS	**Health Hazards** 3 *	**Flammability** 1	**Physical Hazard** 0	**Personal Protection** X

Chronic Hazard Star Legend * = Chronic Health Hazard

Prepared By J-B Weld Company

Revision Date 17-Oct-2014
Revision Note No information available

Notice to reader

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End of Safety Data Sheet

SAFETY DATA SHEET

Issuing Date 12-Jan-2016 **Revision Date** 26-Jul-2016 **Revision Number** 1

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

GHS product identifier

Product Name **Graphite Powder**

Other means of identification

Product Code(s) **MZ-2, MZ-2H, MZ-5, MZ-21, MZ-25**

Synonyms Graphite Powder

Recommended use of the chemical and restrictions on use

Recommended Use Extra Fine Graphite AGS Extra Fine Graphite is the finest all-purpose, dry powder lubricant which is both odorless and non-toxic. Use to guard against sticking, wear, and corrosion. Can be used year-round on all types of material, including metal, wood, plastic, and rubber. Suggested applications: precision instruments, locks, hinges, tools, guns, fishing reels, camera shutters, bicycles, office machines, toys, and other fine mechanisms.

Uses advised against No information available

Supplier's details

Supplier Address
AGS Company
P.O. Box 729
Muskegon, MI
49443
TEL: 800-253-0403

Emergency telephone number

Emergency Telephone Number 800-255-3924

2. HAZARDS IDENTIFICATION

Classification

This product is considered hazardous by the OSHA Hazard Communication Standard 2012 (29 CFR 1910.1200).

Carcinogenicity	Category 1A

GHS Label elements, including precautionary statements

Emergency Overview

Signal Word **Danger**

Hazard Statements

• May cause cancer

Appearance Black. **Physical State** Solid/Powder. **Odor** None.

Precautionary Statements

Prevention

• Obtain special instructions before use.
• Do not handle until all safety precautions have been read and understood.
• Use personal protective equipment as required.

General Advice

• If exposed or concerned: Get medical attention/advice

Storage

• Store locked up.

Disposal

• Dispose of contents/container to an approved waste disposal plant.

Hazard Not Otherwise Classified (HNOC)

Not applicable.

Other information

Contact with dust may cause mechanical irritation of the eyes and skin. Inhalation of dust may cause irritation of the respiratory tract.

15% of the mixture consists of ingredient(s) of unknown toxicity.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms Graphite Powder

Chemical Name	CAS-No	Weight %	Trade secret
Quartz silica	14808-60-7	1-5	*

**The exact percentage (concentration) of composition has been withheld as a trade secret.*

4. FIRST AID MEASURES

Description of necessary first-aid measures

Eye Contact Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

Skin Contact Wash skin with soap and water.

Inhalation Move to fresh air.

Ingestion Clean mouth with water and afterwards drink plenty of water.

Most important symptoms/effects, acute and delayed

Most Important Symptoms/Effects No information available.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable Extinguishing Media No information available.

Specific Hazards Arising from the Chemical
No information available.

Explosion Data
Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal Precautions Ensure adequate ventilation.

Environmental Precautions

Environmental Precautions See Section 12 for additional Ecological Information.

Methods and materials for containment and cleaning up

Methods for Containment Prevent further leakage or spillage if safe to do so.

Methods for Cleaning Up Pick up and transfer to properly labeled containers.

7. HANDLING AND STORAGE

Precautions for safe handling

Handling Handle in accordance with good industrial hygiene and safety practice.

Conditions for safe storage, including any incompatibilities

Storage Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible Products None known based on information supplied.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters

Exposure Guidelines

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH

Quartz silica 14808-60-7	TWA: 0.025 mg/m³ respirable fraction	(vacated) TWA: 0.1 mg/m³ respirable dust : (30)/(%SiO2 + 2) mg/m³ TWA total dust : (250)/(%SiO2 + 5) mppcf TWA respirable fraction : (10)/(%SiO2 + 2) mg/m³ TWA respirable fraction	IDLH: 50 mg/m³ respirable dust TWA: 0.05 mg/m³ respirable dust

Appropriate engineering controls

Engineering Measures Showers
Eyewash stations
Ventilation systems

Individual protection measures, such as personal protective equipment

Eye/Face Protection None required for consumer use. Risk of contact, wear: Safety glasses with side-shields.
Skin and Body Protection None required for consumer use. Repeated or prolonged contact: Gloves should be worn.
Respiratory Protection If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State Solid/Powder.
Appearance Black.
Odor None.
Odor Threshold No information available.

Property	Values	Remarks/ - Method
pH	No data available	None known
Melting Point/Range	3652 °C	None known
Boiling Point/Boiling Range	No data available	None known
Flash Point	No data available	None known
Evaporation rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limits in Air		
upper flammability limit	No data available	
lower flammability limit	No data available	
Vapor Pressure	No data available	None known
Vapor Density	No data available	None known
Specific Gravity	2.26	None known
Water Solubility	Insoluble in water.	None known
Solubility in other solvents	No data available	None known
Partition coefficient: n-octanol/water	No data available	None known
Autoignition Temperature	No data available	None known
Decomposition Temperature	No data available	None known
Viscosity	No data available	None known

Flammable Properties Not flammable

Explosive Properties No data available
Oxidizing Properties No data available

Other information

VOC Content (%) No data available

10. STABILITY AND REACTIVITY

Reactivity

No data available.

Chemical stability

Stable under recommended storage conditions.

Possibility of hazardous reactions

None under normal processing.

Hazardous Polymerization

Hazardous polymerization does not occur.

Conditions to avoid

None known based on information supplied.

Incompatible materials

None known based on information supplied.

Hazardous decomposition products

None known based on information supplied.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information There is no data available for this product
Inhalation There is no data available for this product. Product dust may cause irritation of respiratory tract.
Eye Contact There is no data available for this product.
Skin Contact There is no data available for this product.
Ingestion There is no data available for this product.

Chemical Name	LD50 Oral	LD50 Dermal	LC50 Inhalation
Quartz silica	= 500 mg/kg (Rat)	-	-

Symptoms related to the physical, chemical and toxicological characteristics

Symptoms No information available.

Delayed and immediate effects and also chronic effects from short and long term exposure

Sensitization No information available.
Mutagenic Effects No information available.
Carcinogenicity This product contains crystalline silica (quartz) in a non-respirable form. Inhalation of crystalline silica is unlikely to occur from exposure to this product.

Chemical Name	ACGIH	IARC	NTP	OSHA
Quartz silica	A2	Group 1	Known	X

Legend:

ACGIH: (American Conference of Governmental Industrial Hygienists)
A2 - Suspected Human Carcinogen

IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans

NTP: (National Toxicity Program)
Known - Known Carcinogen

OSHA: (Occupational Safety & Health Administration)
X - Present

Reproductive Toxicity	No information available.
STOT - single exposure	No information available.
STOT - repeated exposure	No information available.
Aspiration Hazard	No information available.

Numerical measures of toxicity - Product

Acute Toxicity	15% of the mixture consists of ingredient(s) of unknown toxicity.

12. ECOLOGICAL INFORMATION

Ecotoxicity
The environmental impact of this product has not been fully investigated.

Persistence and Degradability	No information available.
Bioaccumulation	No information available.

Other Adverse Effects
No information available.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods	This material, as supplied, is not a hazardous waste according to Federal regulations (40 CFR 261). This material could become a hazardous waste if it is mixed with or otherwise comes in contact with a hazardous waste, if chemical additions are made to this material, or if the material is processed or otherwise altered. Consult 40 CFR 261 to determine whether the altered material is a hazardous waste. Consult the appropriate state, regional, or local regulations for additional requirements.
Contaminated Packaging	Do not re-use empty containers.

14. TRANSPORT INFORMATION

DOT	Not regulated
ICAO	Not regulated
IMDG/IMO	Not regulated

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL	Complies

Legend

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

U.S. Federal Regulations

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

CERCLA
This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

U.S. State Regulations

California Proposition 65
This product may contain substance(s) which are known to the State of California to cause cancer or reproductive harm.

Chemical Name	CAS-No	California Prop. 65
Quartz silica	14808-60-7	Carcinogen

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania	Illinois	Rhode Island
Quartz silica	X	X	X		

U.S. EPA Label Information
EPA Pesticide Registration Number Not applicable

16. OTHER INFORMATION

NFPA	**Health Hazard** 1	**Flammability** 0	**Instability** 0	**Physical and Chemical Hazards** -
HMIS	**Health Hazard** 1	**Flammability** 0	**Physical Hazard** 0	**Personal Protection** X

Prepared By Product Stewardship
23 British American Blvd.
Latham, NY 12110
1-800-572-6501
Issuing Date 12-Jan-2016
Revision Date 26-Jul-2016
Revision Note Change to classification.

General Disclaimer
The information provided on this SDS is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of 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:

HEALTH	*	2
FLAMMABILITY		3
PHYSICAL		0
PPE		x

HMIS:

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.

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

Percent Volatile: 100.0 % by weight.

10. STABILITY AND REACTIVITY

Stability: Unstable [ ] Stable [X]

Conditions To Avoid - Instability: No data available.

Incompatibility - Materials To Avoid: Avoid contact with acids, aldehydes, alkalies, amines, ammonia, oxidizing agents, reducing agents, chlorine compounds.

May form explosive mixtures with chromic anhydride, chromyl alcohol, hexachloromelamine, hydrogen peroxide, permonosulfuric acid, potassium tertbutoxide, and thioglycol. Strong oxidizers.

Hazardous Decomposition or Byproducts: Decomposition may produce carbon monoxide, carbon dioxide, and other asphyxiants.

Possibility of Hazardous Reactions: Will occur [ ] Will not occur [X]

Conditions To Avoid - Hazardous Reactions: No data available.

11. TOXICOLOGICAL INFORMATION

Toxicological Information: NEUROTOXICITY: Clinical studies and case reports suggest slight neurological effects, mostly of the subjective type, in individuals exposed to varying concentrations of acetone. In most studies the subjects report discomfort, irritation of the eyes and respiratory passages, mood swings, and nausea following exposure to acetone vapor at concentrations of 500 ppm or higher. The fact that the effects subside following termination of exposure indicates that acetone may be the active compound, rather than a metabolite. Case reports of accidental poisoning also indicate that the effects (e.g., lethargy and drowsiness) are short-lived.

Carcinogenicity/Other Information:

CAS# 67-64-1:
Standard Draize Test, Eyes, Species: Rabbit, 20.00 MG, Severe.
Result:
Behavioral: Change in motor activity (specific assay).
Behavioral: Alteration of classical conditioning.
- American Journal of Ophthalmology., Ophthalmic Pub. Co., 435 N. Michigan Ave., Suite 1415, Chicago, IL 60611, Vol/p/yr: 29,1363, 1946

ACGIH A4 - Not Classifiable as a Human Carcinogen.

CAS #	Hazardous Components (Chemical Name)	NTP	IARC	ACGIH	OSHA
67-64-1	Acetone {2-Propanone}	n.a.	n.a.	A4	n.a.

12. ECOLOGICAL INFORMATION

No data available.

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.

Safety Data Sheet

RUST-OLEUM CORPORATION
* Trusted Quality Since 1921 *
www.rustoleum.com

1. Identification

Product Name: STRUST +SSPR 6PK GLOSS BLACK

Revision Date: 5/9/2017

Product Identifier: 7779830

Supercedes Date: 9/20/2016

Product Use/Class: Topcoat/Aerosols

Supplier:
Rust-Oleum Corporation
11 Hawthorn Parkway
Vernon Hills, IL 60061
USA

Manufacturer:
Rust-Oleum Corporation
11 Hawthorn Parkway
Vernon Hills, IL 60061
USA

Preparer: Regulatory Department

Emergency Telephone: 24 Hour Hotline: 847-367-7700

2. Hazard Identification

Classification

Symbol(s) of Product

Signal Word
Danger

Possible Hazards
34% of the mixture consists of ingredient(s) of unknown acute toxicity.

GHS HAZARD STATEMENTS

Carcinogenicity, category 1B	H350	May cause cancer.
Compressed Gas	H280	Contains gas under pressure; may explode if heated.
Eye Irritation, category 2	H319	Causes serious eye irritation.
Flammable Aerosol, category 1	H222	Extremely flammable aerosol.
Germ Cell Mutagenicity, category 1B	H340	May cause genetic defects.
STOT, repeated exposure, category 2	H373	May cause damage to organs through prolonged or repeated exposure.
STOT, single exposure, category 3, NE	H336	May cause drowsiness or dizziness.

GHS LABEL PRECAUTIONARY STATEMENTS

P201	Obtain special instructions before use.
P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P211	Do not spray on an open flame or other ignition source.
P251	Do not pierce or burn, even after use.
P260	Do not breathe dust/fume/gas/mist/vapors/spray.
P264	Wash hands thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P304+P340	IF INHALED: Remove person to fresh air and keep comfortable for breathing.

P305+P351+P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308+P313	IF exposed or concerned: Get medical advice/attention.
P312	Call a POISON CENTER or doctor/physician if you feel unwell.
P337+P313	If eye irritation persists: Get medical advice/attention.
P403+P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P410+P403	Protect from sunlight. Store in a well-ventilated place.
P410+P412	Protect from sunlight. Do no expose to temperatures exceeding 50°C/ 122°F.
P501	Dispose of contents/container in accordance with local, regional and national regulations.

3. Composition/Information On Ingredients

HAZARDOUS SUBSTANCES

Chemical Name	CAS-No.	Wt.% Range	GHS Symbols	GHS Statements
Acetone	67-64-1	25-50	GHS02-GHS07	H225-319-332-336
Propane	74-98-6	10-25	GHS04	H280
n-Butane	106-97-8	2.5-10	GHS04	H280
n-Butyl Acetate	123-86-4	2.5-10	GHS02-GHS07	H226-336
Barium Sulfate	7727-43-7	2.5-10	Not Available	Not Available
Xylenes (o-, m-, p- isomers)	1330-20-7	2.5-10	GHS02-GHS07	H226-315-319-332
Dimethyl Carbonate	616-38-6	2.5-10	GHS02	H225
Naphtha, Petroleum, Hydrotreated Light	64742-49-0	2.5-10	GHS08	H304
Carbon Black	1333-86-4	1.0-2.5	Not Available	Not Available
Propylene Glycol Monobutyl Ether	5131-66-8	1.0-2.5	GHS07	H302-315-319
Ethylbenzene	100-41-4	1.0-2.5	GHS02-GHS07-GHS08	H225-304-332-351-373
Naphtha, Hydrotreated Heavy	64742-48-9	0.1-1.0	GHS08	H304-340-350

4. First-aid Measures

FIRST AID - EYE CONTACT: Immediately flush eyes with plenty of water for at least 15 minutes holding eyelids open. Get medical attention. Do NOT allow rubbing of eyes or keeping eyes closed.

FIRST AID - SKIN CONTACT: Wash skin with soap and water. Remove contaminated clothing. Get medical attention if irritation develops or persists.

FIRST AID - INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention. Do NOT use mouth-to-mouth resuscitation. If you experience difficulty in breathing, leave the area to obtain fresh air. If continued difficulty is experienced, get medical assistance immediately.

FIRST AID - INGESTION: Aspiration hazard: Do not induce vomiting or give anything by mouth because this material can enter the lungs and cause severe lung damage. Get immediate medical attention. If swallowed, get medical attention.

5. Fire-fighting Measures

EXTINGUISHING MEDIA: Alcohol Film Forming Foam, Carbon Dioxide, Dry Chemical, Dry Sand, Water Fog

UNUSUAL FIRE AND EXPLOSION HAZARDS: FLASH POINT IS LESS THAN 20°F. EXTREMELY FLAMMABLE LIQUID AND VAPOR!Water spray may be ineffective. Closed containers may explode when exposed to extreme heat due to buildup of steam. Closed containers may explode when exposed to extreme heat. Vapors may form explosive mixtures with air. Vapors can travel to a source of ignition and flash back. Keep containers tightly closed. Isolate from heat, electrical equipment, sparks and open flame. Perforation of the pressurized container may cause bursting of the can. No unusual fire or explosion hazards noted.

SPECIAL FIREFIGHTING PROCEDURES: Water may be used to cool closed containers to prevent pressure buildup and possible autoignition or explosion. Full protective equipment including self-contained breathing apparatus should be used. Evacuate area and fight fire from a safe distance. Use water spray to keep fire-exposed containers cool. Containers may explode when heated.

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: Contain spilled liquid with sand or earth. DO NOT use combustible materials such as sawdust. Isolate the hazard area and deny entry to unnecessary and unprotected personnel. Remove all sources of ignition, ventilate area and remove with inert absorbent and non-sparking tools. Dispose of according to local, state (provincial) and federal regulations. Do not incinerate closed containers. Ventilate area, isolate spilled material, and remove with inert absorbent. Dispose of contaminated absorbent, container, and unused contents in accordance with local, state, and federal regulations.

7. Handling and Storage

HANDLING: Wash thoroughly after handling. Wash hands before eating. Remove contaminated clothing and launder before reuse. Use only in a well-ventilated area. Use only with adequate ventilation. Follow all MSDS/label precautions even after container is emptied because it may retain product residues. Avoid breathing fumes, vapors, or mist. Avoid contact with eyes, skin and clothing.

STORAGE: Store in a dry, well ventilated place. Keep container tightly closed when not in use. Keep containers tightly closed. Isolate from heat, electrical equipment, sparks and open flame. Contents under pressure. Do not store above 120 ° F. Store large quantities in buildings designed and protected for storage of flammable aerosols. Keep away from heat, sparks, flame and sources of ignition. Contents under pressure. Do not expose to heat or store above 120 ° F. Avoid excess heat. Product should be stored in tightly sealed containers and protected from heat, moisture, and foreign materials.

8. Exposure Controls/Personal Protection

Chemical Name	CAS-No.	Weight % Less Than	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA PEL-CEILING
Acetone	67-64-1	30.0	250 ppm	500 ppm	1000 ppm	N.E.
Propane	74-98-6	20.0	N.E.	N.E.	1000 ppm	N.E.
n-Butane	106-97-8	10.0	N.E.	1000 ppm	N.E.	N.E.
n-Butyl Acetate	123-86-4	10.0	50 ppm	150 ppm	150 ppm	N.E.
Barium Sulfate	7727-43-7	10.0	5 mg/m3	N.E.	15 mg/m3	N.E.
Xylenes (o-, m-, p- isomers)	1330-20-7	10.0	100 ppm	150 ppm	100 ppm	N.E.
Dimethyl Carbonate	616-38-6	5.0	N.E.	N.E.	N.E.	N.E.
Naphtha, Petroleum, Hydrotreated Light	64742-49-0	5.0	N.E.	N.E.	N.E.	N.E.
Carbon Black	1333-86-4	5.0	3 mg/m3	N.E.	3.5 mg/m3	N.E.
Propylene Glycol Monobutyl Ether	5131-66-8	5.0	N.E.	N.E.	N.E.	N.E.
Ethylbenzene	100-41-4	5.0	20 ppm	N.E.	100 ppm	N.E.
Naphtha, Hydrotreated Heavy	64742-48-9	1.0	N.E.	N.E.	N.E.	N.E.

PERSONAL PROTECTION

ENGINEERING CONTROLS: Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Use explosion-proof ventilation equipment. Provide general dilution of local exhaust ventilation in volume and pattern to keep TLV of hazardous ingredients below acceptable limits. Prevent build-up of vapors by opening all doors and windows to achieve cross-ventilation.

RESPIRATORY PROTECTION: A respiratory protection program that meets OSHA 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use. A NIOSH/MSHA approved air purifying respirator with organic vapor cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits.

SKIN PROTECTION: Use gloves to prevent prolonged skin contact. Use impervious gloves to prevent skin contact and absorption of this material through the skin. Nitrile or Neoprene gloves may afford adequate skin protection.

EYE PROTECTION: Use safety eyewear designed to protect against splash of liquids.

OTHER PROTECTIVE EQUIPMENT: Refer to safety supervisor or industrial hygienist for further guidance regarding types of personal protective equipment and their applications. Refer to safety supervisor or industrial hygienist for further information regarding personal protective equipment and its application.

HYGIENIC PRACTICES: Wash thoroughly with soap and water before eating, drinking or smoking. Remove contaminated clothing immediately and launder before reuse.

9. Physical and Chemical Properties

Appearance:	Aerosolized Mist	**Physical State:**	Liquid
Odor:	Solvent Like	**Odor Threshold:**	N.E.
Relative Density:	0.777	**pH:**	N.A.
Freeze Point, °C:	N.D.	**Viscosity:**	N.D.
Solubility in Water:	Slight	**Partition Coefficient, n-octanol/ water:**	N.D.
Decompostion Temp., °C:	N.D.		
Boiling Range, °C:	-37 - 232	**Explosive Limits, vol%:**	0.9 - 13.0
Flammability:	Supports Combustion	**Flash Point, °C:**	-96
Evaporation Rate:	Faster than Ether	**Auto-ignition Temp., °C:**	N.D.
Vapor Density:	Heavier than Air	**Vapor Pressure:**	N.D.

(See "Other information" Section for abbreviation legend)

10. Stability and Reactivity

CONDITIONS TO AVOID: Avoid temperatures above 120°F (49°C). Avoid contact with strong acid and strong bases. Avoid all possible sources of ignition.

INCOMPATIBILITY: Incompatible with strong oxidizing agents, strong acids and strong alkalies.

HAZARDOUS DECOMPOSITION: By open flame, carbon monoxide and carbon dioxide. When heated to decomposition, it emits acrid smoke and irritating fumes. Contains solvents which may form carbon monoxide, carbon dioxide, and formaldehyde.

HAZARDOUS POLYMERIZATION: Will not occur under normal conditions.

STABILITY: This product is stable under normal storage conditions.

11. Toxicological information

EFFECTS OF OVEREXPOSURE - EYE CONTACT: Causes Serious Eye Irritation

EFFECTS OF OVEREXPOSURE - SKIN CONTACT: Substance may cause slight skin irritation. May cause skin irritation. Allergic reactions are possible. Prolonged or repeated contact may cause skin irritation.

EFFECTS OF OVEREXPOSURE - INHALATION: Harmful if inhaled. High gas, vapor, mist or dust concentrations may be harmful if inhaled. Avoid breathing fumes, spray, vapors, or mist. High vapor concentrations are irritating to the eyes, nose, throat and lungs. Prolonged or excessive inhalation may cause respiratory tract irritation.

EFFECTS OF OVEREXPOSURE - INGESTION: Harmful if swallowed. Aspiration hazard if swallowed; can enter lungs and cause damage.

EFFECTS OF OVEREXPOSURE - CHRONIC HAZARDS: May cause central nervous system disorder (e.g., narcosis involving a loss of coordination, weakness, fatigue, mental confusion, and blurred vision) and/or damage. High concentrations may lead to central nervous system effects (drowsiness, dizziness, nausea, headaches, paralysis, and blurred vision) and/or damage. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Overexposure to xylene in laboratory animals has been associated with liver abnormalities, kidney, lung, spleen, eye and blood damage as well as reproductive disorders. Effects in humans, due to chronic overexposure, have included liver, cardiac abnormalities and nervous system damage. Contains carbon black. Chronic inflammation, lung fibrosis, and lung tumors have been observed in some rats experimentally exposed for long periods of time to excessive concentrations of carbon black and several insoluble fine dust particles. Tumors have not been observed in other animal species (i.e., mouse and hamster) under similar circumstances and study conditions. Epidemiological studies of North American workers show no evidence of clinically significant adverse health effects due to occupational exposure to carbon black.

Carbon black is listed as a Group 2B-"Possibly carcinogenic to humans" by IARC and is proposed to be listed as A4- "not classified as a human carcinogen" by the American Conference of Governmental Industrial Hygienists. Significant exposure is not anticipated during brush application or drying. Risk of overexposure depends on duration and level of exposure to dust from repeated sanding of surfaces or spray mist and the actual concentration of carbon black in the formula. IARC lists Ethylbenzene as a possible human carcinogen (group 2B).

PRIMARY ROUTE(S) OF ENTRY: Eye Contact, Ingestion, Inhalation, Skin Absorption, Skin Contact

ACUTE TOXICITY VALUES

The acute effects of this product have not been tested. Data on individual components are tabulated below:

CAS-No.	Chemical Name	Oral LD50	Dermal LD50	Vapor LC50
67-64-1	Acetone	5800 mg/kg Rat	>15700 mg/kg Rabbit	50.1 mg/L Rat
74-98-6	Propane	N.I.	N.I.	658 mg/L Rat

106-97-8	n-Butane	N.I.	N.I.	658 mg/L Rat
123-86-4	n-Butyl Acetate	10768 mg/kg Rat	>17600 mg/kg Rabbit	> 21 mg/L Rat
1330-20-7	Xylenes (o-, m-, p- isomers)	3500 mg/kg Rat	>4350 mg/kg Rabbit	29.08 mg/L Rat
616-38-6	Dimethyl Carbonate	13000 mg/kg Rat	>5000 mg/kg Rabbit	140 mg/L Rat
64742-49-0	Naphtha, Petroleum, Hydrotreated Light	>5000 mg/kg Rat	>3160 mg/kg Rabbit	>4951 mg/L Rat
1333-86-4	Carbon Black	>15400 mg/kg Rat	N.I.	N.I.
5131-66-8	Propylene Glycol Monobutyl Ether	1900 mg/kg Rat	N.I.	N.I.
100-41-4	Ethylbenzene	3500 mg/kg Rat	15400 mg/kg Rabbit	17.4 mg/L Rat
64742-48-9	Naphtha, Hydrotreated Heavy	>5000 mg/kg Rat	>3160 mg/kg Rabbit	N.I.

N.I. - No Information

12. Ecological Information

ECOLOGICAL INFORMATION: Product is a mixture of listed components. Product is a mixture of listed components.

13. Disposal Information

DISPOSAL INFORMATION: Dispose of material in accordance to local, state, and federal regulations and ordinances. Do not allow to enter waterways, wastewater, soil, storm drains or sewer systems.

14. Transport Information

	Domestic (USDOT)	International (IMDG)	Air (IATA)	TDG (Canada)
UN Number:	N.A.	1950	1950	N.A.
Proper Shipping Name:	Paint Products in Limited Quantities	Aerosols	Aerosols	Paint Products in Limited Quantities
Hazard Class:	N.A.	2.1	2.1	N.A.
Packing Group:	N.A.	N.A.	N.A.	N.A.
Limited Quantity:	Yes	Yes	Yes	Yes

15. Regulatory Information

U.S. Federal Regulations:

CERCLA - SARA Hazard Category

This product has been reviewed according to the EPA 'Hazard Categories' promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

Fire Hazard, Pressure Hazard, Acute Health Hazard, Chronic Health Hazard

Sara Section 313:

This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR part 372:

Chemical Name	CAS-No.
Xylenes (o-, m-, p- isomers)	1330-20-7
Dimethyl Carbonate	616-38-6
Ethylbenzene	100-41-4

Toxic Substances Control Act:

This product contains the following chemical substances subject to the reporting requirements of TSCA 12(b) if exported from the United States:

No TSCA 12(b) components exist in this product.

16. Other Information

HMIS RATINGS

Health:	2*	**Flammability:**	4	**Physical Hazard:**	0	**Personal Protection:**	X

NFPA RATINGS

Health:	2	**Flammability:**	4	**Instability**	0

VOLATILE ORGANIC COMPOUNDS, g/L: 530

SDS REVISION DATE: 5/9/2017

REASON FOR REVISION:
Regulatory Formula Source Changed
Product Composition Changed
Substance and/or Product Properties Changed in Section(s):
02 - Hazard Identification
09 - Physical & Chemical Properties
16 - Other Information
Statement(s) Changed

Legend: N.A. - Not Applicable, N.E. - Not Established, N.D. - Not Determined

Rust-Oleum Corporation believes, to the best of its knowledge, information and belief, the information contained herein to be accurate and reliable as of the date of this safety data sheet. However, because the conditions of handling, use, and storage of these materials are beyond our control, we assume no responsibility or liability for personal injury or property damage incurred by the use of these materials. Rust-Oleum Corporation makes no warranty, expressed or implied, regarding the accuracy or reliability of the data or results obtained from their use. All materials may present unknown hazards and should be used with caution. The information and recommendations in this material safety data sheet are offered for the users' consideration and examination. It is the responsibility of the user to determine the final suitability of this information and to comply with all applicable international, federal, state, and local laws and regulations.

MATERIAL SAFETY DATA SHEET (MSDS)

Section 1: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **TAP Super Hard Epoxy Hardener**
CHEMICAL FAMILY: Aliphatic Amines
MFR'S NAME: Rhino Linings, 9151 Rehco Road, San Diego, CA 92121
EMERGENCY PHONE: 800/424--9300 (Chemtrec) GENERAL INFORMATION: 858/410-6044 (Rhino)

Section 2: COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT	%	CAS #	EXPOSURE LIMITS
Reaction products w/Phenol/Formaldehyde	40-70	32610-77-8	N/E
Triethylenetetramine	15-40	112-24-3	N/E
Phenol	15-40	108-95-2	N/E

Section 3: HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Epoxy hardener solution. Certain individuals may have pre-existing skin or respiratory conditions causing a sensitivity or allergy which manifests as various reactions. Heating or spraying this product or the mixed parts increases potential health hazards. Health and safety professionals should examine all handling procedures and remedy any health and safety hazards.

POTENTIAL HEALTH EFFECTS:

EYE:
- May cause severe irritation.

SKIN:
- May cause moderate irritation.

INGESTION:
- May inflame or damage the G.I. tract. Ingestion may be harmful.

INHALATION:
- May cause severe irritation.

CHRONIC EFFECTS:
- Repeated exposure may cause irritation or sensitization.

SIGNS & SYMPTOMS:
- Skin rash, irritation, reddening, or eczema; Breathing irritation or difficulty.

Section 4: FIRST AID MEASURES

♦USE APPROPRIATE BLOOD-BORNE PATHOGENS PROTECTIONS♦

EYE:
- Hold eyelids apart and flood with copious amounts of water. Seek medical attention.

SKIN:
- Remove excess product. Wash thoroughly with soap and water. If irritation persists, seek medical attention.

INGESTION:
- Do not induce vomiting unless directed by medical personnel. Seek medical attention.

INHALATION:
- Remove to fresh air. Seek medical attention.

Section 5: FIRE FIGHTING MEASURES

FLASH POINT: 135°C 276°F UEL: N.D.A.% LEL: N.D.A. VAPOR DENSITY: N.D.A.
NFPA FLAMMABILITY RATING: 1 AUTOIGNITION: N.D.A.
COMBUSTION PRODUCTS: CO, CO_2, NO_x, & misc. hydrocarbons
SPECIAL HAZARDS: Firefighters should wear butyl rubber boots, gloves, and body suit with SCBA. May generate toxic and irritating combustion products. Use DOT Response Guide #153.
EXTINGUISHING MEDIA: Use foam, CO_2, dry chemical, water fog.
FIRE FIGHTER INSTRUCTIONS: Stay upwind. Wear at least full bunker gear and SCBA.

Section 6: ACCIDENTAL RELEASE MEASURES

Isolate the spill area. Keep out of sewer and storm drains. Stop the leak and contain the spill. Vacuum, scoop, or absorb spilled with non-combustible materials. Clean spill residues with soap and water.

Section 7: HANDLING AND STORAGE

Avoid skin and eye contact and breathing vapors by appropriate measures. Do not eat or smoke while handling this product. Wash thoroughly with soap and water after handling or exposure to this product.

Store in original sealed container at ambient temperatures (65°-80°F) in dry, well-ventilated areas.

Section 8: EXPOSURE CONTROLS, PERSONAL PROTECTION

For Personal exposure Limits (PEL), Threshold Limit Values (TLV), or other exposure limits, see Sec.2.
GENERAL: Provide adequate ventilation that will keep airborne concentration at a minimum.
EYE/FACE: Safety glasses or splash goggles with face shield.
SKIN: Butyl or nitrile rubber chemical gloves. Don chemical resistant clothing where exposure may occur.
RESPIRATORY: NIOSH approved respirator with organic vapor/HEPA filter cartridges.
OTHER: Decontaminate or discard clothing and materials that have come in contact with this product.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: amber liquid	ODOR: phenol	PHYSICAL STATE: liquid
VAPOR PRESS: <1 mm/Hg	SPECIFIC GRAVITY: 1.08	pH: alkaline
BOILING PT: N.D.A.	MELT PT: N/A	SOLUBILITY IN H_2O: moderate

Section 10: STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable.
INCOMPATIBILITY: Strong oxidizers, acids, epoxy resins in uncontrolled conditions; contact with other unpolymerized monomers or polymers.
HAZARDOUS POLYMERIZATION: Will not occur.
HAZARDOUS DECOMPOSITION: None known, other than Sec. 5's Combustion Products.

Section 11: TOXICOLOGICAL INFORMATION

Oral: N.D.A.
Dermal: N.D.A.
Inhalation: N.D.A.
Carcinogens under OSHA, ACGIH, NTP, IARC, or Other: None ≥ 0.1%.

Section 12: ECOLOGICAL INFORMATION

N.D.A.

Section 13: DISPOSAL CONSIDERATIONS

Dispose of in accordance with applicable federal, state, and local laws and regulations.

Section 14: TRANSPORT INFORMATION

DOT: Not Regulated.
IATA:
IMO:

Section 15: REGULATORY INFORMATION

OSHA: 1910.1200 Hazardous Chemical “Irritant”, “Sensitizer”.
TSCA: Contains listed ingredients.
SARA III: Sec311 & 312 Immediate Health Hazard; Sec313 Chemical above de minimus level: Phenol.
CA PROP. 65 NOTICE: Not listed.
NFPA: HEALTH 2 FIRE 1 REACTIVITY 0 OTHER N/A

Section 16: CANADIAN REGULATORY INFORMATION

WHMIS: Hazard Classification: Class D Division 2A, Class D Division 2B.
WHMIS Symbols: Stylized T.
Trade Secrets: N/A.
Hazardous Products Act Information: This product MSDS contains ingredients which are Controlled and/or on the Ingredient Disclosure List (HPA sections 13 and 14).

ABBREVIATIONS: N/A = not applicable; N.D.A. = no data available; NE = not established

END OF MSDS

MATERIAL SAFETY DATA SHEET (MSDS)

Section 1: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **TAP Super Hard Epoxy Resin**
Chemical Family: Epoxy Resin Mixture
MFR'S NAME: Rhino Linings, 9151 Rehco Road, San Diego, CA 92121
EMERGENCY PHONE: 800/424--9300 (Chemtrec) GENERAL INFORMATION: 858/410-6044 (Rhino)

Section 2: COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT	%	CAS #	EXPOSURE LIMITS
Bisphenol A Reaction Product	<80	25085-99-8	N/E
Aliphatic Glycidyl Ether	>10	68609-97-2	N/E
Proprietary ingredients	>10	Trade secret	N/E

Section 3: HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Epoxy resin solution. Certain individuals may have pre-existing skin or respiratory conditions causing a sensitivity or allergy which manifests as various reactions. Heating or spraying this product or the mixed parts increases potential health hazards. Health and Safety personnel should examine the handling procedures and remedy any existing or potential health and safety hazards.

POTENTIAL HEALTH EFFECTS:

EYE:
- May cause irritation.

SKIN:
- May cause irritation. Low dermal absorption hazard.

INGESTION:
- May inflame or damage the G.I. tract. Ingestion may be harmful.

INHALATION:
- May cause irritation.

CHRONIC EFFECTS:
- Repeated exposure may cause irritation and sensitization.

SIGNS & SYMPTOMS:
- Skin rash, irritation, reddening, or eczema; breathing irritation or difficulty.

Section 4: FIRST AID MEASURES

♦USE APPROPRIATE BLOOD-BORNE PATHOGENS PROTECTIONS♦

EYE:
- Hold eyelids apart and flood with copious amounts of water. Seek medical attention.

SKIN:
- Remove excess product. Wash thoroughly with soap and water. If irritation persists, seek medical attention.

INGESTION:
- Do not induce vomiting unless directed by medical personnel. Seek medical attention.

INHALATION:
- Remove to fresh air. Seek medical attention.

Section 5: FIRE FIGHTING MEASURES

FLASH POINT: 177°C 350°F UEL: N/A LEL: N/A VAPOR DENSITY: N/A
NFPA FLAMMABILITY RATING: 1 AUTOIGNITION: 300°C 570°F
COMBUSTION PRODUCTS: CO, CO_2, NO_x, & misc. hydrocarbons.
SPECIAL HAZARDS: Pre-sensitization to epoxy.
EXTINGUISHING MEDIA: Use foam, CO_2, dry chemical, water fog.
FIRE FIGHTER INSTRUCTIONS: Stay upwind. Wear at least full bunker gear and SCBA.

Section 6: ACCIDENTAL RELEASE MEASURES

Isolate spill area. Keep out of sewer and storm drains. Stop the leak and contain the spill. Vacuum, scoop, or absorb spill with non-combustible materials. Clean up spill residues with soap and water.

Section 7: HANDLING AND STORAGE

Avoid skin and eye contact and breathing vapors or mists by appropriate measures. Do not eat or smoke while handling this product. Wash thoroughly after handling or exposure to this product.

Store in original sealed container at ambient temperatures (65°-80°F) in dry, well-ventilated areas.

Section 8: EXPOSURE CONTROLS, PERSONAL PROTECTION

For Personal Exposure Limits (PEL), Threshold Limit Values (TLV) or other exposure limits, see Sec. 2.
GENERAL: Provide ventilation that will keep airborne concentration at a minimum.
EYE/FACE: Safety glasses or splash goggles with face shield.
SKIN: Butyl or nitrile rubber chemical gloves. Don chemical resistant clothing where exposure may occur.
RESPIRATORY: NIOSH approved respirator with organic vapor/HEPA filter cartridges.
OTHER: Decontaminate or discard clothing and materials that have come in contact with this product.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: clear syrup ODOR: slightly sweet PHYSICAL STATE: liquid
VAPOR PRESS: N.D.A. SPECIFIC GRAVITY: 1.10 pH: N.D.A.
BOILING PT: N.D.A. MELT PT: N/A SOLUBILITY IN H_2O: slightly

Section 10: STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable.
INCOMPATIBILITY: Strong acids, caustics, oxidizers, and epoxy hardeners in an uncontrolled condition.
HAZARDOUS POLYMERIZATION: Will not occur.
HAZARDOUS DECOMPOSITION: None known, other than Sec. 5's Combustion Products.

Section 11: TOXICOLOGICAL INFORMATION

Oral: N.D.A.
Dermal: N.D.A.
Inhalation: N.D.A.
Carcinogens under OSHA, ACGIH, NTP, IARC, or Other: None ≥ 0.1%.

Section 12: ECOLOGICAL INFORMATION

N.D.A.

Section 13: DISPOSAL CONSIDERATIONS

Dispose of in accordance with applicable federal, state, and local laws and regulations.

Section 14: TRANSPORT INFORMATION

DOT: Not Regulated.
IATA:
IMO:

Section 15: REGULATORY INFORMATION

OSHA: 29 CFR 1910.1200 Hazardous Chemical “Irritant”, “Sensitizer”.
TSCA: Ingredients listed.
SARA III: Sec311 & 312 Immediate Health Hazard; Sec313 Not listed.
CA PROP. 65 NOTICE: Not listed.
NFPA: Health 1 Fire 1 Reactivity 0 Other N/A

Section 16: CANADIAN REGULATORY INFORMATION

WHMIS: Hazard Classification: Class D2B Skin Sensitizer. Refer to MSDS for specific warnings.
WHMIS Symbols: Stylized T.
WHMIS Trade Secret Registry Numbers: None.
Hazardous Products Act Information: This product MSDS contains ingredients which are Controlled and/or on the Ingredient Disclosure List (HPA sections 13 and 14).

ABBREVIATIONS: N/A = not applicable; N.D.A. = no data available; NE = not established

END OF MSDS

Safety Data Sheet

1 - Identification

Product Name: WD-40 Multi-Use Product Aerosol *NOT FOR SALE IN CALIFORNIA* **Product Use: Lubricant, Penetrant, Drives Out Moisture, Removes and Protects Surfaces From Corrosion** **Restrictions on Use: None identified** **SDS Date Of Preparation: 07/20/2014**	**Manufacturer: WD-40 Company** **Address: 1061 Cudahy Place (92110)** **P.O. Box 80607** **San Diego, California, USA** **92138 –0607** **Telephone:** **Emergency only: 1-888-324-7596 (PROSAR)** **Information: 1-888-324-7596** **Chemical Spills: 1-800-424-9300 (Chemtrec)** **1-703-527-3887 (International Calls)**

2 – Hazards Identification

Hazcom 2012/GHS Classification:
Flammable Aerosol Category 1
Gas Under Pressure: Compressed Gas
Aspiration Toxicity Category 1

Note: This product is a consumer product and is labeled in accordance with the US Consumer Product Safety Commission regulations which take precedence over OSHA Hazard Communication labeling. The actual container label will not include the label elements below. The labeling below applies to industrial/professional products.

Label Elements:

DANGER!
Extremely Flammable Aerosol.
Contains gas under pressure; may explode if heated.
May be fatal if swallowed and enters airways.

Prevention
Keep away from heat, sparks, open flames, hot surfaces – No smoking.
Do not spray on an open flame or other ignition source.
Pressurized container: Do not pierce or burn, even after use.

Response
IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting.

Storage
Store locked up.
Protect from sunlight. Do not expose to temperatures exceeding 50°C/122°F. Store in a well-ventilated place.

Disposal
Dispose of contents and container in accordance with local and national regulations.

3 - Composition/Information on Ingredients

Ingredient	CAS #	Weight Percent	US Hazcom 2012/ GHS Classification
Aliphatic Hydrocarbon	64742-47-8	45-50	Flammable Liquid Category 3

			Aspiration Toxicity Category 1
Petroleum Base Oil	64742-56-9 64742-65-0 64742-53-6 64742-54-7 64742-71-8	<25	Not Hazardous
LVP Aliphatic Hydrocarbon	64742-47-8	12-18	Aspiration Toxicity Category 1
Carbon Dioxide	124-38-9	2-3	Simple Asphyxiant Gas Under Pressure, Compressed Gas
Non-Hazardous Ingredients	Mixture	<10	Not Hazardous

Note: The exact percentages are a trade secret.

4 – First Aid Measures

Ingestion (Swallowed): Aspiration Hazard. DO NOT induce vomiting. Call physician, poison control center or the WD-40 Safety Hotline at 1-888-324-7596 immediately.
Eye Contact: Flush thoroughly with water. Remove contact lenses if present after the first 5 minutes and continue flushing for several more minutes. Get medical attention if irritation persists.
Skin Contact: Wash with soap and water. If irritation develops and persists, get medical attention.
Inhalation (Breathing): If irritation is experienced, move to fresh air. Get medical attention if irritation or other symptoms develop and persist.
Signs and Symptoms of Exposure: May cause eye and respiratory irritation. Inhalation may cause coughing, headache and dizziness. Skin contact may cause drying of the skin.
Indication of Immediate Medical Attention/Special Treatment Needed: Immediate medical attention is needed for ingestion.

5 – Fire Fighting Measures

Suitable (and unsuitable) Extinguishing Media: Use water fog, dry chemical, carbon dioxide or foam. Do not use water jet or flooding amounts of water. Burning product will float on the surface and spread fire.
Specific Hazards Arising from the Chemical: Contents under pressure. Keep away from ignition sources and open flames. Exposure of containers to extreme heat and flames can cause them to rupture often with violent force. Vapors are heavier than air and may travel along surfaces to remote ignition sources and flash back. Combustion will produce oxides of carbon and hydrocarbons.
Special Protective Equipment and Precautions for Fire-Fighters: Firefighters should always wear positive pressure self-contained breathing apparatus and full protective clothing. Cool fire-exposed containers with water. Use shielding to protect against bursting containers.

6 – Accidental Release Measures

Personal Precautions, Protective Equipment and Emergency Procedures: Wear appropriate protective clothing (see Section 8). Eliminate all sources of ignition and ventilate area.
Methods and Materials for Containment/Cleanup: Leaking cans should be placed in a plastic bag or open pail until the pressure has dissipated. Contain and collect liquid with an inert absorbent and place in a container for disposal. Clean spill area thoroughly. Report spills to authorities as required.

7 – Handling and Storage

Precautions for Safe Handling: Avoid contact with eyes. Avoid prolonged contact with skin. Avoid breathing vapors or aerosols. Use only with adequate ventilation. Keep away from heat, sparks, pilot lights, hot surfaces and open flames. Unplug electrical tools, motors and appliances before spraying or bringing the can near any source of electricity. Electricity can burn a hole in the can and cause contents to burst into flames. To avoid serious burn injury, do not let the can touch battery terminals, electrical connections on motors or appliances or any other source of electricity. Wash thoroughly with soap and water after handling. Keep containers closed when not in use. Keep out of the reach of children. Do not puncture, crush or incinerate containers, even when empty.

Conditions for Safe Storage: Store in a cool, well-ventilated area, away from incompatible materials Do not store above 120°F or in direct sunlight. U.F.C (NFPA 30B) Level 3 Aerosol. Store away from oxidizers.

8 – Exposure Controls/Personal Protection

Chemical	Occupational Exposure Limits
Aliphatic Hydrocarbon	1200 mg/m3 TWA (manufacturer recommended)
Petroleum Base Oil	5 mg/m3 TWA, 10 mg/m3 STEL ACGIH TLV 5 mg/m3 TWA OSHA PEL
LVP Aliphatic Hydrocarbon	1200 mg/m3 TWA (manufacturer recommended)
Carbon Dioxide	5000 ppm TWA (OSHA/ACGIH), 30,000 ppm STEL (ACGIH)
Non-Hazardous Ingredients	None Established

The Following Controls are Recommended for Normal Consumer Use of this Product
Appropriate Engineering Controls: Use in a well-ventilated area.
Personal Protection:
Eye Protection: Avoid eye contact. Always spray away from your face.
Skin Protection: Avoid prolonged skin contact. Chemical resistant gloves recommended for operations where skin contact is likely.
Respiratory Protection: None needed for normal use with adequate ventilation.

For Bulk Processing or Workplace Use the Following Controls are Recommended
Appropriate Engineering Controls: Use adequate general and local exhaust ventilation to maintain exposure levels below that occupational exposure limits.
Personal Protection:
Eye Protection: Safety goggles recommended where eye contact is possible.
Skin Protection: Wear chemical resistant gloves.
Respiratory Protection: None required if ventilation is adequate. If the occupational exposure limits are exceeded, wear a NIOSH approved respirator. Respirator selection and use should be based on contaminant type, form and concentration. Follow OSHA 1910.134, ANSI Z88.2 and good Industrial Hygiene practice.
Work/Hygiene Practices: Wash with soap and water after handling.

9 – Physical and Chemical Properties

Appearance:	Light amber liquid	Flammable Limits: (Solvent Portion)	LEL: 0.6% UEL: 8%
Odor:	Mild petroleum odor	Vapor Pressure:	95-115 PSI @ 70°F
Odor Threshold:	Not established	Vapor Density:	Greater than 1 (air=1)
pH:	Not Applicable	Relative Density:	0.8 – 0.82 @ 60°F
Melting/Freezing Point	Not established	Solubilities:	Insoluble in water
Boiling Point/Range:	361 - 369°F (183 - 187°C)	Partition Coefficient; n-octanol/water:	Not established
Flash Point:	122°F (49°C) Tag Closed Cup (concentrate)	Autoignition Temperature:	Not established
Evaporation Rate:	Not established	Decomposition Temperature:	Not established
Flammability (solid, gas)	Flammable Aerosol	Viscosity:	2.79-2.96 cSt @ 100°F
VOC:	412 grams/liter (49.5%)	Pour Point:	-63°C (-81.4°F) ASTM D-97

10 – Stability and Reactivity

Reactivity: Not reactive under normal conditions
Chemical Stability: Stable

Possibility of Hazardous Reactions: May react with strong oxidizers generating heat.
Conditions to Avoid: Avoid heat, sparks, flames and other sources of ignition. Do not puncture or incinerate containers.
Incompatible Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide and carbon dioxide.

11 – Toxicological Information

Symptoms of Overexposure:
Inhalation: High concentrations may cause nasal and respiratory irritation and central nervous system effects such as headache, dizziness and nausea. Intentional abuse may be harmful or fatal.
Skin Contact: Prolonged and/or repeated contact may produce mild irritation and defatting with possible dermatitis.
Eye Contact: Contact may be irritating to eyes. May cause redness and tearing.
Ingestion: This product has low oral toxicity. Swallowing may cause gastrointestinal irritation, nausea, vomiting and diarrhea. This product is an aspiration hazard. If swallowed, can enter the lungs and may cause chemical pneumonitis, severe lung damage and death.
Chronic Effects: None expected.
Carcinogen Status: None of the components are listed as a carcinogen or suspect carcinogen by IARC, NTP, ACGIH or OSHA.
Reproductive Toxicity: None of the components is considered a reproductive hazard.

Numerical Measures of Toxicity:
The oral toxicity of this product is estimated to be greater than 5,000 mg/kg and the dermal toxicity greater than 2,000 mg/kg based on an assessment of the ingredients. This product is not classified as toxic by established criteria. It is an aspiration hazard.

12 – Ecological Information

Ecotoxicity: No specific aquatic toxicity data is currently available, however components of this product are not expected to be harmful to aquatic organisms
Persistence and Degradability: Component are readily biodegradable.
Bioaccumulative Potential: Bioaccumulation is not expected based on an assessment of the ingredients.
Mobility in Soil: No data available
Other Adverse Effects: None known

13 - Disposal Considerations

If this product becomes a waste, it would be expected to meet the criteria of a RCRA ignitable hazardous waste (D001). However, it is the responsibility of the generator to determine at the time of disposal the proper classification and method of disposal. Do not puncture or incinerate containers, even empty. Dispose in accordance with federal, state, and local regulations.

14 – Transportation Information_

DOT Surface Shipping Description:
UN1950, Aerosols, 2.1 Ltd. Qty (Note: Shipping Papers are not required for Limited Quantities unless transported by air or vessel – each package must be marked with the Limited Quantity Mark)
IMDG Shipping Description: Un1950, Aerosols, 2.1, LTD QTY
ICAO Shipping Description: UN1950, Aerosols, flammable, 2.1 NOTE: WD-40 does not test aerosol cans to assure that they meet the pressure and other requirements for transport by air. We do not recommend that our aerosol products be transported by air.

15 – Regulatory Information

U.S. Federal Regulations:
CERCLA 103 Reportable Quantity: This product is not subject to CERCLA reporting requirements, however, oil spills are reportable to the National Response Center under the Clean Water Act and many

states have more stringent release reporting requirements. Report spills required under federal, state and local regulations.
SARA TITLE III:
Hazard Category For Section 311/312: Acute Health, Fire Hazard, Sudden Release of Pressure
Section 313 Toxic Chemicals: This product contains the following chemicals subject to SARA Title III Section 313 Reporting requirements: None
Section 302 Extremely Hazardous Substances (TPQ): None
EPA Toxic Substances Control Act (TSCA) Status: All of the components of this product are listed on the TSCA inventory.
VOC Regulations: This product complies with the consumer product VOC limits of the US EPA and states adopting the OTC VOC rules but does not comply with CARB.
California Safe Drinking Water and Toxic Enforcement Act (Proposition 65): This product does not contain chemicals regulated under California Proposition 65.
Canadian Environmental Protection Act: One of the components is listed on the NDSL. All of the other ingredients are listed on the Canadian Domestic Substances List or exempt from notification.
Canadian WHMIS Classification: Class A (Compressed gas), Class B-5 (Flammable Aerosol)
This MSDS has been prepared according to the criteria of the Controlled Products Regulation (CPR) and the MSDS contains all of the information required by the CPR.

16 – Other Information:

HMIS Hazard Rating:
Health – 1 (slight hazard), Fire Hazard – 4 (severe hazard), Reactivity – 0 (minimal hazard)

Revision Date: July 20, 2014 Supersedes: May 23, 2014

Revision Summary: Convert to Hazcom 2012. Changes in all sections.

Prepared by: Industrial Health & Safety Consultants, Inc. Shelton, CT, USA

APPROVED By: I. Kowalski Regulatory Affairs Dept.

5049000/No.0015205

Requirements Verification

Requirements	Plan
General	● Demonstrations of previous years' rockets, timelines, designs, and manufacturing methods will ensure that all students on the team understand the project and every aspect of it. This will allow the team to maintain the policy of the rocket being 100% built by students, in addition to the reports, presentations, and all other project requirements. ● Previous years' timelines have been analyzed and improved upon to ensure completion of reports and timely completion of rocket.
Vehicle	● Time has been allotted to test all aspects of the rocket. This includes the altimeters that will be used to record the altitude of the rocket and release the recovery system, the payload, and integration of all body tubes, couplers, and the motor mount. ● Simulations will be analyzed throughout the design and manufacturing to ensure the rocket meets the minimum altitude, stability margin, and velocity requirements, in addition to the CG and CP. ● Prior to launch, the rocket will be thoroughly inspected. Attention will be closely paid to the dimensions to make sure they match what was used in simulations, thus ensuring it will launch successfully and safely.
Recovery System	● Altimeters will be tested to ensure they record accurate altitudes and deploy the recovery system at the right height. ● Simulations will be analyzed to ensure no part of the rocket will reach a kinetic energy higher than 75 ft-lbf. ● Inspections of the payload will be completed to make sure the altimeters in the avionics bay will only be used to deploy the parachutes, and not to fulfill the challenge.
Payload/Experiment	● The payload will be tested to ensure that all data types in the microcontroller will successfully be recorded during launch. ● Analysis of simulations will be used to confirm that our rocket is fin-stabilized with a static margin of 1 or greater. ● Inspection of the payload will be completed to ensure it is wired correctly.
Safety	● Analyses will be completed in order to be aware of all dangers during launch and to develop a launch and safety checklist. ● Demonstrations will be carried out by the safety officer to make all team members aware of safety measures during the design, construction, and launch of the rocket. ● Virtual inspections will be attended by team members to ensure rocket is ready and safe to launch.

UCLA Bearospace

2018-2019 Proposed Budget

	Expense	Company	Projected Units	Projected Unit Price	Projected Total Price
Structures	***Totals:***				$695
	Body Tube	Public Missiles	1	$250	$250
	Coupler	Public Missiles	1	$50	$50
	Fiberglass	TAP Plastics	1	$150	$150
	Motor Mount & Ring/Epoxy	Apogee Components	1	$100	$100
	Wood Sheets	McMaster	1	$65	$65
	Carbon Fiber Sheets	RockWest Composites	1	$60	$60
	Screws	McMaster	1	$20	$20
Electrical	***Totals:***				$112
	RRC3 Sport Altimeter	Missile Works	1	$70	$70
	SR44 Silver Oxide Battery	Amazon	2	$6	$11
	Battery Cell Holders (N-type)	Newark	2	$1	$2
	MPU6050 3 Axis Accelerometer (	Amazon	1	$5	$5
	SD Card Player Modules (x5)	Amazon	1	$6	$6
	Arduino Uno	Amazon	1	$17	$17
Tools	***Totals:***				$137
	Dremel Rotary Tool & Kit	Dremel/Amazon/HD	1	$130	$130
	Dremel Blades	Home Depot	1	$7	$7
Safety	***Totals:***				$146
	Gloves (100 pack)	Fisher Scientific	1	$31	$31
	Masks	Fisher Scientific	4	$15	$60
	Goggles		4	$9	$35
	Lab coats		2	$10	$20
Travel	***Totals:***				$2,110
	Toolbox	Arline	1	$25	$25
	Rocket Box	Airline	1	$25	$25
	Uber to LAX	Uber	1	$25	$25
	Plane Tickets (Round Trip)	Airline	6	$275	$1,650
	Baggage Fees	Airline	1	$25	$25
	Bus tickets	Coach USA	6	$50	$300
	Uber to hotel	Uber	1	$20	$20
	Uber to bus stop	Uber	1	$20	$20
	Uber to UCLA	Uber	1	$20	$20
	Grand Total				**$3,200**