2019 First Nation Launch

Critical Design Report

For Wisconsin Space Grant Consortium

University of California, Los Angeles
2-25-2019

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1 Team Information

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NAR/TRA Certification:	Level 3

2 Summary of Critical Design Report

2.1 Launch Vehicle Summary

Vehicle Dimensions and Mass

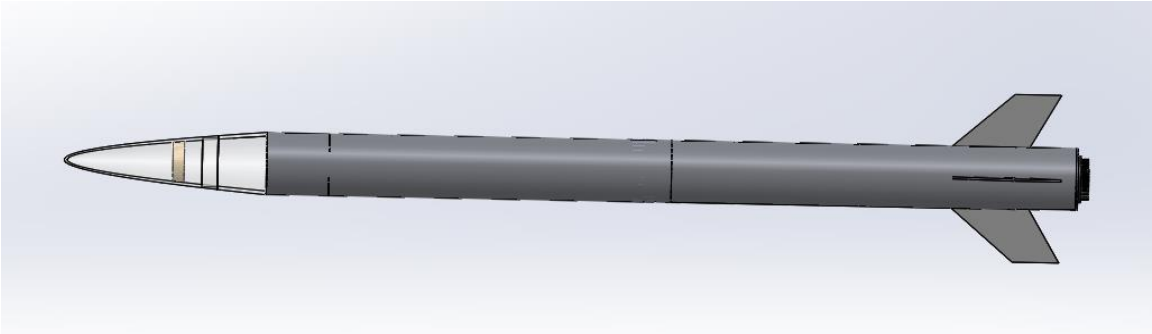

Figure 2.1.1: SolidWorks Model of Rocket Structure

Table 2.1.1: Part Materials and Dimensions

Part	Material	Dimensions	
Lower Body Tube	Carbon Fiber	Inner Diameter	3.866’’
		Wall Thickness	0.040’’
		Length	26’’
Upper Body Tube	Carbon Fiber	Inner Diameter	3.923’’
		Wall Thickness	0.040’’
		Length	26’’
Nosecone	3D-Printed PLA/ABS	Shoulder	3.82’’
		Wall Thickness	0.20’’
		Length	13’’
Fins	Fiberglass	Thickness	0.134’’
Coupler	Carbon Fiber	Outer Diameter	3.879’’
		Wall Thickness	0.58’’

		Length	7.8’’
Fin Securing Mechanism	Pine	Outer Diameter	3.866’’
		Wall Thickness	0.75’’
		Slits	3.0’’ x 0.134’’
Centering Rings	Pine	Outer Diameter	3.866’’
		Inner Diameter	2.165’’
		Thickness	0.75’’
Locking Mechanism	Pine	Outer Diameter	3.923’’
		Thickness	1.5’’
Bulkheads	Pine	Outer Diameter	3.923’’
		Thickness	0.75’’
Nosecone Bulkhead	Pine	Small Diameter	2.46’’
		Large Diameter	2.6’’
		Thickness	0.732’’

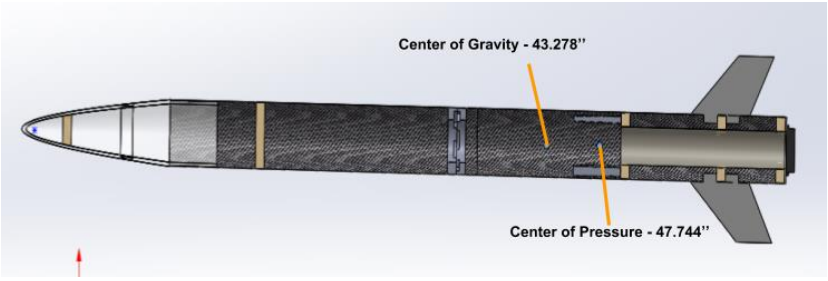

Figure 2.1.2: Cross Section Side View of Rocket

Table 2.1.2: Rocket Specifications

Specifications	
Total Length	65.75’’
Center of Pressure (from the tip of the nosecone)	47.744’’
Center of Gravity (from the tip of the nosecone)	43.278’’
Stability Margin	1.13
Total Mass	10.375 lb
Mass w/o Motor	7.67 lb

Final 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 4.5 of this report.

Target Altitude

The target altitude is 4209 feet, which was given from the rocket simulation software OpenRocket. To get the most accurate value, the parameters listed in Table 2.1.3 were inputted into Open Rocket.

Table 2.1.3: OpenRocket Simulation Parameters

Average wind speed		10 mph
Standard deviation of wind speed		1 mph
Wind turbulence intensity		10% (medium turbulence)
Wind direction		90 degrees (perpendicular to flight path)
Launch Site	Latitude	42.6 degrees north
	Longitude	87.8 degrees east
	Altitude	604 ft
Launch Rod Length		72 in

These values are meant to match what actual flight conditions will be but since there is no way to predict what type of weather and wind will be present the day of launch, rough estimates are given here. To give a generally accurate reading International Standard Atmosphere conditions were also put into place in the simulation to give average temperature and pressure readings to be taken into the launch conditions. Under these conditions it is expected that the time to apogee will be 15.6 seconds.

Recovery System Description

Currently, our main method of decelerating the rocket to a safe landing speed is through a drogue chute deployed at apogee and the main chute deployed at 500 feet, which is the lowest altitude that is allowed by the competition.
The drogue chute that we have chosen is 21.5 inches in diameter, has a drag coefficient of 0.80, and is made of ripstop nylon. It has 6 shroud lines made of round elastic cord, each about 11.811 inches. This drogue chute will be attached to the rocket through use of a shock cord that is 25 feet in length and 3 quicklinks. It will be protected from any ejection charges or explosions using a firecloth.

The main chute has a diameter of 60 inches, has a drag coefficient of 0.80, and is made of ripstop nylon (same as the drogue chute). It also has 16 shroud lines which are each 54 inches in length. It will be attached to the rocket, as well as the nosecone, through use of a 28.05 ft shock cord, 3 quick links, and a firecloth to protect it from any ejection charges.

Rail Button Size

We will be using 1-inch rail buttons to ensure that we have adequate spacing between the rocket and the launch rail.

2.2 Payload/Challenge Summary

Payload/Challenge Solution Description

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 an Arduino, 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 wooden CNC’ed 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 reduce vibrations experienced by the electronic components and provide more accurate data.

3 Changes Made Since PDR

Changes to Vehicle Criteria

The vehicle has been modified even further 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 Preliminary Design Report. This includes: the addition of a bulkhead to the nosecone, the fabrication of the nosecone with both ABS and PLA plastic, the fin shape, the wall thickness of the nosecone, the addition of two large threaded rods above the top motor mount centering ring to add weight, and the addition of a motor retainer to the bottom of the rocket. Our construction methods have also changed as we were unable to use a laser cutter for our parts, but were able to CNC our parts with little to no change in accuracy to the simulation dimensions.

Changes to Payload Criteria

The payload will contain the same internal components which are an Arduino Uno, a gyroscope/accelerometer module, a barometric pressure sensor, an SD card module, and a 9V battery. The only change made to the payload is on the locking mechanism that will protect the avionics bay from the ejection charges. Originally, the locking mechanism was going to be 3D printed using ABS and essentially would be a giant screw that would allow easy access to the avionics bay. This idea was dismissed due to the lack of strength of ABS plastic. Since wood could not be threaded to the desired size, the locking mechanism was reverted similar to the one from last year using wood, with slight improvements. The goal is to create a secure and airtight seal that can also resist the forces from the attached U-bolt. The following design was adopted.

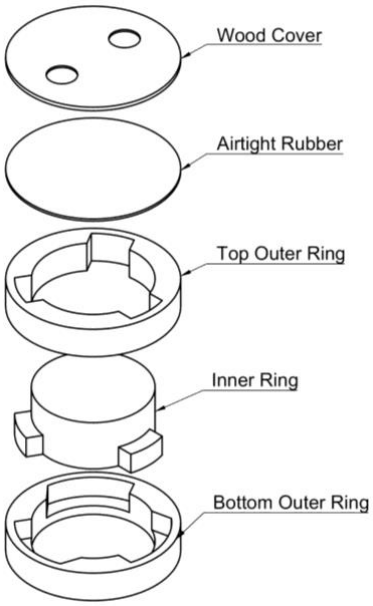

Figure 3.1: Blow up view of current locking mechanism for avionics bay/payload. The rubber sheet will attach to the inner tube, which will ensure an airtight seal. The wood cover is also attached to the rubber to provide more rigidity and shield the rubber from ejection charges.

Changes to Project Plan

The project timeline has been changed due to unforeseen manufacturing issues. Manufacturing should have been completed on February 18, allowing for sufficient time for testing. However, manufacturing will now continue until March 4. While testing for the main body of the rocket will not be able to be done until then, testing of the microcontroller has started and should be completed by the time we can test the entire rocket.

4 Vehicle Criteria

4.1 Design and Verification of Launch Vehicle

Mission Statement and 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 must include the following: a non-metallic nosecone that needs to be designed and fabricated, reaching an altitude of 3500 feet - 5000 feet AGL, having an aerodynamic design and enable motor deployment charge, and having an altimeter to record the altitude of apogee and deploy the main parachute at a specific altitude. 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.

Final Selected Launch Vehicle Components

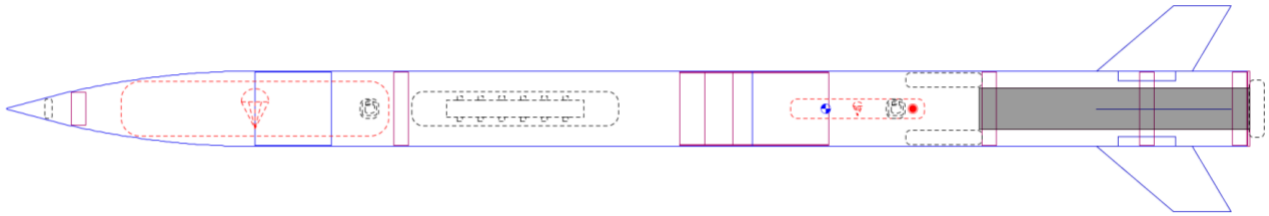

Figure 4.1.1: *Cross Section Side View of Rocket from OpenRocket simulation*

Most of the design choices we chose for the PDR have stayed the same, other than a few minor dimension changes to adequately reflect real measurements. We changed the design for the nosecone, as we had to print it in two parts, with the top part being made of ABS and containing a female connector and the bottom part being made of PLA and containing a male connector. We decided on this combination due to availability of printers and materials, and the top part needing to be mechanically strong because it houses the nosecone bulkhead.

We added in a nosecone bulkhead and an eyebolt-nut system on the bulkhead in order for the quicklink on the shock cord to be anchored on the rocket. The bulkhead was secured into the nosecone using epoxy. To ensure that there are no airpockets within the nosecone which would subject it to fracture upon impact, the tip of the nosecone was first filled with expanding foam sealant. This way, it would be harder for the nosecone to crack inwards if it were to take some force to the tip of it. This ensures that the force of the main parachute deploying would not rip a hole in the plastic nosecone,

but also connected it to a strong material (0.75” thick pine) that could withstand the impulse given by the parachute.

We chose the bulkhead to be made of thick pine. It contains an eyebolt-nut system because it would also have to withstand the force of the main parachute deployment. We bought the coupler from the same vendor we bought our body tubes, where it is made of cured carbon fiber, and we chose this because we knew that it would be strong enough to hold the two bodies together without fracturing and we would not have to worry whether it would fit within the rocket. We chose the wooden centering rings to be made of thick pine for the same reason as the bulkheads, but also because the bottom centering would have to anchor the screws coming from the motor retainer through the aluminum centering ring. For the aluminum centering ring, we had the material already available from prior years, and were sure from past launches that it would be able to withstand the pressure and heat coming from the motor at launch and while in flight.

We also decided to create a fin securing mechanism as we wanted to minimize the risk of fin flutter and ensure that the fins were even and precisely perpendicular to each other. We decided to make it out of the same thick pine used in the bulkheads and the centering rings because it would be able to hold the fin in place securely and withstand the pressure forces from the outside, which would cause the fin flutter. Finally, our current design for the fins was chosen to bring the rocket back within the static stability margin without having a lower apogee and to be made of fiberglass due to its high structural integrity and also because it’s a material we had on hand.

CAD Drawings

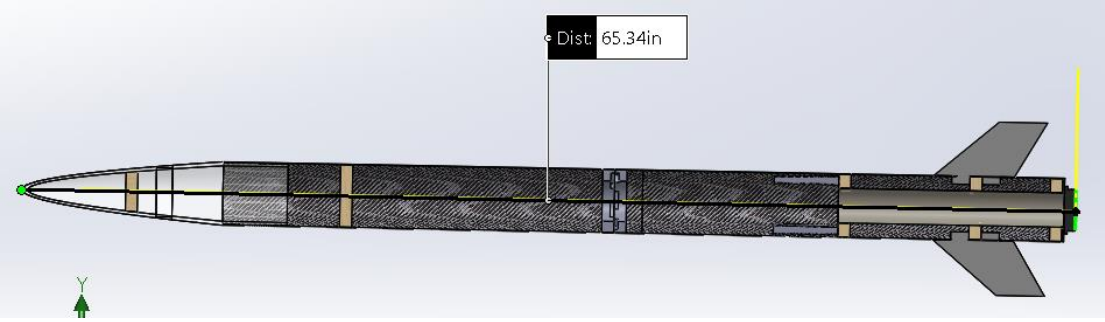

Figure 4.1.2: *Total Length of the Launch Vehicle is ~65.75”*

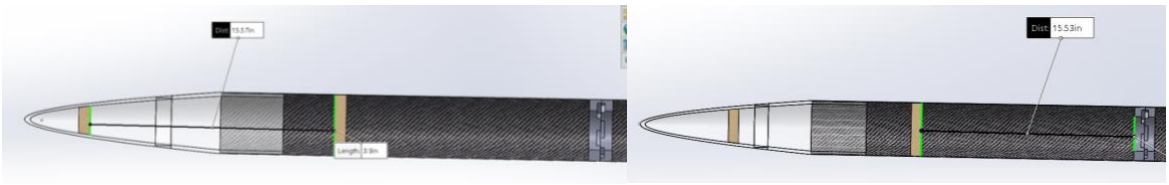

Figure 4.1.3: *The Main Parachute Storage Section is ~15" (left); Avionics Bay Section is ~15.5" (right)*

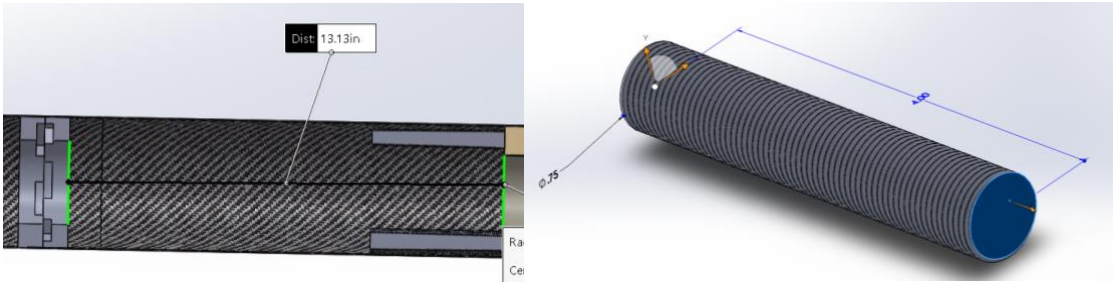

Figure 4.1.4: *The Drogue Chute Storage Section is ~13"; 3 ¾" diameter and 4" long Threaded Rods added for weight; dimensions in inches*

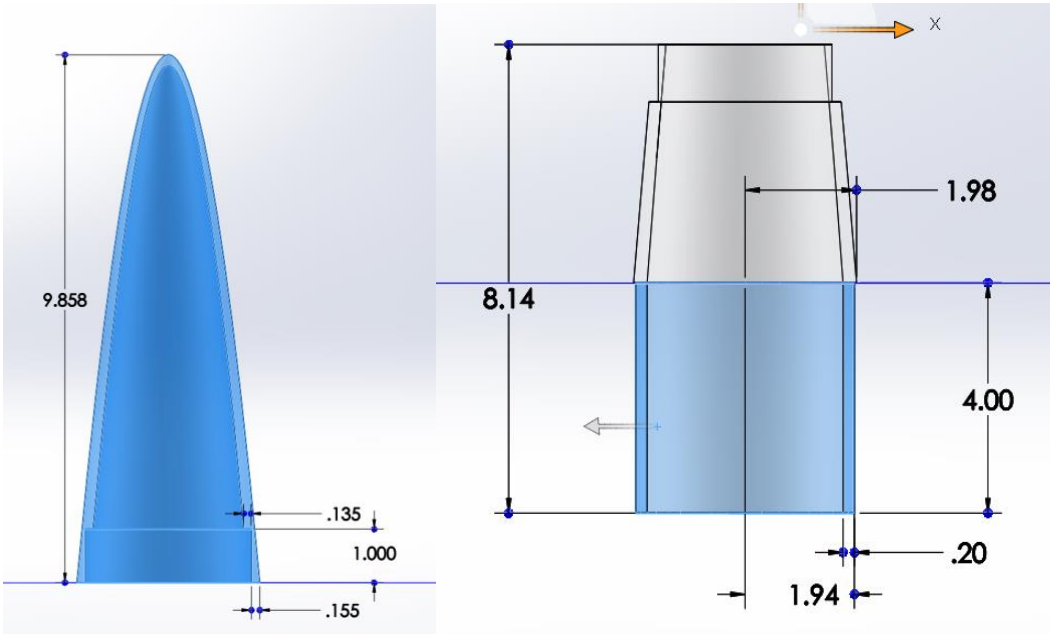

Figure 4.1.5: *Top Part of Nosecone (ABS); Bottom Part of Nosecone (PLA); dimensions in inches*

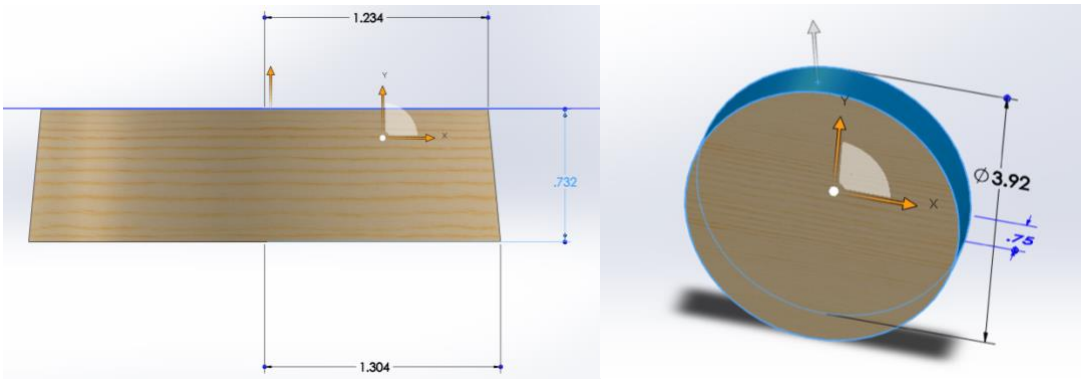

Figure 4.1.6: *0.7320" thick Pine Nosecone Bulkhead ; 0.75" thick Pine Bulkhead; dimensions in inches*

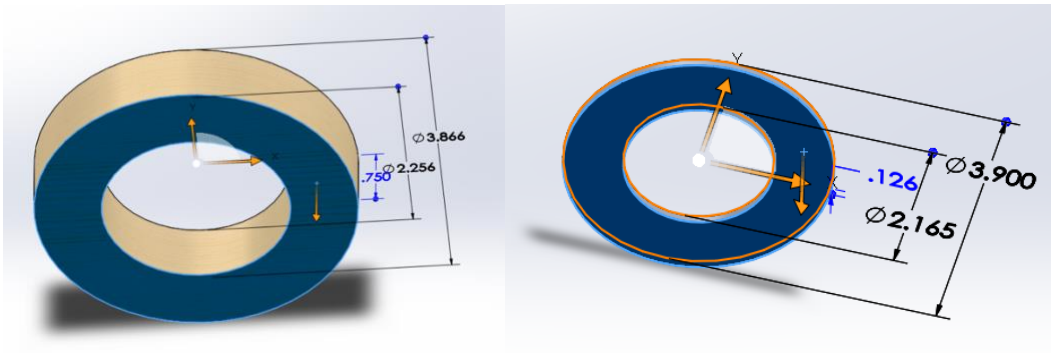

Figure 4.1.7: *0.75" thick Wooden Centering Ring; 0.126" thick Aluminum Centering Ring; dimensions in inches*

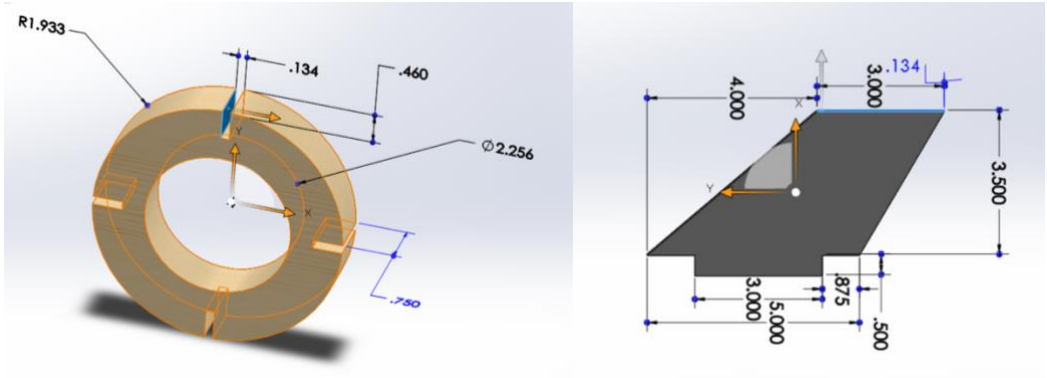

Figure 4.1.8: *0.75" thick Fin Securing Mechanism; 0.134" thick Fiberglass Fins; dimensions in inches*

Manufacturing Stage of Designs

Table 4.1.1 demonstrates the completion of the design process of the rocket and details where in the manufacturing stage our team is with respect to each individual part of the rocket.

Table 4.1.1: Description of Manufacturing Stages of Each Rocket Component

Component	Manufacturing Stage
Body Tubes	Completed
Coupler	Completed; in the process of being epoxied to the inner side of one of the body tubes
Nosecone	Printed out; currently is in the process of having the nosecone bulkhead epoxied within, but then the two parts will be epoxied together
Nosecone Bulkhead	Has been CNC'ed, sanded, and had an eyebolt drilled into it secured by a nut; in the process of being epoxied within the nosecone
Bulkhead	Has been CNC'ed, sanded, and had an eyebolt drilled into it secured by a nut; in the process of being epoxied within the upper body tube
Locking Mechanism	In the process of being CNC'ed but will then be attached as detailed in Section 4.4 of this report
Screws	Need one more to be bought and then epoxied to the top motor mount centering ring
Wooden Centering Rings	Has been CNC'ed and sanded; in the process of getting an eyebolt drilled into it secured by a nut and being attached to the motor mount
Fin Securing Mechanism	The centering ring base has been CNC'ed and sanded; in the process of

	cutting slots into it to fit the fin tabs and then to be epoxied onto the motor mount and the lower body tube
Aluminum Centering Ring	In the process of being manufactured within a machine shop; needs to be epoxied onto the wooden centering ring above it and screwed through from the motor retainer
Fins	In the process of finalizing the design after multiple simulations; to be manufactured soon

Integrity of Design

Shape and Fin Style

The fin shape and style, shown in Figure 4.1.7, is very sustainable due to its easiness in manufacturing. While a tapered or curved fin style could easily have small undetectable errors that can't be easily normalized (such as a tapering curve), ensuring that fins have a rectangular cross section, as well as straight edges, allows for easier assessment of accuracy and duplication of design if needed. The design of the fins also keeps the rocket well within the static stability margin without lowering the apogee by a massive amount, which will help us stay within competition guidelines. Finally, the amount of material accessible restricted our design.

Proper Use of Materials

We have chosen thick pine wood for most of our bulkheads and centering rings as it has been an abundant resource for our team, but also because it provides the strength and resilience we need for components that will be withstanding large impulses upon parachute deployment. We have chosen carbon fiber for our body tubes and coupler, as we have done in previous years, as it is a strong material that can withstand the massive amount of pressure incurred at launch and while in flight. We have chosen fiberglass for our fins as fiberglass also can withstand the massive amount of pressure gained from aerodynamic forces. We have chosen aluminum for our bottommost centering ring as it can withstand a large amount of heat without burning or melting and also because it can withstand the force coming from the motor at launch and while in flight. Each of these components were also examined visually to be free of any visible defects such as chips and cracks and were not used if it was deemed any of these were seen. By doing this, it was ensured that all our components would have a maximized structural integrity fit for launch as proven from rockets that launched in past years.

Sufficient Motor Mounting and Retention

The motor mount, which is a 14 inch phenolic tube, will have a wooden centering ring epoxied to the top of it, a fin securing mechanism epoxied onto it near the middle, and another wooden centering ring at the bottom of it. All these centering rings will be epoxied to the inner side of the lower body tube. An aluminum centering ring also will be epoxied onto the bottommost centering ring and the lower body tube. A motor retainer will be attached via screws through the aluminum centering ring and into the bottom wooden centering ring. The aluminum centering ring that is below the wooden one will ensure that the motor mount does not misalign or warp during landing and helps to ensure a stable second launch. The bottommost wooden centering ring and aluminum centering ring that are epoxied to the lower body tube gives the motor retainer two strong 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 lower body tube. The motor should 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 and stay in place during flight. These techniques are proven to be effective from past rockets with successful launches and recovery. This is discussed again in Section 4.5 of this report.

Mass of Launch Vehicle and Subsystems

The total mass of the rocket is 166 oz. The mass of each individual component is listed in Table 4.1.2.

Table 4.1.2: Mass of Launch Vehicle and Components

Item	Mass (oz.)	Item	Mass (oz.)
Nosecone	7.44	Nosecone Bulkhead (w/ eyebolt and nut)	1.38
Body Tube (Top)	10.5	Locking Mechanism	5.44
Expanding Foam	0.32	Bulkhead	2.72
Body Tube (bottom)	10.3	Main Parachute (w/ shock cords, quicklinks, and firecloth)	16.23
Pine Centering Ring (top of motor mount)	1.45	Pine Centering Ring (bottom of motor	1.66

		mount)	
Tube Coupler	4.13	Aluminum Centering Ring	1.63
Inner Tube	0.97	Fin Securing Mechanism	1.78
Motor with Propellant	43	Avionics Bay	10.9
Unspecified (screws, bolts, etc)	49.28	Fins	9.22
Drogue Parachute (w/ shock cords, quicklinks, and firecloth)	11.96	Motor Retainer	1.76
Total Mass of Launch Vehicle			**166.0**

Design Justification

When dimensioning our rocket, the main concern was that there was adequate space for the avionics bay. Since there are more electrical components and sensors because of the nature of the challenge, it was prioritized in planning. Other dimensions were mainly acquired from basic rocketry design as well as the parameters of the body tube. We had a choice between a body tube with a diameter of 3.9” and 6” and, this year, we chose to go with the 3.9” diameter to maximize apogee. Once this was decided, components such as bulkheads, centering rings, coupler, shoulder of the nosecone, and locking mechanism dimensions were set. The nosecone dimensions and curve were designed to be the most adequate for high altitude suborbital flight since that was our goal in the competition. Other more variable dimensions such as exact bulkhead placement and fin design were altered so that the rocket would have a center of gravity and center of pressure that place the overall stability of the rocket within a safe margin.

Materials were chosen due to abundance, ease of manufacturing, and past success with those materials. A carbon fiber body tube has been proven in past flights to be strong enough to endure forces during launch and easily purchased and cut down to any size needed. Wooden bulkheads and centering rings were chosen due to the abundance of material along with the easiness of manufacturing. In the past, our team has experimented with carbon fiber bulkheads and centering rings but these were very hard to manufacture because the machinery that our team had access to did not allow for carbon fiber to be cut on them so our team had to Dremel circles by hand which was very difficult to do perfectly. By changing our material back to thick pine, our team was

able to CNC perfect circles so manufacturing was much easier and more accurate. Furthermore, thick pine had been used in previous launches and proven to be very reliable.

As stated before, the nose cone was made of ABS and PLA plastic for the top and bottom component as stated before. This was done due to our team having used PLA plastic in the past for the nosecone and seeing that it was adequately strong. Due to printer constraints, along with the fact that ABS plastic is structurally stronger, the top half was printed with ABS since that portion of the nosecone is more easily subject to a force that will crack it. It was then filled with expanding foam due to this being successful in the past. The bottom aluminum centering ring was chosen to be used since material for it was in supply and it has been used on past launches and deemed adequately strong. The locking mechanism holding in the payload is made from wood and rubber due to this being very easy to machine (these are CNCed), as well as these materials being successful in past years when this design has been used.

4.2 Subscale Flight Results (AISES Only)**

We are not having a subscale flight for this design of our rocket, therefore we will not be including subscale flight results in the Critical Design Report.

4.3 Recovery Subsystem

Final Selected Components for Recovery System

Our two options for parachutes had either a 56 inch diameter or a 96 inch diameter. While initially our plan was to use the parachute with the 96 inch diameter, we chose to use the 56 inch parachute in the end because our flight time was much too long. With a 500 foot altitude at the event of the deployment of the main parachute, simulations to calculate descent time were run for both sizes of parachutes to see which better fit the competition requirements. The descent time (apogee to ground) for the 56 inch rocket was 80.4 seconds, which is well within the competition requirements, while the descent time for the 96 inch parachute was 95.2 seconds, which is outside of competition range. Another factor in choosing the parachute was the easiness of deployment from the nosecone and body tube during launch. The 96 inch parachute is much bigger folded when compared to the 56 inch parachute. We didn’t want to have to rely on a lubricating agent, such as graphite, to ensure that the parachute would properly dislodge from the nosecone. By choosing the 56 inch parachute, this was no longer a concern as it was with the bigger parachute since it has adequate space within the nosecone when folded and can dislodge easily. The one factor that made the bigger parachute seem more appealing was the ground hit velocity. For the bigger parachute, the ground hit velocity was 12.7 ft/s while for the smaller one it was 21 ft/s. Though this is a significantly higher

ground hit velocity, it is still within competition guidelines and it is not expected to be problematic which allowed our team to decide on the smaller parachute.

Parachutes, Harnesses, Bulkheads, and Attachment Hardware

The main parachute is made of ripstop nylon and is 56 inches in diameter. It has 16 shroud lines made from heavy duty thread that are connected to a 28.05 ft shock cord that uses three quicklinks to attach it to the eyebolts drilled into the bulkheads in the nosecone and top of the top body tube. It also has a firecloth attached to the shroud lines so as to wrap the half of the parachute that is exposed to the black powder ejection charges while in the rocket to ensure that it is not damaged. The parachute has been inspected for holes and rips visually and any that were found were patched with parachute tape that does not tamper with the integrity or effectiveness of the parachute. The drogue chute is 16 inches in diameter and made of the same material as the main parachute and has 6 shroud lines. The shroud lines are attached to a 25 ft shock cord as well as three quicklinks that connect the parachute to the top of the motor and the bottom of the top body tube (essentially each of the body tubes). The drogue chute also has a firecloth attached to it so that, like the main parachute, it will be protected from the ejection charges within the rocket when folded.

Location Trackers

No tracking system is equipped.

Sketch of Recovery System

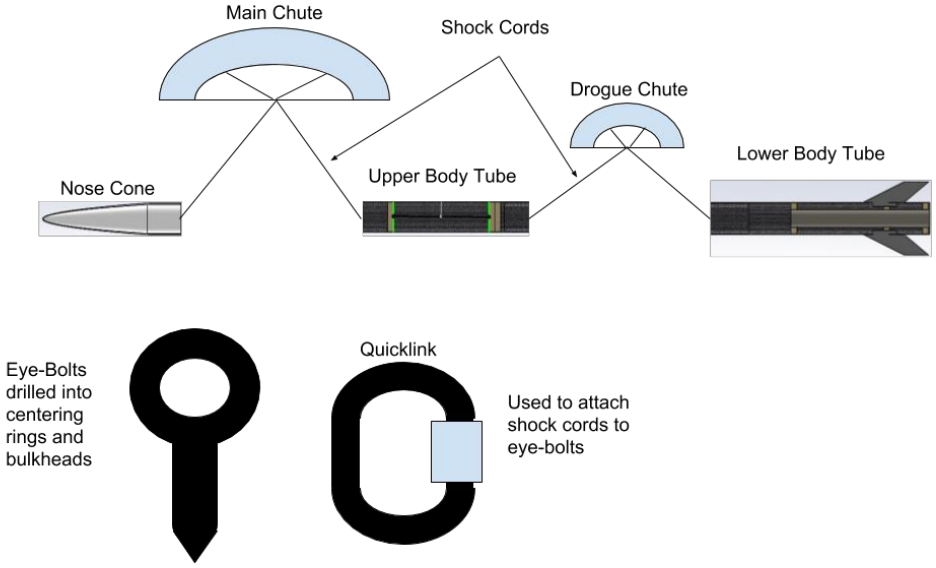

Figure 4.3.1: *Parachute locations in rocket (top); eye-bolts and quicklinks used to attach parachutes to rocket (bottom)*

4.4 Avionics Subsystem

Avionics Bay Description

The avionics bay will consist of a 3.9” diameter x 16.25” space for a total volume of 194.0 in^3. For electrical components to read static pressure, four holes will be drilled on the body tube connected to the avionics bay measuring 0.219 inches in diameter. The hole will be located 5.5” from the locking mechanism of the avionics bay to provide static pressure readings for the altimeters and barometric pressure sensor. The top of the avionics bay will be capped off with a wooden CNC’ed locking mechanism. The locking mechanism will be lined with a rubber sheet to create an airtight seal and a wooden cover will be added to protect the rubber from the ejection charges. All electrical components will be fastened to a 3D printed sled that attaches to the inner ring and will snugly hold all components. The sled will be the in the shape of a T and will hold two altimeters (MissileWorks RRC3 sports altimeter and StratoLogger SL100 altimeter for redundancy), an Arduino Uno, an SD card module, a barometric pressure sensor (BMP180), a 6 DOF accelerometer/gyroscope module (MPU6050), and three 9V batteries. Each individual altimeter will be powered by a single 9V battery. The Arduino will be powered by a 9V battery which will provide power for the other electrical components.

Altimeters

The avionics bay has two primary altimeters that will be used to deploy the recovery system. First, the MissileWorks RRC3 altimeter will ensure that parachutes are deployed at the correct altitudes. Second, the StratoLogger SL 100 altimeter is used for redundancy, in the case that the RRC3 altimeter fails. The details of these altimeters can be found in Table 4.4.1.

Table 4.4.1: Specifications of Altimeters

	Altimeter	
Specifications	MissileWorks RRC3	StratoLogger SL 100
Power Source	Single 9V battery	Single 9V battery
Dimensions	3.92” x 0.925”	2.75” x 0.9”
Weight	0.60 oz	0.45 oz
Purpose	Releases parachutes at desired heights and records the rocket’s altitude every few milliseconds to produce altitude and velocity charts post-landing.	Performs the same functions as the RRC3 and is used for redundancy.

Avionics Sled Material, Avionics Bay Layout, and Vent Holes

The avionics sled will be 3D printed with PLA filament. It is 10.8 inches in length and has designated slots for each electrical component and their power sources, including the altimeters for the deployment of the recovery system, and the modules in the microcontroller, which are further discussed in Section 6. Figure 4.4.1 displays an angled view of the sled. The sled is in turn attached to the bottom of the bulkhead centering ring. If need be, the avionics bay can be removed through the use of the locking mechanism, which is comprised of one outer ring, one inner ring, a rubber sheet, and a wood cover. A detailed view of this locking mechanism can be seen in Figure 4.4.2. Four vent hoales will be placed within the avionics bay. They will be 0.219 inches in diameter and located 5.5 inches from the locking mechanism. The vent hole diameter was calculated using the following equation from the MissileWorks manual:

$$MultiPort\ Diameter = 2 \cdot \sqrt{(single\ vent\ area/\#\ of\ holes)/\pi)}$$

$$MultiPort\ Diameter = 2 \cdot \sqrt{(0.15/4)/\pi)} = 0.219in$$

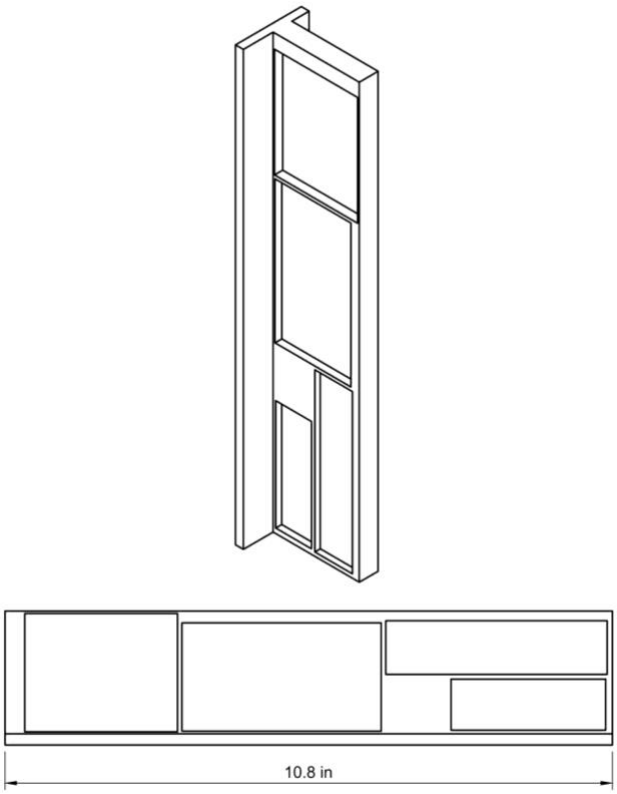

Figure 4.4.1: *(Top) Angled view of the prototype electronics sled, showing T-shape. (Bottom) Side view, showing impressions for placing the electronics.*

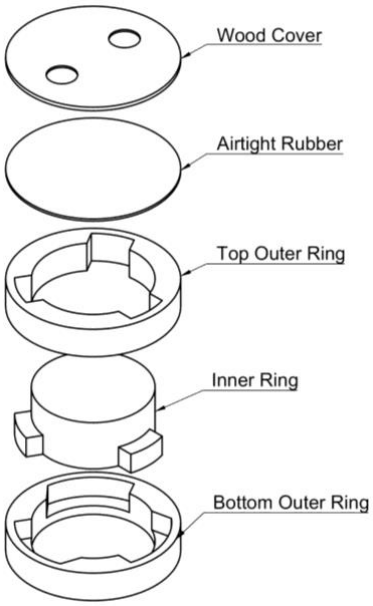

Figure 4.4.2 *Exploded view of the locking mechanism with relevant parts labelled*

Switch

Anderson Powerpole Connector Pins will be used to act as safety switches. Three sets of switches will be used: one for each altimeter and one for the Arduino. The Arduino will have a switch in order to not drain the battery before flight. The Powerpole Connector pins will be taped on the outside of the rocket.

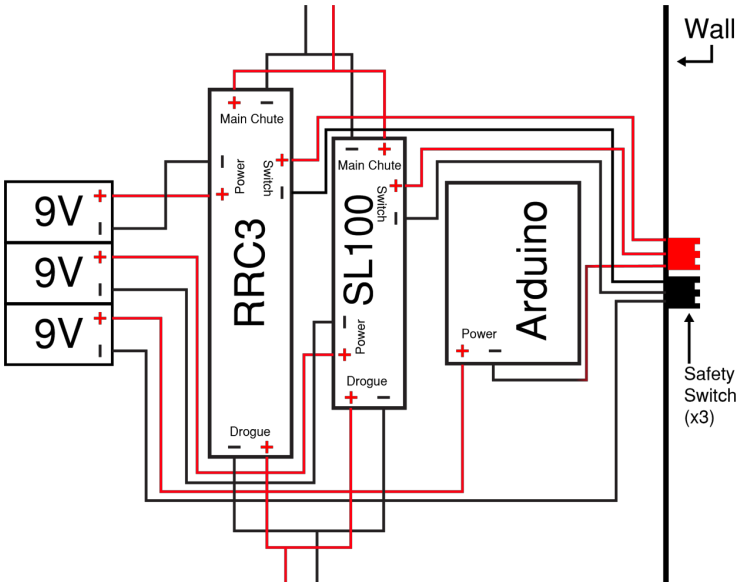

Figure 4.4.3 *Avionics schematic highlighting the use of safety switches with the altimeters and microcontroller. Each major component will have its own set of safety switches for a total of three safety switches. Since the Arduino has no pins for switches, the ground of the battery will be attached to the switch, which induces a current once the switch is connected.*

4.5 Motor Selection

Final Motor Selection

We have decided to select the AEROTECH 54mm HP SU DMS MOTOR - J450DM - 14A. We selected this motor based on flight time. While using this motor, our descent time is already very near the maximum of 90 seconds so using the more powerful K motor would extend an already long flight time. Specifications for this motor can be seen in Table 4.5.1.

Table 4.5.1: 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	

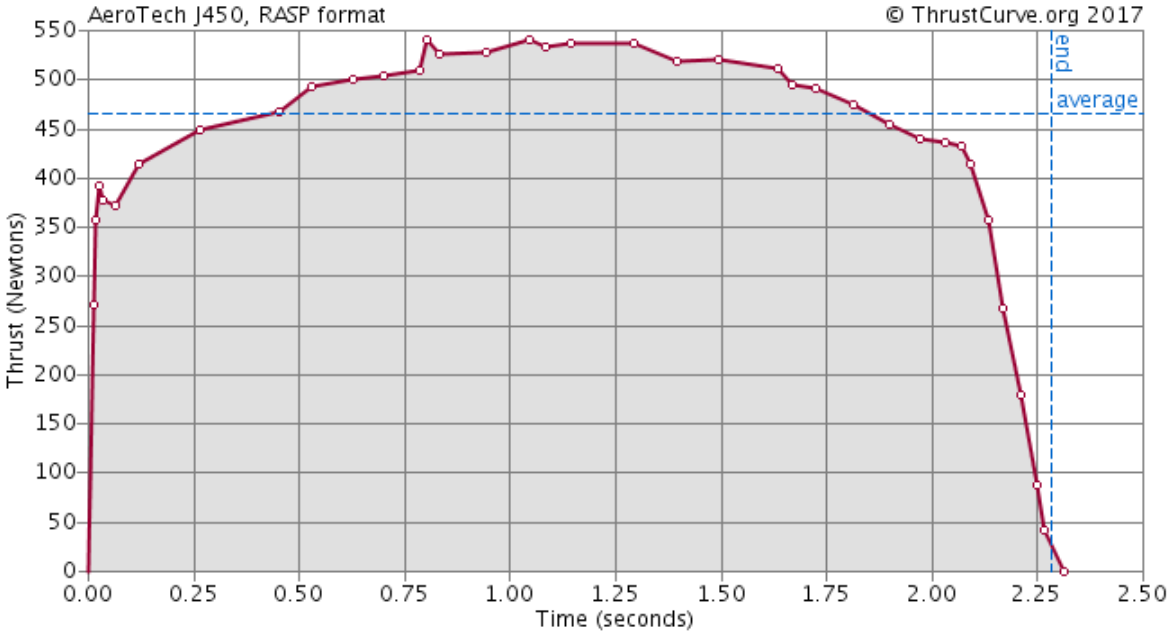

Figure 4.5.1: *Plot displaying the thrust curve given by the AEROTECH 54 mm HP SU DMS MOTOR - J450DM - 14A motor.*

Motor Retention System

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 below the wooden one will ensure that the motor mount does not misalign or warp during landing and helps to ensure a stable second launch. The centering rings are epoxied to the lower body tube, which gives the motor retainer two strong 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 lower body tube. The motor should 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 and stay in place during flight.

4.6 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 72” launch rail oriented straight up. Below are shown the simulated vehicle data (Table4.6.1), component weights (Table 4.6.2) and motor thrust curve (Figure 4.6.1) from the 0 MPH windspeed calculation. The weight and thrust data are not affected by windspeed therefore only one set will be shown.

Table 4.6.1: 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.

Windspeed	**0 MPH**	**10 MPH**	**20 MPH**
Motor Configuration	J450DM-14	J450DM-14	J450DM-14
Velocity off Rod	58.3 ft/s	58.3 ft/s	58.3 ft/s
Apogee	4225 ft	4209 ft	4210 ft
Velocity at Main Chute Deployment	63.2 ft/s	63.2 ft/s	63.1 ft/s
Optimum Delay for Ejection Charge	13.4 s	13.4 s	13.4 s
Max Velocity	649 ft/s	648 ft/s	647 ft/s
Max Acceleration	348 ft/s^2	348 ft/s^2	348 ft/s^2
Time to Apogee	15.6 s	15.6 s	15.6 s
Flight Time	96.7 s	96 s	95.8 s
Ground Hit Velocity	21.1 ft/s	21 ft/s	21.2 ft/s

Table 4.6.2: Component Weights

Italicized values are simulated with OpenRocket material data and component dimensions

Component	Mass (oz.)	Component	Mass (oz.)
Motor Mount Body Tube	10.3	Avionics Body Tube	10.5
Fins	9.22	Coupler	4.13
Pine Centering rings (2)	1.66	*Locking Mechanism*	5.56
Drogue Chute + Recovery Hardware	11.96	Pine Bulkhead	2.72
Phenolic Tubing	2.72	Main Parachute	7.58
Aluminum Centering Ring	1.63	Avionics Bay	10.9
Fin Securement Mechanism	1.78	Recovery Hardware	8.68
Motor Retainer	1.76	**Subtotal (Avionics B.T.)**	**50**
Corrective Mass Element (3)	7.02	Nosecone	7.44
Subtotal (Motor Mount B.T.)	**63.6**	Nosecone Bulkhead	1.7
Motor	**42**	**Subtotal (Nosecone)**	**9.14**
		Grand Total	**164.74**

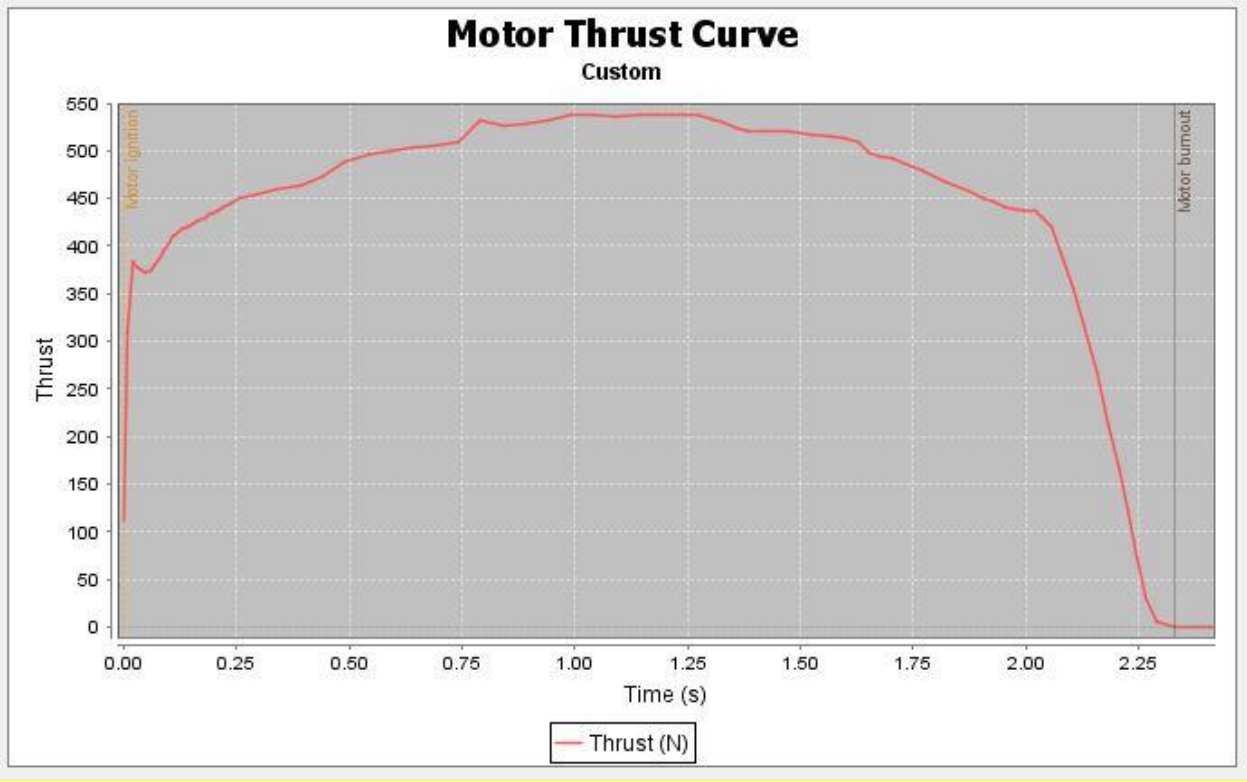

Figure 4.6.1: Simulated Motor Thrust Curve Plot

Flight Profile

Figure 4.6.2 below shows the altitude, vertical velocity and vertical acceleration over time with flight events indicated. This flight simulation was defined with a no wind condition and the launch coordinates and altitude of Kenosha, Wisconsin:
42.6 ° N, 87.8 ° E, altitude 604 ft.

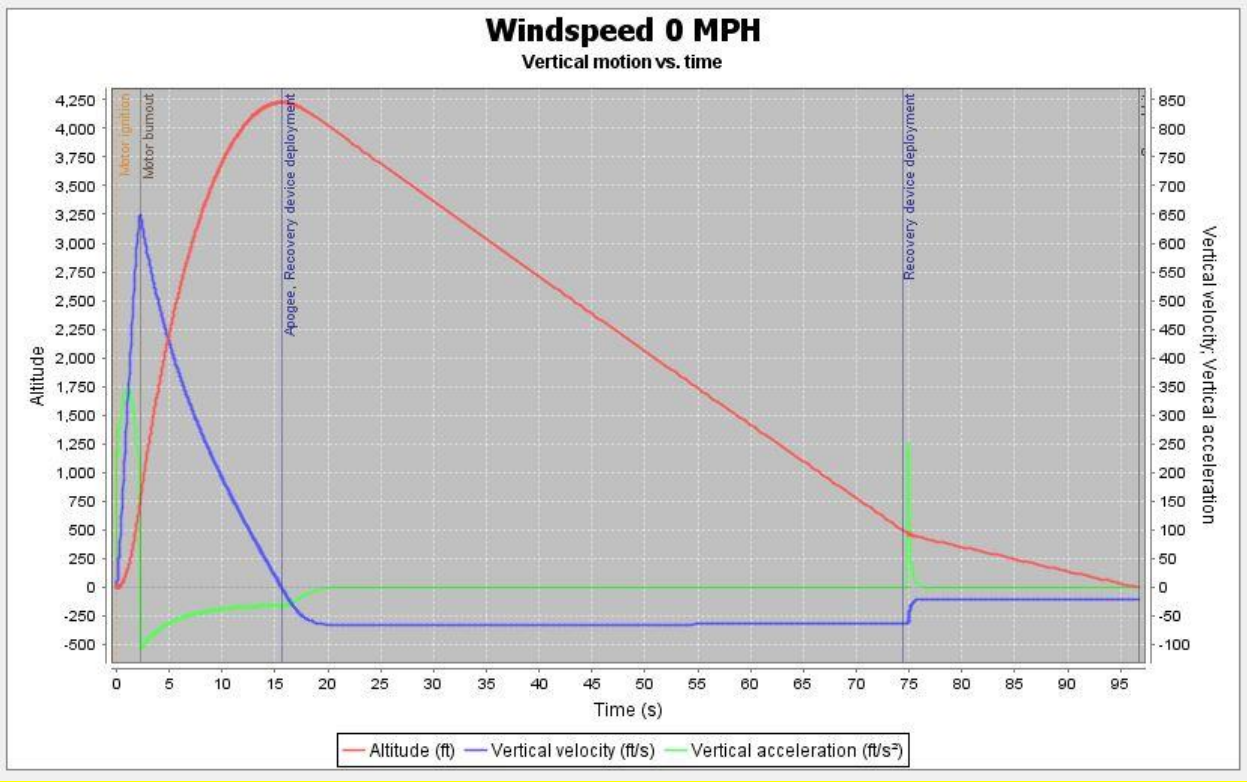

Figure 4.6.2: No Wind Flight Profile. Altitude, vertical velocity and vertical acceleration for a no wind simulation.

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. A schematic of their locations on the rocket is shown below in Figure 4.6.3.

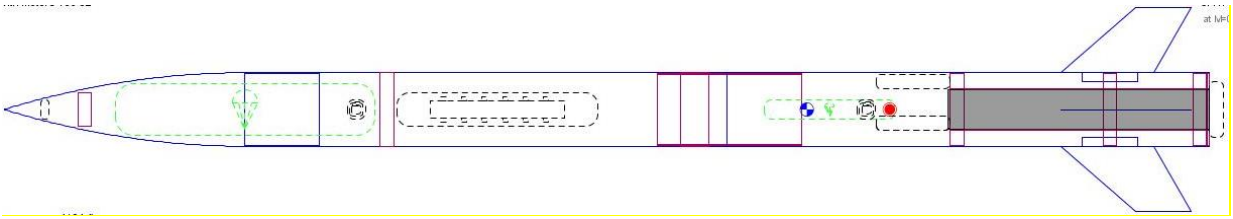

Figure 4.6.3: Simulated Stability, CP, and CG on OpenRocket. Both the CG and CP are shown on the area of the coupler, indicated with a blue and red arrow respectively. CP: 47.744 in, CG: 43.278 in, Stability Margin: 1.13 cal

Descent Rate and Time

From simulation data, descent rate is 63.2 ft/s under the drogue parachute until the main parachute deploys at 500 ft AGL and reduces the rate to approximately 21.1 ft/s. Subtracting flight time (96.7) from time to apogee (15.6) we can calculate total descent time to be **81.1 s**.

Kinetic Energy at Landing

With the ground hit velocity of 21.1 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).

$$KE = \frac{1}{2}(164.74\ oz)\left(\frac{.0625\ lb}{1\ oz}\right)\left(21.1\ \frac{ft}{s}\right)^2 = 108.6\ \text{ft} \cdot \text{lbf}$$

Drift

From figures 4.6.4-6, we can determine the drift from the launch pad with the assumption that the apogee is directly above it. This is done by adding the drift from the launch pad to apogee to the final drift location. Table 4.6.3 is a summary of these different drifts.

Table 4.6.3: Drift from Launchpad *Assume apogee occurs directly over launchpad

Windspeed (MPH)	Drift from launchpad* (ft)
0	4.2
10	1125
20	1900

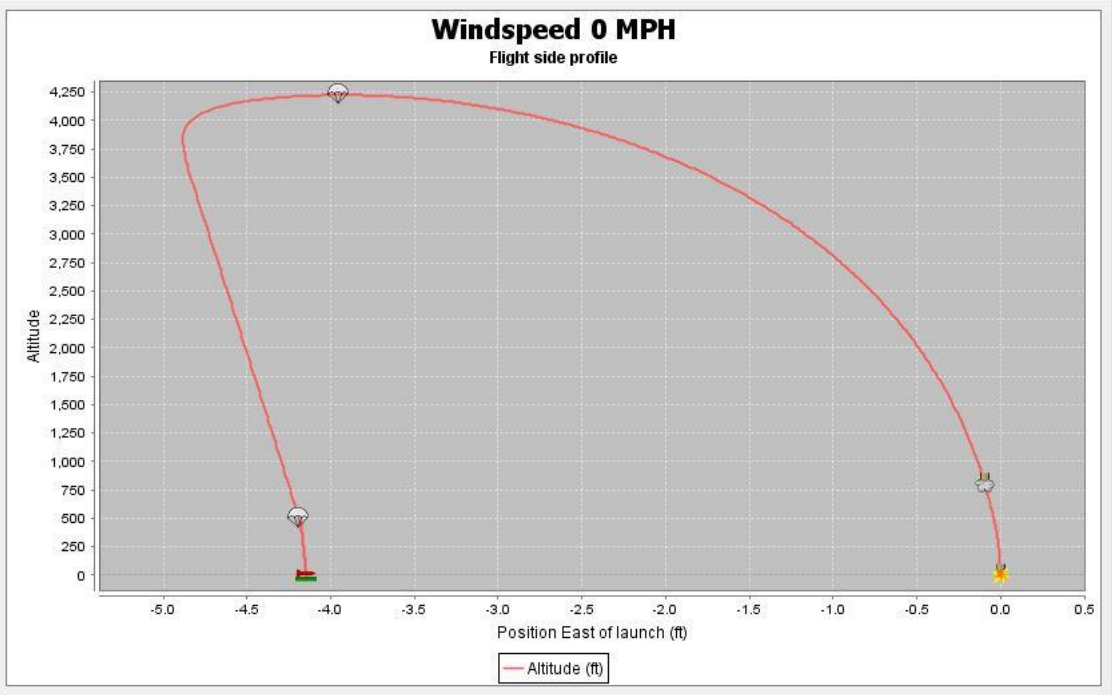

Figure 4.6.4: No Wind Simulation Plot. Flight profile of a no wind simulation

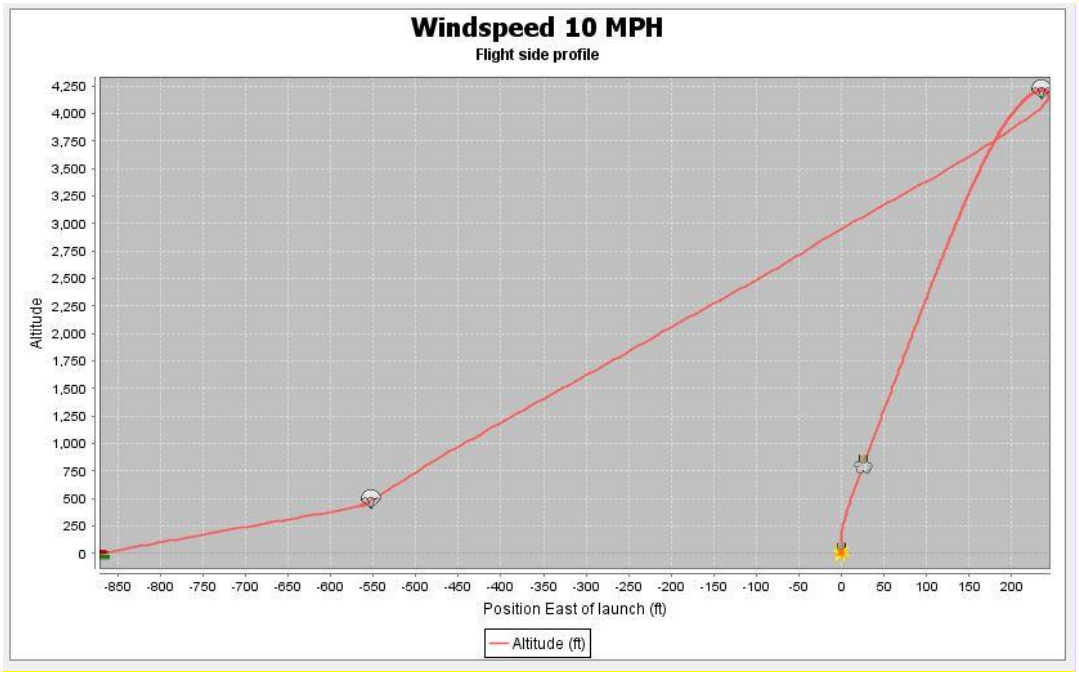

Figure 4.6.5: 10 MPH Wind Simulation Plot. Flight profile of a 10 MPH south eastern wind simulation with rocket position indicated in ft east of launch

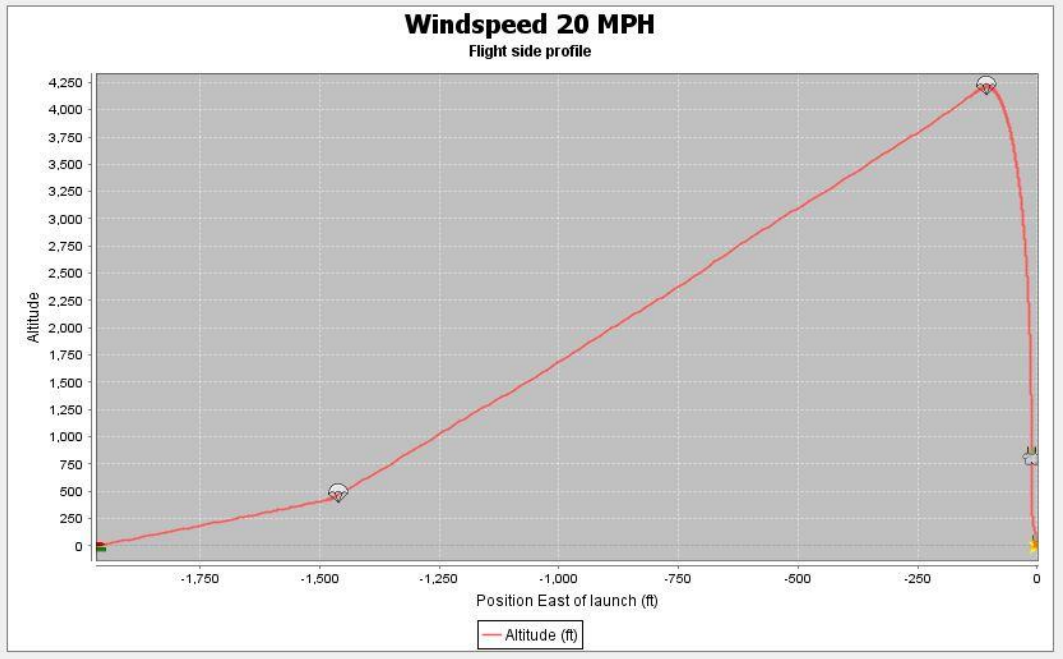

Figure 4.6.6: 20 MPH Wind Simulation. Plot Flight profile of a 10 MPH south eastern wind simulation with rocket position indicated in ft east of launch

5 Safety

5.1 Launch Concerns and Operation Procedures

Recovery Checklist:

1. Fold the main parachute and drogue chute
   Hazard: If the main parachute is improperly folded it may not be able to properly deploy, causing damage to the rocket upon landing.
2. Attach the main parachute to the shock chord
3. Pack a firecloth in between the main parachute and black powder charge
   Hazard: If the firecloth is not properly packed, the parachute may be damaged when the black powder charge goes off
4. Pack the main parachute into the section between the upper body tube and nose cone
   Safety: Make sure gloves are worn during the next step
5. Use graphite powder to lubricate the inside of the section if necessary
6. Insert drogue chute

Motor Prep Checklist:

1. Load the motor into the rocket
2. Secure the motor retainer

   Hazard: If the motor is not secured properly then there is a chance that it will fall out or the rocket will take off at a dangerous angle

3. Align the launch buttons

Launch Pad Setup Checklist:

1. Affix the rocket to the launch rail

   Hazard: It's important the altimeters aren't primed until the rocket is at the launch pad, in case of altimeter malfunction that would cause the charges to go off

2. Prime the altimeters
3. Check for altimeter malfunction
4. Install igniter properly
5. Everyone retreats to a safe distance
6. Launch

   Safety: The Range Safety Officer should be present for launch pad setup and will make sure all steps are performed correctly

Igniter Installation Checklist:

1. Have at least one team member attend an igniter installation workshop
2. Install the igniter
3. Attach alligator clips to igniter ends
4. Attach alligator clips to launch box

Troubleshooting Checklist:

1. Motor - Check the wiring to ensure its securely attached
2. Altimeter - Listen for beeps that indicate whether or not the altimeter is working properly
3. Charges - Ensure that the safety switch is engaged

Post-flight Inspection Checklist:

1. Locate the rocket and request assistance retrieving it if it has landed in a tree or other location where it is unsafe to retrieve by ourselves

   Safety: The safety officer must be present when the rocket is being recovered to determine whether or not it's safe for the team to retrieve without any assistance

2. Inspect the airframe and fins of the rocket for visible damage
3. Make sure parachutes have not acquired any holes or damage
4. Carefully inspect the inside of the rocket to make sure nothing was damaged significantly (including the electronics bay)
5. Recover data from microcontroller and altimeters

5.2 Safety and Environment (Vehicle and Payload)**

A finalized list of hazards, their causes, effects, and mitigations are provided in Table 5.2.1. The MSDS for all hazardous materials that we will be working with are provided in the Appendix. The Safety Officer, Joshua Diaz, is responsible for ensuring that all mitigations are verified, and verifications are provided after the following table.

Table 5.2.1: Personnel Hazard Analysis and the Failure Modes and Effects Analysis

Hazard	Effects	Cause	Severity	Chance	Mitigations	Impact of Mitigations
Carbon Fiber / Fiberglass Dust Inhalation	Both materials known to cause health problems given long enough exposure	Cutting Carbon Fiber or Fiberglass material with a Dremel in a dry environment	Medium	Low	P100 rated respirator masks and filters, a lab coat, gloves, and goggles will be worn when working with these materials along The materials will only be cut in a safe workspace in accordance with UCLA EH&S policy	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 ($108)

Inhalation of Lead Fumes	Lead has been known to cause mental health problems when ingested or inhaled	Using lead based solder	High	Low	Lead based solder will not be used If lead based solder is used, it will be done in an environment with a fan to diffuse the fumes away from the user	Instead of lead-based solder the team must buy solder wire that does not contain lead, which may impact budget The tools to use lead based solder (mainly the fan) are located in a UCLA facility that has its own hours of operation and thus impacts the schedule
Use of Machining Equipment (Lathe, Drill Press, Dremel)	Potential team member injury if used improperly	Inexperienced team member improperly using machining equipment	High	Low	All team members will be trained on equipment before use by UCLA staff or experienced members, and supervised when machining	Team members will have knowledge and guidance, but schedules of team members must be coordinated

Spilled epoxy resin and/or hardener	Improper use of epoxy or accident occurs while someone is using epoxy	Inexperienced team member working with epoxy and/or poor communication of the work going on in the area	Medium	Low	Team members will be trained on how to use epoxy and supervised until they are capable Epoxy work will be well communicated when it is going on	The schedules of team members will have to be coordinated so an educated member is always present

Table 5.2.2 shows the corresponding verifications to the mitigations proposed above.

Table 5.2.2: Verification Plan for Mitigations.

Mitigation	**Verification**
PPE used when cutting fiberglass or carbon fiber with a Dremel, which includes a lab coat, gloves, goggles, and a P100 rated respirator	Checklist: 1. Team member must already be wearing long pants, closed toe shoes, and no loose clothing 2. Team member must then put on a lab coat, gloves, goggles, and a P100 rated respirator 3. If any of the above are missing, the team member will not be allowed to cut fiberglass or carbon fiber
Carbon fiber and fiberglass will only be cut in the workspace designated by UCLA Environmental Health and Safety Department	Procedure: 1. First, team members will put on the appropriate PPE 2. Team members will then bring the material to be cut to the appropriate workspace designated by EH&S, which is well ventilated and reserved in advance 3. At least one team member present will have experience cutting material before 4. The area where cutting occured will be cleaned up and the dust particles will be disposed of properly
Lead based solder will not be used or will be used with a solder smoke absorber present	Procedure: 1. Lead based solder will not be purchased by the team

	2. If lead based solder work is to be done, it will be done in the engineering makerspace at UCLA which is equipped with solder smoke absorbers and lead based solder
Machine training for the drill press, lathe, and other heavy machining equipment	Procedure: 1. All team members will complete UCLA's online Laboratory Safety Training and Shop Safety Training courses. 2. Members interested in training on machining equipment must contact the Safety Officer, who will set up a training session with UCLA's engineering machine shop 3. When team members machine a part they will have experience beforehand or be accompanied by a team member who already has experience 4. Team members will act respectfully when they use workspaces that are shared with other engineering students
Training team members to use epoxy resin	Procedure: 1. Epoxy will be stored safely, in containers in plastic bags and when retrieved, only as much as is needed will be taken out of the containers and placed in secondary containers to be applied 2. The proper PPE will be worn while working with epoxy, which consists of gloves and a lab coat 3. Team members will inform anyone else working in the same area that there is epoxy work going on in the area 4. An experienced team member will either be performing the epoxy work or supervising it 5. Any unused epoxy will be disposed of in the proper waste container 6. Epoxied materials that are left to dry will have signs posted notifying others that they are not to be disturbed

6 Payload Criteria

6.1 Design of Payload/Challenge Solution

Final Selected Design of Payload

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. Each of these components were also chosen based on the reliability of the vendors and because they are simple to program and obtain data from. Both of the data capturing modules capture a total of 5 data types, which can act as a fail safe in the off chance the individual components on the modules fail.

Payload Design at System Level

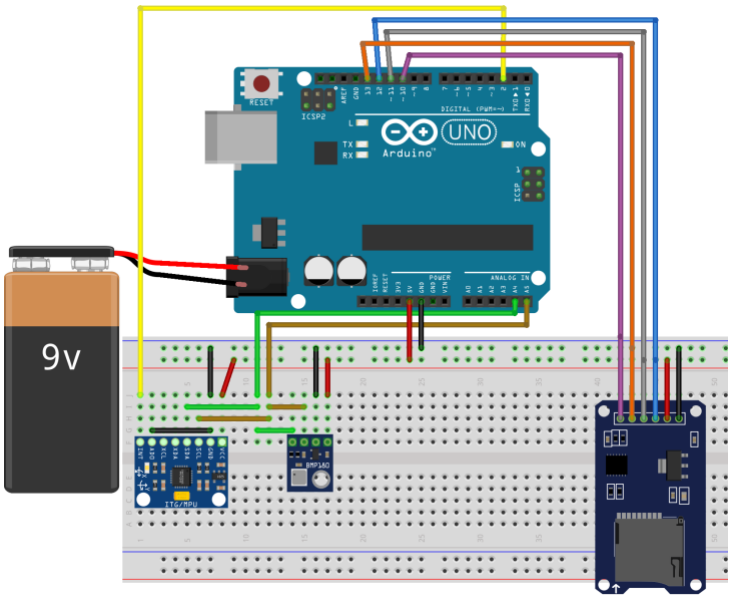

Figure 6.1.1 *Wiring schematic of the payload. Shown here is the Arduino Uno hooked up to the MPU6050 (bottom left), BMP180 (bottom middle), and SD Card module (bottom right). The assembly is powered by a single 9V battery using a DC adapter plug.*

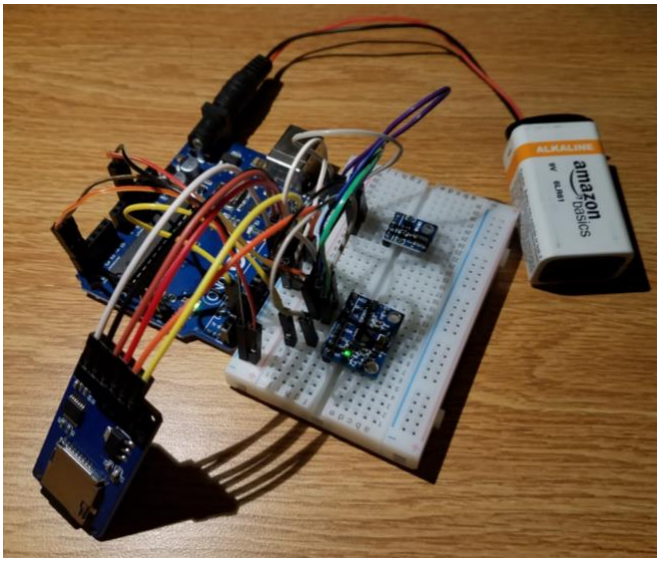

Figure 6.1.2 *Actual wiring of the payload. All components will be implemented into the payload sled except for the breadboard. All pins will be connected using jumper cables with fitted male or female ends in place of the breadboard.*

Interaction Between Payload Components

The payload does not actively interact with the rest of the vehicle with the exception of holes necessary for proper pressure readings from the BMP180 and the two altimeters in the avionics bay. These holes can slightly alter the trajectory of the rocket during flight due to pressure differences and resistance caused by the added holes.

The interactions that occur between each payload component is outlined in Figure 6.1.3.

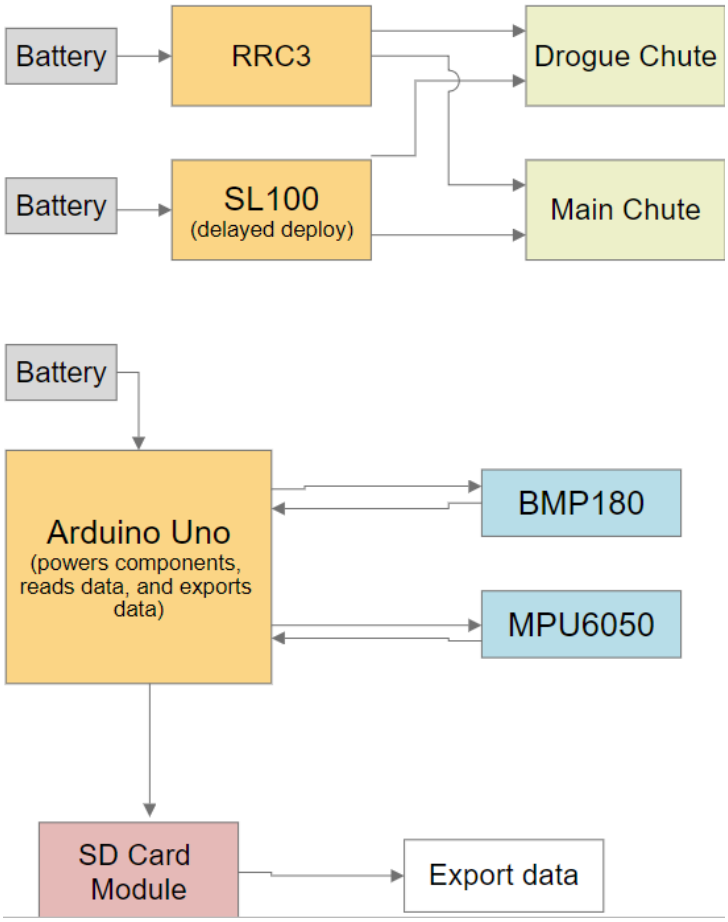

Figure 6.1.3 *Block diagram of the whole avionics bay.*

The two altimeters will have their own power supply using 9V batteries and are connected to the main and drogue chutes. The Stratologger 100 (SL100) will serve as the redundant altimeter and will have a delayed deployment in case the RRC3 does not work. The Arduino Uno will interact with the BMP180 and MPU6050 modules by providing power for the modules and by reading and processing the data they export. The processed data will then be sent to an SD Card module for post-launch data processing.

Integration of Payload with Vehicle

The payload will be located in the avionics bay, on the avionics sled with the altimeters that will deploy the recovery system. Each component of the payload has a designated slot onto which they will be attached and is organized in such a way that they will be easy to wire. The avionics bay is equipped with vent holes that will allow for accurate pressure readings from the BMP 180. Finally, the avionics sled will be placed within the rocket through the use of the locking mechanism that was described in Section 4.4.

Manufacturing Stages of Avionics Bay Components

Table 6.1.1: Manufacturing Stages of Avionics Bay Components

Component	Manufacturing Stage
Coding/Programming	Completed for the payload; still need to program altimeters
Wiring	Completed wiring the payload components to each other; Still need to connect everything to switches and heat shrink all the wires to keep the e-bay neat
Locking mechanism	Successfully CNC'ed all parts; Need to sand and epoxy the parts together and into the rocket
Avionics Sled	Prototype 3D printed; Need to make relevant changes and reprint the sled; Need to place all electronics on sled and screw them down
Testing Instruments	Tested BMP180 sensor and calibrated it; Need to calibrate the MPU6050 sensor

Table 6.1.1 above displays where in the manufacturing stage each component of the avionics bay is. This demonstrates that the design stage is completed, with the exception of small changes that need to be altered as we physically begin putting parts together.

Payload Electronics

9V batteries are used because they've been used in the past and are known to supply a constant current to prevent component failure. The 9V batteries are also lightweight, have an excess amount of energy necessary for an entire flight, provide a usable voltage for the Arduino Uno and altimeters, and easy to use DC cable adapters for 9V batteries are available.

Safety switches are necessary to not only safely power the altimeters connected to the ejection charges, but to also save energy by reducing idle time on the altimeters and microcontroller. Anderson Powerpole Connector switches will be used. All switches will be placed halfway the length of the sled and will all be clumped in the same area. Figure 6.1.4 will go more in depth on the safety switches.

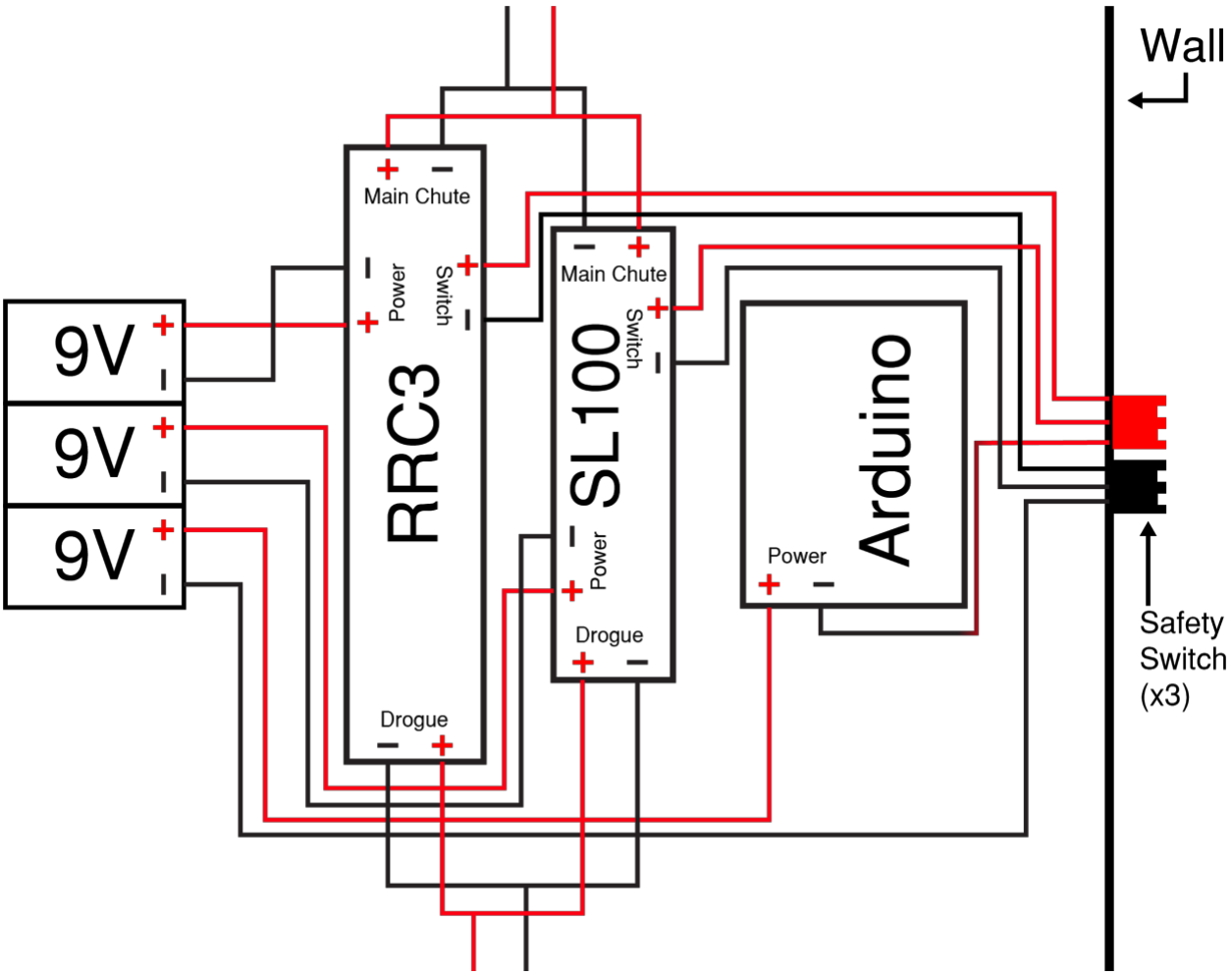

Figure 6.1.4 *Avionics schematic highlighting the use of safety switches with the altimeters and microcontroller.*

Each major component will have its own set of safety switches for a total of three safety switches. Since the Arduino has no dedicated pins for switches like the two altimeters, the ground of the battery will be attached to the switch, which induces a current once the switch is connected. The safety switch ends will be located outside of the rocket to facilitate powering the entire avionics bay. The use of switches will make it safer and more efficient to power the rocket.

No transmitter will be used, as the data will be printed on to an SD card, so there is no frequency to report.

Justification of Payload Design

The payload will be housed in the avionics bay and will reside on the sled mentioned before. The locking mechanism will be made of wood and rubber for structural integrity

and to ensure an airtight seal. The sled will be 3D printed using PLA plastic due to it having less printing limitations. Four 0.219” holes will be drilled equidistant from each other 5.5” from the locking mechanism. The distance from the locking mechanism was chosen to be halfway between the sled so the BMP180 and altimeters each experience an equal amount of ambient pressure.

7 Project Plan

7.1 Testing**

The overall design of our rocket is similar to designs used in the past, so we can trust that if we use the same process, the overall design should uphold at launch. Thus, testing will focus primarily on ensuring that the avionics bay is fully functional. The nature of the challenge this year requires that our payload records three different sets of in flight data. Several modules will be used to accomplish this. Please refer to the appendix for a complete plan for the testing of each component, to ensure that the challenge is successfully completed.

7.2 Requirements Compliance**

Table 7.2.1 lists all of the requirements in sections 1-5 of the Project Requirements that our team has yet to fulfill or is in the process of fulfilling. It also contains how each requirement needs to be verified and our plan for their verification.

Table 7.2.1: Verification Plan for Incomplete Project Requirements

Requirement	Method	Plan
General Requirements		
The team must identify all team members attending launch week activities by the time of the Critical Design Report.	Inspection	Each member on the rocket team will be inspected by the program directors. If the members have been involved with the project, they will be selected to attend the competition. This will be decided on February 24.
All teams will be required to use the launch pads provided by Tripoli Wisconsin.	Inspection	The launch pads at the competition will be inspected to ensure they are the correct ones provided by Tripoli Wisconsin. If there is doubt, our team will ask at the competition.
All projects must be completely constructed (at least 90%) ready to fly at least two (2) weeks prior to launch date.	Analysis	Analysis of previous years' design and manufacturing schedules have allowed us to create our own schedule that will ensure the rocket is complete and tested 2 weeks before the competition.
All projects mush have a picture slide show depicting construction of the motor mount and fin fillet assembly process submitted for safety inspection.	Demonstration	By demonstrating through photos how the motor mount and fin fillet assembly were manufactured, we will have sufficient evidence for the safety inspection.

Recovery System Requirements	Test	Each altimeter and the parachutes will be tested to ensure that the recovery system successfully deploys at the correct altitudes.
Safety Requirements		
For proof of construction and a safe flight, photographs/video should be made during the construction process (especially of sealed or hidden components) to ensure proper technique has been followed.	Demonstration	By demonstrating through photos and videos our methods for manufacturing our rocket, we will be able to show that proper techniques have been used.
All projects must have a minimum of two (2) virtual inspections with the WSGC Technical Advisor, prior to (to coincide with) Flight Readiness Review.	Demonstration	We will set aside times where the virtual inspection can occur in order to demonstrate the progress of our rocket.
Payload/Experiment Requirements		
Airframe parts should be Commerical off the shelf (COTS). Otherwise, must be approved by WSGC.	Demonstration	When purchasing parts, we will demonstrate that they were purchased from viable vendors through receipts and the like. Otherwise, we will send a detailed plan with the materials we will be using and how we plan to manufacture them to Frank Nobile to receive approval.
Vehicle Requirements		
The launch vehicle will be capable of being prepared for flight at the launch site within 2 hours of the time the Federal Aviation Administration flight waiver opens.	Test	Running integration tests will ensure that members attending the competition will know how to put the entire rocket together on launch day and how to prepare it for the competition.
The launch vehicle will be capable of remaining in launch-ready configuration on the pad for a minimum of 2 hours without losing the functionality of any critical on-board components	Inspection	After the rocket is fully manufactured, it will be inspected to ensure that all parts are fully functional and fit together correctly. By putting the rocket together prior to launch, we will be able to confirm that it will remain fully functional until the launch date.
The Center of Gravity (CG) and Center of Pressure (CP) must be indicated on the exterior of the rocket, from simulation, using the fully loaded configuration prior to flight.	Analysis	The final simulation run with the final rocket design will be analyzed to calculate the center of gravity and center of pressure of the manufactured rocket. This data will then be indicated on the rocket.

7.3 Project Budget

Table 7.3.1 outlines components needed by subteams with respective totals, adding up to the full budget total. It also includes funds required for travel to and from the competition.

Table 7.3.1: 2018-2019 budget.

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**

Table 7.3.2 cointains 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.

Table 7.3.2: Funding Sources for 2018-2019.

Funding Source	**Funding Access**	**Amount**
Wisconsin Space Grant Consortium (WSGC)	Reimbursements for Materials and Supplies	$3000
Previous Award Money	Purchase Orders Through the UCLA Engineering Department	$575
UCLA Engineering Alumni Association (EAA)	Purchase Orders Through the UCLA Engineering Department	$650 (materials and supplies only)
UCLA Student Organizations, Leadership & Engagement Office (SOLE)	Purchase Orders Through the UCLA Community Activities Committee (CAC) Leadership Development Fund	$1850 (travel only)
Total		**$6075**

7.4 Project Timeline

Figure 7.4.1: Timeline highlighting phases of rocket design, manufacturing, and testing.

8 Appendix

- Clear Epoxy Resin
- Graphite Powder
- GREAT STUFF Gaps & Cracks Insulating Foam
- Klean-Strip Acetone
- STRUST +SSPR 6PK GLOSS BLACK
- TAP Super Hard Epoxy Hardener
- TAP Super Hard Epoxy Resin
- WD-40

Tests	Objective	Success Criteria	Variable	Method	Justification	Results
Dropping the MPU6050 module	To ensure accuracy and functionality of accelerometer	The downward acceleration should read 9.8 m/s^2.	Acceleration	This will be tested by dropping the MPU6050 from a couple of stories.	The module needs to be tested to ensure that at least 3 sets of data are collected to fulfill the challenge.	If this test fails, a new module will need to be purchased and tested so that all 3 in flight data types are collected.
Rotating the MPU6050 module	To ensure accuracy and functionality of gyroscope	The angular velocity readings of the module should match the angular velocities programmed into the servo.	Angular velocity	This will be tested by rotating the module using a servo motor. The motor will be programmed to rotate at specific speeds.	The module needs to be tested to ensure that at least 3 sets of data are collected to fulfill the challenge.	If this test fails, a new module will need to be purchased and tested so that all 3 in flight data types are collected.
Refrigerating the BMP 180 module	To ensure accuracy and functionality of the temperature sensor	The data retrieved from the sensor should match the temperatures we set it to.	Temperature	The sensor will be placed first in a refrigerator, and then in a freezer. A digital thermometer will also be placed with it, to have a reading to compare the data to.	The module needs to be tested to ensure that at least 3 sets of data are collected to fulfill the challenge.	If this test fails, a new module will need to be purchased and tested so that all 3 in flight data types are collected.
Elevating the BMP 180 module	To ensure accuracy and functionality of the pressure sensor/altimeter readings	The data retrieved should match the increase/decrease in height of the module.	Altitude	The sensor uses pressure to measure the altitude. By taking the module from the bottom to the top of a building with a known height, we can gauge its accuracy.	The module needs to be tested to ensure that at least 3 sets of data are collected to fulfill the challenge.	If this test fails, a new module will need to be purchased and tested so that all 3 in flight data types are collected.

Tests	Objective	Success Criteria	Variable	Method	Justification	Results
Elevating the MissileWorks RRC3 altimeter	To ensure accuracy and functionality of the pressure sensor/altimeter readings	The data retrieved should match the increase/decrease in height of the module.	Altitude	The altimeter uses pressure to measure the altitude. By taking the module from the bottom to the top of a building with a known height, we can gauge its accuracy.	The altimeter needs to be tested to ensure that the altitude readings are accurate so that the recovery system will be deployed correctly in flight.	If this test fails, a new altimeter will need to be purchased and tested to ensure the recovery system deploys.
Elevating the StratoLogger altimeter	To ensure accuracy and functionality of the pressure sensor/altimeter readings	The data retrieved should match the increase/decrease in height of the module.	Altitude	The altimeter uses pressure to measure the altitude. By taking the module from the bottom to the top of a building with a known height, we can gauge its accuracy.	The altimeter needs to be tested to ensure that the altitude readings are accurate so that the recovery system will be deployed correctly in flight. The functionality of this altimeter is particularly important because it is the back up if the RRC3 altimeter fails.	If this test fails, a new altimeter will need to be purchased and tested to ensure the recovery system deploys.
Integration testing	To ensure all parts of the rocket fit well together	All parts of the rocket should fit together and nothing should slip.	Integrative-ness of rocket parts	A mock run through of the launch will be run, where all components will be put together. This includes folding the parachute within the nose cone, inserting the avionics bay, and putting together the nose cone and body tubes.	A mock run through where all of the rocket parts are put together is necessary to ensure that everything was manufactured properly. For example, if the locking mechanism is sanded down too far, the avionics bay could potentially slip. It also ensures things will run smoothly at launch. For example, that the proper method is used when folding the parachute so that it deploys correctly.	Potentially, this could result in parts having to be remade.

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
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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
THE DOW CHEMICAL COMPANY

Product name: GREAT STUFF™ Gaps & Cracks Insulating Foam Sealant 12oz HC ES STW 12ct **Issue Date:** 01/06/2016

Print Date: 06/16/2016

THE DOW CHEMICAL COMPANY encourages and expects you to read and understand the entire (M)SDS, as there is important information throughout the document. We expect you to follow the precautions identified in this document unless your use conditions would necessitate other appropriate methods or actions.

1. IDENTIFICATION

Product name: GREAT STUFF™ Gaps & Cracks Insulating Foam Sealant 12oz HC ES STW 12ct

Recommended use of the chemical and restrictions on use
Identified uses: Polyurethane foam.

COMPANY IDENTIFICATION
THE DOW CHEMICAL COMPANY
2030 WILLARD H DOW CENTER
MIDLAND MI 48674-0000
UNITED STATES

Customer Information Number: 800-258-2436
SDSQuestion@dow.com

EMERGENCY TELEPHONE NUMBER
24-Hour Emergency Contact: CHEMTREC +1 800-424-9300
Local Emergency Contact: 800-424-9300

2. HAZARDS IDENTIFICATION

Hazard classification
This material is hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29CFR 1910.1200.
Flammable aerosols - Category 2
Gases under pressure - Liquefied gas
Acute toxicity - Category 4 - Inhalation
Skin irritation - Category 2
Eye irritation - Category 2B
Respiratory sensitisation - Category 1
Skin sensitisation - Category 1
Effects on or via lactation
Specific target organ toxicity - single exposure - Category 3
Specific target organ toxicity - repeated exposure - Category 2 - Inhalation

Label elements
Hazard pictograms

Signal word: **DANGER!**

Hazards
Flammable aerosol.
Contains gas under pressure; may explode if heated.
Causes skin and eye irritation.
May cause an allergic skin reaction.
Harmful if inhaled.
May cause allergy or asthma symptoms or breathing difficulties if inhaled.
May cause respiratory irritation.
May cause harm to breast-fed children.
May cause damage to organs (Respiratory Tract) through prolonged or repeated exposure if inhaled.

Precautionary statements

Prevention
Obtain special instructions before use.
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.
Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
Avoid contact during pregnancy/ while nursing.
Wash skin thoroughly after handling.
Do not eat, drink or smoke when using this product.
Use only outdoors or in a well-ventilated area.
Contaminated work clothing should not be allowed out of the workplace.
Wear protective gloves.
In case of inadequate ventilation wear respiratory protection.

Response
IF ON SKIN: Wash with plenty of soap and water.
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
IF exposed or concerned: Get medical advice/ attention.
If skin irritation or rash occurs: Get medical advice/ attention.
If eye irritation persists: Get medical advice/ attention.
Take off contaminated clothing and wash before reuse.

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

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

Other hazards
No data available

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical nature: Polyurethane prepolymer
This product is a mixture.

Component	CASRN	Concentration
Diphenylmethane Diisocyanate, isomers and homologues	9016-87-9	>= 10.0 - <= 30.0 %
4,4' -Methylenediphenyl diisocyanate	101-68-8	>= 10.0 - <= 30.0 %
Polymethylenepolyphenylisocyanate, propoxylated glycerin polymer	57029-46-6	>= 10.0 - <= 30.0 %
Polymethylenepolyphenyl polyisocyanate, polypropyleneglycol copolymer	53862-89-8	>= 10.0 - <= 30.0 %
Tris(1-chloro-2-propyl) phosphate	13674-84-5	>= 5.0 - <= 10.0 %
Paraffin waxes and Hydrocarbon waxes, chlorinated	63449-39-8	>= 5.0 - <= 10.0 %
Isobutane	75-28-5	>= 7.0 - <= 13.0 %
Methyl ether	115-10-6	>= 1.0 - <= 5.0 %
Propane	74-98-6	>= 1.0 - <= 5.0 %

Note
Note: CAS 101-68-8 is an MDI isomer that is part of CAS 9016-87-9.

4. FIRST AID MEASURES

Description of first aid measures
General advice: First Aid responders should pay attention to self-protection and use the recommended protective clothing (chemical resistant gloves, splash protection). If potential for exposure exists refer to Section 8 for specific personal protective equipment.

Inhalation: Move person to fresh air. If not breathing, give artificial respiration; if by mouth to mouth use rescuer protection (pocket mask, etc). If breathing is difficult, oxygen should be administered by qualified personnel. Call a physician or transport to a medical facility.

Skin contact: Remove material from skin immediately by washing with soap and plenty of water. Remove contaminated clothing and shoes while washing. Seek medical attention if irritation persists. Wash clothing before reuse. An MDI skin decontamination study demonstrated that cleaning very soon after exposure is important, and that a polyglycol-based skin cleanser or corn oil may be more effective than soap and water. Discard items which cannot be decontaminated, including leather articles such as shoes, belts and watchbands. Suitable emergency safety shower facility should be available in work area.

Eye contact: Immediately flush eyes with water; remove contact lenses, if present, after the first 5 minutes, then continue flushing eyes for at least 15 minutes. Obtain medical attention without delay, preferably from an ophthalmologist. Suitable emergency eye wash facility should be immediately available.

Ingestion: If swallowed, seek medical attention. Do not induce vomiting unless directed to do so by medical personnel.

Most important symptoms and effects, both acute and delayed: Aside from the information found under Description of first aid measures (above) and Indication of immediate medical attention and special treatment needed (below), any additional important symptoms and effects are described in Section 11: Toxicology Information.

Indication of any immediate medical attention and special treatment needed
Notes to physician: Maintain adequate ventilation and oxygenation of the patient. May cause respiratory sensitization or asthma-like symptoms. Bronchodilators, expectorants and antitussives may be of help. Treat bronchospasm with inhaled beta2 agonist and oral or parenteral corticosteroids. Respiratory symptoms, including pulmonary edema, may be delayed. Persons receiving significant exposure should be observed 24-48 hours for signs of respiratory distress. Exposure may increase "myocardial irritability". Do not administer sympathomimetic drugs such as epinephrine unless absolutely necessary. If you are sensitized to diisocyanates, consult your physician regarding working with other respiratory irritants or sensitizers. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient. Excessive exposure may aggravate preexisting asthma and other respiratory disorders (e.g. emphysema, bronchitis, reactive airways dysfunction syndrome).

5. FIREFIGHTING MEASURES

Suitable extinguishing media: Water fog or fine spray. Dry chemical fire extinguishers. Carbon dioxide fire extinguishers. Foam. Alcohol resistant foams (ATC type) are preferred. General purpose synthetic foams (including AFFF) or protein foams may function, but will be less effective.

Unsuitable extinguishing media: Do not use direct water stream. Straight or direct water streams may not be effective to extinguish fire.

Special hazards arising from the substance or mixture
Hazardous combustion products: During a fire, smoke may contain the original material in addition to combustion products of varying composition which may be toxic and/or irritating. Combustion products may include and are not limited to: Nitrogen oxides. Isocyanates. Hydrogen chloride. Carbon monoxide. Carbon dioxide. Hydrogen cyanide.

Unusual Fire and Explosion Hazards: Contains flammable propellant. Aerosol cans exposed to fire can rupture and become flaming projectiles. Propellant release may result in a fireball. Vapors are

heavier than air and may travel a long distance and accumulate in low lying areas. Ignition and/or flash back may occur. Dense smoke is produced when product burns.

Advice for firefighters
Fire Fighting Procedures: Keep people away. Isolate fire and deny unnecessary entry. Stay upwind. Keep out of low areas where gases (fumes) can accumulate. Water may not be effective in extinguishing fire. Do not use direct water stream. May spread fire. Fight fire from protected location or safe distance. Consider the use of unmanned hose holders or monitor nozzles. Eliminate ignition sources. Move container from fire area if this is possible without hazard. Use water spray to cool fire-exposed containers and fire-affected zone until fire is out.

Special protective equipment for firefighters: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, trousers, boots, and gloves). Avoid contact with this material during fire fighting operations. If contact is likely, change to full chemical resistant fire fighting clothing with self-contained breathing apparatus. If this is not available, wear full chemical resistant clothing with self-contained breathing apparatus and fight fire from a remote location. For protective equipment in post-fire or non-fire clean-up situations, refer to the relevant sections.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures: Evacuate area. Only trained and properly protected personnel must be involved in clean-up operations. Keep personnel out of low areas. Keep personnel out of confined or poorly ventilated areas. Keep upwind of spill. Ventilate area of leak or spill. No smoking in area. Check area with combustible gas detector before reentering area. Ground and bond all containers and handling equipment. Confined space entry procedures must be followed before entering the area. Eliminate all sources of ignition in vicinity of spill or released vapor to avoid fire or explosion. Vapor explosion hazard. Keep out of sewers. See Section 10 for more specific information. Use appropriate safety equipment. For additional information, refer to Section 8, Exposure Controls and Personal Protection.

Environmental precautions: Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. See Section 12, Ecological Information.

Methods and materials for containment and cleaning up: Contain spilled material if possible. Ground and bond all containers and handling equipment. Isolate area until gas has dispersed. Use non-sparking tools in cleanup operations. Eliminate all sources of ignition in vicinity of spill or released vapor to avoid fire or explosion. Check area with combustible gas detector before reentering area. Ground and bond all containers and handling equipment. Collect in suitable and properly labeled containers. Absorb with materials such as: Clay. Dirt. Milsorb®. Sand. Sawdust. Vermiculite. See Section 10 for more specific information. See Section 13, Disposal Considerations, for additional information.

7. HANDLING AND STORAGE

Precautions for safe handling: Keep away from heat, sparks and flame. No smoking, open flames or sources of ignition in handling and storage area. Avoid contact with eyes, skin, and clothing. Avoid prolonged or repeated contact with skin. Avoid breathing vapor. Never use air pressure for transferring product. Wash thoroughly after handling. Keep container closed. Use only with adequate ventilation. Keep out of reach of children. Vapors are heavier than air and may travel a long distance

and accumulate in low lying areas. Ignition and/or flash back may occur. Contents under pressure. Do not puncture or incinerate container. Containers, even those that have been emptied, can contain vapors. Do not cut, drill, grind, weld, or perform similar operations on or near empty containers. Do not enter confined spaces unless adequately ventilated. Use of non-sparking or explosion-proof equipment may be necessary, depending upon the type of operation. See Section 8, EXPOSURE CONTROLS AND PERSONAL PROTECTION.

Conditions for safe storage: Minimize sources of ignition, such as static build-up, heat, spark or flame. Store in a dry place. See Section 10 for more specific information.

Storage stability

Storage temperature:	Storage Period:
25 °C (77 °F)	12 Month

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure limits are listed below, if they exist.

Component	Regulation	Type of listing	Value/Notation
4,4' -Methylenediphenyl diisocyanate	Dow IHG	TWA	0.005 ppm
	Dow IHG	STEL	0.02 ppm
	ACGIH	TWA	0.005 ppm
	OSHA Z-1	C	0.2 mg/m3 0.02 ppm
	NIOSH REL	TWA	0.05 mg/m3 0.005 ppm
	NIOSH REL	C	0.2 mg/m3 0.02 ppm
Isobutane	ACGIH	STEL	1,000 ppm
Methyl ether	US WEEL	TWA	1,000 ppm
Propane	ACGIH		Asphyxiant
	OSHA Z-1	TWA	1,800 mg/m3 1,000 ppm

This material contains a simple asphyxiant which may displace oxygen. Insure adequate ventilation to prevent an oxygen deficient atmosphere.
The minimum requirement of 19.5% oxygen at sea level (148 torr O2, dry air) provides an adequate amount of oxygen for most work assignments.

Exposure controls

Engineering controls: Use only with adequate ventilation. Local exhaust ventilation may be necessary for some operations. Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines. Exhaust systems should be designed to move the air away from the source of vapor/aerosol generation and people working at this point. The odor and irritancy of this material are inadequate to warn of excessive exposure. Lethal concentrations may exist in areas with poor ventilation.

Individual protection measures

Eye/face protection: Use safety glasses (with side shields).

Skin protection

Hand protection: Use gloves chemically resistant to this material. Examples of preferred glove barrier materials include: Butyl rubber. Chlorinated polyethylene. Polyethylene. Ethyl vinyl alcohol laminate ("EVAL"). Examples of acceptable glove

barrier materials include: Neoprene. Nitrile/butadiene rubber ("nitrile" or "NBR"). Viton. Polyvinyl chloride ("PVC" or "vinyl"). NOTICE: The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials, as well as the instructions/specifications provided by the glove supplier.
Other protection: Use protective clothing chemically resistant to this material. Selection of specific items such as face shield, boots, apron, or full body suit will depend on the task.

Respiratory protection: Atmospheric levels should be maintained below the exposure guideline. When atmospheric levels may exceed the exposure guideline, use an approved air-purifying respirator equipped with an organic vapor sorbent and a particle filter. For situations where the atmospheric levels may exceed the level for which an air-purifying respirator is effective, use a positive-pressure air-supplying respirator (air line or self-contained breathing apparatus). For emergency response or for situations where the atmospheric level is unknown, use an approved positive-pressure self-contained breathing apparatus or positive-pressure air line with auxiliary self-contained air supply. In confined or poorly ventilated areas, use an approved self-contained breathing apparatus or positive pressure air line with auxiliary self-contained air supply.
The following should be effective types of air-purifying respirators: Organic vapor cartridge with a particulate pre-filter.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	
Physical state	Foam
Color	Yellow
Odor	Mild
Odor Threshold	No test data available
pH	Not applicable
Melting point/range	No test data available
Freezing point	No test data available
Boiling point (760 mmHg)	Not applicable
Flash point	**closed cup** -104 °C (-155 °F) *Closed Cup*
Evaporation Rate (Butyl Acetate = 1)	No test data available
Flammability (solid, gas)	No data available
Lower explosion limit	No test data available
Upper explosion limit	No test data available
Vapor Pressure	1,151 hPa at 55 °C (131 °F) *Not reported* Container is under pressure.
Relative Vapor Density (air = 1)	No test data available
Relative Density (water = 1)	1.06 *Estimated.*
Water solubility	Insoluble
Partition coefficient: n-octanol/water	No data available

Auto-ignition temperature	No test data available
Decomposition temperature	No test data available
Kinematic Viscosity	Not applicable
Explosive properties	Not explosive
Oxidizing properties	No
Molecular weight	No test data available

NOTE: The physical data presented above are typical values and should not be construed as a specification.

10. STABILITY AND REACTIVITY

Reactivity: No data available

Chemical stability: Stable under recommended storage conditions. See Storage, Section 7. Unstable at elevated temperatures.

Possibility of hazardous reactions: Can occur. Exposure to elevated temperatures can cause product to decompose and generate gas. This can cause pressure build-up and/or rupturing of closed containers. Acids.

Conditions to avoid: Avoid temperatures above 50 °C
Elevated temperatures can cause container to vent and/or rupture. Exposure to elevated temperatures can cause product to decompose.

Incompatible materials: Avoid contact with: Acids. Alcohols. Amines. Ammonia. Bases. Metal compounds. Strong oxidizers. Products based on diisocyanates like TDI and MDI react with many materials to release heat. The reaction rate increases with temperature as well as with increased contact; these reactions can become violent. Contact is increased by stirring or if the other material acts as a solvent. Products based on diisocyanates such as TDI and MDI are not soluble in water and will sink to the bottom, but react slowly at the interface. The reaction forms carbon dioxide gas and a layer of solid polyurea. Reaction with water will generate carbon dioxide and heat.

Hazardous decomposition products: Decomposition products depend upon temperature, air supply and the presence of other materials. Toxic gases are released during decomposition.

11. TOXICOLOGICAL INFORMATION

Toxicological information appears in this section when such data is available.

Acute toxicity

Acute oral toxicity

Low toxicity if swallowed. Small amounts swallowed incidentally as a result of normal handling operations are not likely to cause injury; however, swallowing larger amounts may cause injury. Observations in animals include: Gastrointestinal irritation.

As product: Single dose oral LD50 has not been determined.

LD50, Rat, > 2,000 mg/kg Estimated.

Acute dermal toxicity
Prolonged skin contact is unlikely to result in absorption of harmful amounts.

As product: The dermal LD50 has not been determined.

LD50, Rabbit, > 2,000 mg/kg Estimated.

Acute inhalation toxicity
In confined or poorly ventilated areas, vapor can easily accumulate and can cause unconsciousness and death due to displacement of oxygen. Excessive exposure may cause irritation to upper respiratory tract (nose and throat) and lungs. May cause pulmonary edema (fluid in the lungs.) Effects may be delayed. May cause central nervous system depression. Symptoms of excessive exposure may be anesthetic or narcotic effects; dizziness and drowsiness may be observed. Excessive exposure may increase sensitivity to epinephrine and increase myocardial irritability (irregular heartbeats). Decreased lung function has been associated with overexposure to isocyanates.
As product: The LC50 has not been determined.

Skin corrosion/irritation
Prolonged contact may cause moderate skin irritation with local redness.
Material may stick to skin causing irritation upon removal.
May stain skin.

Serious eye damage/eye irritation
May cause moderate eye irritation.
May cause slight temporary corneal injury.

Sensitization
Skin contact may cause an allergic skin reaction.
Animal studies have shown that skin contact with isocyanates may play a role in respiratory sensitization.

May cause allergic respiratory reaction.
MDI concentrations below the exposure guidelines may cause allergic respiratory reactions in individuals already sensitized.
Asthma-like symptoms may include coughing, difficult breathing and a feeling of tightness in the chest. Occasionally, breathing difficulties may be life threatening.

Specific Target Organ Systemic Toxicity (Single Exposure)
May cause respiratory irritation.
Route of Exposure: Inhalation

Specific Target Organ Systemic Toxicity (Repeated Exposure)
Tissue injury in the upper respiratory tract and lungs has been observed in laboratory animals after repeated excessive exposures to MDI/polymeric MDI aerosols.

Carcinogenicity
Lung tumors have been observed in laboratory animals exposed to respirable aerosol droplets of MDI/Polymeric MDI (6 mg/m3) for their lifetime. Tumors occurred concurrently with respiratory

irritation and lung injury. Current exposure guidelines are expected to protect against these effects reported for MDI.

Teratogenicity
In laboratory animals, MDI/polymeric MDI did not cause birth defects; other fetal effects occurred only at high doses which were toxic to the mother.

Reproductive toxicity
Based on information for component(s): May cause harm to breastfed babies.

Mutagenicity
In vitro genetic toxicity studies were negative for component(s) tested. Genetic toxicity data on MDI are inconclusive. MDI was weakly positive in some in vitro studies; other in vitro studies were negative. Animal mutagenicity studies were predominantly negative.

Aspiration Hazard
Based on physical properties, not likely to be an aspiration hazard.

COMPONENTS INFLUENCING TOXICOLOGY:

Diphenylmethane Diisocyanate, isomers and homologues

Acute inhalation toxicity
LC50, Rat, 4 Hour, dust/mist, 0.49 mg/l

For similar material(s): 2,4'-Diphenylmethane diisocyanate (CAS 5873-54-1). LC50, Rat, 4 Hour, Aerosol, 0.31 mg/l

For similar material(s): 4,4'-Methylenediphenyl diisocyanate (CAS 101-68-8). LC50, Rat, 1 Hour, Aerosol, 2.24 mg/l

4,4' -Methylenediphenyl diisocyanate

Acute inhalation toxicity
LC50, Rat, 1 Hour, dust/mist, 2.24 mg/l

Polymethylenepolyphenylisocyanate, propoxylated glycerin polymer

Acute inhalation toxicity
The LC50 has not been determined.

Polymethylenepolyphenyl polyisocyanate, polypropyleneglycol copolymer

Acute inhalation toxicity
The LC50 has not been determined.

Tris(1-chloro-2-propyl) phosphate

Acute inhalation toxicity
LC50, Rat, 4 Hour, dust/mist, > 7 mg/l

Paraffin waxes and Hydrocarbon waxes, chlorinated

Acute inhalation toxicity
The LC50 has not been determined.

Isobutane

Acute inhalation toxicity
LC50, Mouse, 1 Hour, 52 mg/l

Methyl ether

Acute inhalation toxicity
LC50, Rat, 4 Hour, gas, 164000 ppm

Propane

Acute inhalation toxicity
LC50, Rat, male and female, 4 Hour, vapour, > 425000 ppm

12. ECOLOGICAL INFORMATION

Ecotoxicological information appears in this section when such data is available.

Toxicity

Diphenylmethane Diisocyanate, isomers and homologues

Acute toxicity to fish
The measured ecotoxicity is that of the hydrolyzed product, generally under conditions maximizing production of soluble species.
Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).
Based on information for a similar material:
LC50, Danio rerio (zebra fish), static test, 96 Hour, > 1,000 mg/l, OECD Test Guideline 203 or Equivalent

Acute toxicity to aquatic invertebrates
Based on information for a similar material:
EC50, Daphnia magna (Water flea), static test, 24 Hour, > 1,000 mg/l, OECD Test Guideline 202 or Equivalent

Acute toxicity to algae/aquatic plants
Based on information for a similar material:
NOEC, Desmodesmus subspicatus (green algae), static test, 72 Hour, Growth rate inhibition, 1,640 mg/l, OECD Test Guideline 201 or Equivalent

Toxicity to bacteria
Based on information for a similar material:
EC50, activated sludge, static test, 3 Hour, Respiration rates., > 100 mg/l

Toxicity to soil-dwelling organisms
EC50, Eisenia fetida (earthworms), Based on information for a similar material:, 14 d, > 1,000 mg/kg

Toxicity to terrestrial plants
EC50, Avena sativa (oats), Growth inhibition, 1,000 mg/l
EC50, Lactuca sativa (lettuce), Growth inhibition, 1,000 mg/l

4,4' -Methylenediphenyl diisocyanate

Acute toxicity to fish
The measured ecotoxicity is that of the hydrolyzed product, generally under conditions maximizing production of soluble species.

Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).
Based on information for a similar material:
LC50, Danio rerio (zebra fish), static test, 96 Hour, > 1,000 mg/l, OECD Test Guideline 203 or Equivalent

Acute toxicity to aquatic invertebrates
Based on information for a similar material:
EC50, Daphnia magna (Water flea), static test, 24 Hour, > 1,000 mg/l, OECD Test Guideline 202 or Equivalent

Acute toxicity to algae/aquatic plants
Based on information for a similar material:
NOEC, Desmodesmus subspicatus (green algae), static test, 72 Hour, Growth rate inhibition, 1,640 mg/l, OECD Test Guideline 201 or Equivalent

Toxicity to bacteria
Based on information for a similar material:
EC50, activated sludge, static test, 3 Hour, Respiration rates., > 100 mg/l

Toxicity to soil-dwelling organisms
EC50, Eisenia fetida (earthworms), Based on information for a similar material:, 14 d, > 1,000 mg/kg

Toxicity to terrestrial plants
EC50, Avena sativa (oats), Growth inhibition, 1,000 mg/l
EC50, Lactuca sativa (lettuce), Growth inhibition, 1,000 mg/l

Polymethylenepolyphenylisocyanate, propoxylated glycerin polymer

Acute toxicity to fish
For this family of materials:
Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).

Polymethylenepolyphenyl polyisocyanate, polypropyleneglycol copolymer

Acute toxicity to fish
Not expected to be acutely toxic to aquatic organisms.

Tris(1-chloro-2-propyl) phosphate

Acute toxicity to fish
Material is slightly toxic to aquatic organisms on an acute basis (LC50/EC50 between 10 and 100 mg/L in the most sensitive species tested).
LC50, Lepomis macrochirus (Bluegill sunfish), static test, 96 Hour, 84 mg/l, OECD Test Guideline 203 or Equivalent

Acute toxicity to aquatic invertebrates
EC50, Daphnia magna (Water flea), 48 Hour, 131 mg/l

Acute toxicity to algae/aquatic plants
ErC50, Pseudokirchneriella subcapitata (green algae), static test, 96 Hour, Growth rate inhibition, 82 mg/l, OECD Test Guideline 201 or Equivalent

Toxicity to bacteria

EC50, activated sludge, Respiration inhibition, 3 Hour, 784 mg/l, OECD 209 Test

Chronic toxicity to aquatic invertebrates
NOEC, Daphnia magna (Water flea), semi-static test, 21 d, number of offspring, 32 mg/l
LOEC, Daphnia magna (Water flea), semi-static test, 21 d, number of offspring, > 32 mg/l

Paraffin waxes and Hydrocarbon waxes, chlorinated

Acute toxicity to fish
Material is highly toxic to aquatic organisms on an acute basis (LC50/EC50 between 0.1 and 1 mg/L in the most sensitive species tested).
LC50, Oncorhynchus mykiss (rainbow trout), 96 Hour, > 0.1 mg/l

Isobutane

Acute toxicity to fish
No relevant data found.

Methyl ether

Acute toxicity to fish
Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).
LC50, Poecilia reticulata (guppy), semi-static test, 96 Hour, > 4,000 mg/l

Acute toxicity to aquatic invertebrates
LC50, Daphnia magna (Water flea), 48 Hour, > 4,000 mg/l, OECD Test Guideline 202 or Equivalent

Propane

Acute toxicity to fish
No relevant data found.

Persistence and degradability

Diphenylmethane Diisocyanate, isomers and homologues

Biodegradability: In the aquatic and terrestrial environment, material reacts with water forming predominantly insoluble polyureas which appear to be stable. In the atmospheric environment, material is expected to have a short tropospheric half-life, based on calculations and by analogy with related diisocyanates.
10-day Window: Not applicable
Biodegradation: 0 %
Exposure time: 28 d
Method: OECD Test Guideline 302C or Equivalent

4,4' -Methylenediphenyl diisocyanate

Biodegradability: In the aquatic and terrestrial environment, material reacts with water forming predominantly insoluble polyureas which appear to be stable. In the atmospheric environment, material is expected to have a short tropospheric half-life, based on calculations and by analogy with related diisocyanates.
10-day Window: Not applicable
Biodegradation: 0 %
Exposure time: 28 d
Method: OECD Test Guideline 302C or Equivalent

Polymethylenepolyphenylisocyanate, propoxylated glycerin polymer

Biodegradability: For this family of materials: Material is readily biodegradable. Passes OECD test(s) for ready biodegradability.

Polymethylenepolyphenyl polyisocyanate, polypropyleneglycol copolymer

Biodegradability: Expected to degrade slowly in the environment.

Tris(1-chloro-2-propyl) phosphate

Biodegradability: Material is expected to biodegrade very slowly (in the environment). Fails to pass OECD/EEC tests for ready biodegradability.
10-day Window: Fail
Biodegradation: 14 %
Exposure time: 28 d
Method: OECD Test Guideline 301E or Equivalent
10-day Window: Not applicable
Biodegradation: 95 %
Exposure time: 64 d
Method: OECD Test Guideline 302A or Equivalent

Theoretical Oxygen Demand: 1.17 mg/mg

Photodegradation
Test Type: Half-life (indirect photolysis)
Sensitizer: OH radicals
Atmospheric half-life: 0.24 d
Method: Estimated.

Paraffin waxes and Hydrocarbon waxes, chlorinated

Biodegradability: Expected to degrade slowly in the environment.

Theoretical Oxygen Demand: 2.89 mg/mg

Isobutane

Biodegradability: Biodegradation may occur under aerobic conditions (in the presence of oxygen).

Theoretical Oxygen Demand: 3.58 mg/mg

Photodegradation
Test Type: Half-life (indirect photolysis)
Sensitizer: OH radicals
Atmospheric half-life: 4.4 d
Method: Estimated.

Methyl ether

Biodegradability: Material is expected to biodegrade very slowly (in the environment). Fails to pass OECD/EEC tests for ready biodegradability.
10-day Window: Fail
Biodegradation: 5 %
Exposure time: 28 d
Method: OECD Test Guideline 301A or Equivalent

Theoretical Oxygen Demand: 2.08 mg/mg

Photodegradation
Test Type: Half-life (indirect photolysis)
Sensitizer: OH radicals
Atmospheric half-life: 6.4 d
Method: Estimated.

Propane

Biodegradability: No relevant data found.

Theoretical Oxygen Demand: 3.64 mg/mg

Photodegradation
Test Type: Half-life (indirect photolysis)
Sensitizer: OH radicals
Atmospheric half-life: 8.4 d
Method: Estimated.

Bioaccumulative potential

Diphenylmethane Diisocyanate, isomers and homologues

Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3). Reacts with water. In the aquatic and terrestrial environment, movement is expected to be limited by its reaction with water forming predominantly insoluble polyureas.
Bioconcentration factor (BCF): 92 Cyprinus carpio (Carp) 28 d

4,4' -Methylenediphenyl diisocyanate

Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3). Reacts with water. In the aquatic and terrestrial environment, movement is expected to be limited by its reaction with water forming predominantly insoluble polyureas.
Bioconcentration factor (BCF): 92 Cyprinus carpio (Carp) 28 d

Polymethylenepolyphenylisocyanate, propoxylated glycerin polymer

Bioaccumulation: No relevant data found.

Polymethylenepolyphenyl polyisocyanate, polypropyleneglycol copolymer

Bioaccumulation: In the aquatic and terrestrial environment, movement is expected to be limited by its reaction with water forming predominantly insoluble polyureas.

Tris(1-chloro-2-propyl) phosphate

Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3).
Partition coefficient: n-octanol/water(log Pow): 2.59 Measured
Bioconcentration factor (BCF): 0.8 - 4.6 Cyprinus carpio (Carp) 42 d Measured

Paraffin waxes and Hydrocarbon waxes, chlorinated

Bioaccumulation: Bioconcentration potential is low (BCF less than 100 or log Pow greater than 7).
Partition coefficient: n-octanol/water(log Pow): 7.4 Estimated.

Isobutane

Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3).
Partition coefficient: n-octanol/water(log Pow): 2.76 Measured

Methyl ether

Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3).
Partition coefficient: n-octanol/water(log Pow): 0.10 Measured

Propane
Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3).
Partition coefficient: n-octanol/water(log Pow): 2.36 Measured

Mobility in soil

Diphenylmethane Diisocyanate, isomers and homologues
In the aquatic and terrestrial environment, movement is expected to be limited by its reaction with water forming predominantly insoluble polyureas.

4,4' -Methylenediphenyl diisocyanate
In the aquatic and terrestrial environment, movement is expected to be limited by its reaction with water forming predominantly insoluble polyureas.

Polymethylenepolyphenylisocyanate, propoxylated glycerin polymer
No relevant data found.

Polymethylenepolyphenyl polyisocyanate, polypropyleneglycol copolymer
In the aquatic and terrestrial environment, movement is expected to be limited by its reaction with water forming predominantly insoluble polyureas.

Tris(1-chloro-2-propyl) phosphate
Potential for mobility in soil is slight (Koc between 2000 and 5000).
Partition coefficient(Koc): 1300 Estimated.

Paraffin waxes and Hydrocarbon waxes, chlorinated
Expected to be relatively immobile in soil (Koc > 5000).
Given its very low Henry's constant, volatilization from natural bodies of water or moist soil is not expected to be an important fate process.
Partition coefficient(Koc): > 5000 Estimated.

Isobutane
Potential for mobility in soil is very high (Koc between 0 and 50).
Partition coefficient(Koc): 35 Estimated.

Methyl ether
Potential for mobility in soil is very high (Koc between 0 and 50).
Partition coefficient(Koc): 1.29 - 14 Estimated.

Propane
Potential for mobility in soil is very high (Koc between 0 and 50).
Partition coefficient(Koc): 24 - 460 Estimated.

13. DISPOSAL CONSIDERATIONS

Disposal methods: DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. All disposal practices must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and

compliance with applicable laws are the responsibility solely of the waste generator. AS YOUR SUPPLIER, WE HAVE NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS INTENDED CONDITION AS DESCRIBED IN MSDS SECTION: Composition Information. FOR UNUSED & UNCONTAMINATED PRODUCT, the preferred options include sending to a licensed, permitted: Incinerator or other thermal destruction device.

14. TRANSPORT INFORMATION

DOT

Proper shipping name	Aerosols
UN number	UN 1950
Class	2.1
Packing group	
Reportable Quantity	MDI

Classification for SEA transport (IMO-IMDG):

Proper shipping name	AEROSOLS
UN number	UN 1950
Class	2.1
Packing group	
Marine pollutant	Paraffin waxes and Hydrocarbon waxes, chlorinated
Transport in bulk according to Annex I or II of MARPOL 73/78 and the IBC or IGC Code	Consult IMO regulations before transporting ocean bulk

Classification for AIR transport (IATA/ICAO):

Proper shipping name	Aerosols, flammable
UN number	UN 1950
Class	2.1
Packing group	

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Transportation classifications may vary by container volume and may be influenced by regional or country variations in regulations. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

15. REGULATORY INFORMATION

OSHA Hazard Communication Standard
This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Sections 311 and 312
Acute Health Hazard
Chronic Health Hazard
Fire Hazard

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Section 313
This product contains the following substances which are subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and which are listed in 40 CFR 372.

Components	**CASRN**
Diphenylmethane Diisocyanate, isomers and homologues	9016-87-9
4,4' -Methylenediphenyl diisocyanate	101-68-8

Pennsylvania Worker and Community Right-To-Know Act:
The following chemicals are listed because of the additional requirements of Pennsylvania law:

Components	**CASRN**
Isobutane	75-28-5
Methyl ether	115-10-6
Propane	74-98-6

California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986)
This product contains no listed substances known to the State of California to cause cancer, birth defects or other reproductive harm, at levels which would require a warning under the statute.

United States TSCA Inventory (TSCA)
All components of this product are in compliance with the inventory listing requirements of the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

16. OTHER INFORMATION

Revision
Identification Number: 101265380 / A001 / Issue Date: 01/06/2016 / Version: 8.0
Most recent revision(s) are noted by the bold, double bars in left-hand margin throughout this document.

Legend

ACGIH	USA. ACGIH Threshold Limit Values (TLV)
Asphyxiant	Asphyxiant
C	Ceiling

Dow IHG	Dow Industrial Hygiene Guideline
NIOSH REL	USA. NIOSH Recommended Exposure Limits
OSHA Z-1	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
STEL	Short term exposure limit
TWA	Time weighted average
US WEEL	USA. Workplace Environmental Exposure Levels (WEEL)

Information Source and References
This SDS is prepared by Product Regulatory Services and Hazard Communications Groups from information supplied by internal references within our company.

THE DOW CHEMICAL COMPANY urges each customer or recipient of this (M)SDS to study it carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this (M)SDS and any hazards associated with the product. The information herein is provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his activities comply with all federal, state, provincial or local laws. The information presented here pertains only to the product as shipped. Since conditions for use of the product are not under the control of the manufacturer, it is the buyer's/user's duty to determine the conditions necessary for the safe use of this product. Due to the proliferation of sources for information such as manufacturer-specific (M)SDSs, we are not and cannot be responsible for (M)SDSs obtained from any source other than ourselves. If you have obtained an (M)SDS from another source or if you are not sure that the (M)SDS you have is current, please contact us for the most current version.

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)

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

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