NASA STUDENT LAUNCH
CDR RESPONSE

CEDAR PARK HOME SCHOOL

C/O CAPSTONE WORKS, INC.
715 DISCOVERY BLVD., STE 101
CEDAR PARK, TX 78613

SUBMITTED: 11/4/2016

EXPLORATION OF THE USE OF MAGNETIC LEVITATION TO DAMPEN G-FORCES EXPERIENCED DURING LAUNCH

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ADULT EDUCATORS

Charles Adams, B.S. Physics, Carnegie Mellon University, 1983
Sr. Team Mentor
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- NAR Member #98900 SR/AARG #583
- HPR Cert Level 1

Alexander Adams, Born to Lead Academy, Graduate 2016
Team Mentor
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alex.adams@capstoneworks.com

- NAR Member #101808 SR/AARG #583
- HPR Cert Level 1

SAFETY OFFICER

Ryan Raglin, 8th Grade, Home Schooled

Alex Adams, NAR Mentor Safety Oversight

TEAM LEAD/PROJECT MANAGER

Josh Thayer, 11th Grade, Home Schooled

14 students will be participating - their names, duties and responsibilities are included in the Team Member Info section.

NAR SECTION

We will be launching with and be mentored by NAR Section #585, the Austin Area Rocketry Group

FACILITIES AND EQUIPMENT

Our main facility will be TechShop, a membership based workshop where you can use any tool or machine you want as long as you take the Safety and Basic Use (SBU) class for each one. The hours for the facility main lobby are 10AM to 8PM, Monday through Saturday, but people can access the workshop from 9AM to 12AM if they have a member's pass.

TechShop has a metal shop with welders, machines to manipulate sheet metal, painting booth, equipment for powder coating, and a CNC waterjet, it also has a wood shop with different types of saws, including a CNC shopbot, in addition, it has a machine shop, with tools for shaping metal including lathes and mills, finally, in the main area, it has laser cutters, 3D printers, power tools, and basic materials like tape and glue.

Since an adult with a membership has to accompany minors, Morinne Kearns will be one of the people who must be present. Aedan Kearns also has a TechShop membership, be he is a minor. Both Morinne and Aedan Kearns have taken the SBU's for many of the machines, so for work to be done at a reasonable pace they both have to be there. One of the mentors, Alex or Chuck Adams, would also have to be there to supervise.

TOOLS NEEDED:

- Saws (manual and electric)
- Drills and drill bits
- Spray gun
- Vices
- Tape measures
- Screwdrivers
- Pliers
- Scissors
- Solder
- Solder gun
- Electrical tape
- Sand paper
- Latex gloves safety goggles
- Breathing masks

REQUIRED MATERIALS:

- Assorted fiberglass tubes and fins
- Plastic nose cone
- Loctite Epoxy
- Acetone
- Screws, nuts, washers, bolts, etc.
- TelemetryPro® Tracking System
- (2) Perfect Flite Stratologger Altimeter
-
- (4) Spark Fun ADXL345 or similar
- Super glue
- Spray paint

- Various Grits of Sandpaper
- Redundant Batteries
- Redundant Ejection Systems
- Recovery Systems, Drogue and Main

CHANGES MADE SINCE PDR

SCALE MODEL PARTS LIST

Materials:

- Bass wood triangular fins
- 7-inch Balsa nose cone with a diameter of 2 inches.
- Payload body tube section 12 inches long 2 1/4-inch diameter
- Lower body tube section 12 inches long 2 1/4-inch diameter
- Paper coupler 4 inches' long 2-inch inner diameter
- Balsa bulkhead
- Stainless steel eyebolt
- Two balsa centering rings OD 2 inches ID 24 MM
- 24 mm motor tube
- 58 inch Kevlar shock cord
- 28-inch elastic shock cords
- 6.9 seconds to apogee
- 18.1 seconds decent
- Diameter of parachute 14 inches
- 31 total inches

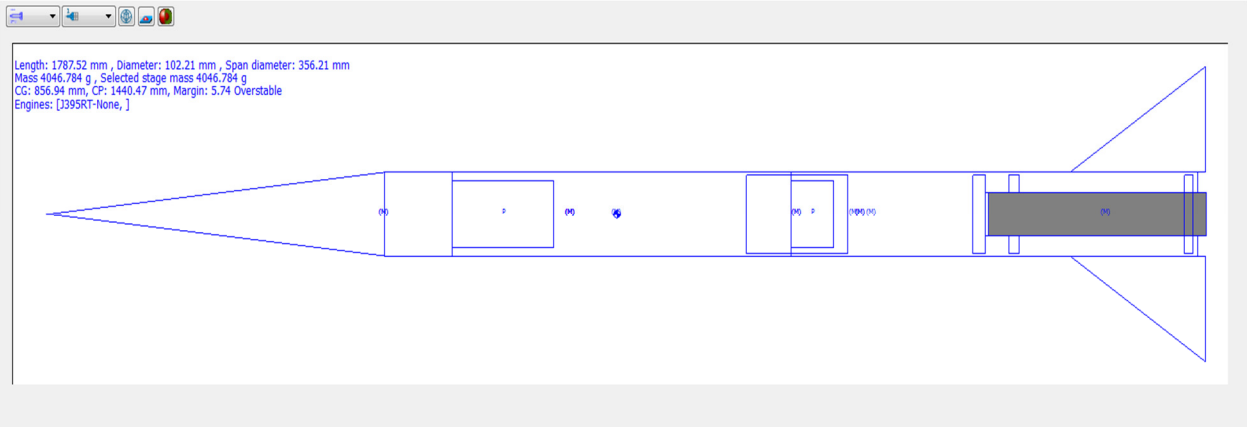
Minimum and Maximum Price Estimates

$969.00 - $1518.40

Motor Prices (ea)

$74 - $85

TECHNICAL DESIGN



Length: 1787.52 mm , Mass 4046.784g ,
Diameter: 102.21 mm , Span Diameter 356.21 mm ,
CG: 856.94 mm, CP: 1440.47 mm, Margin: 5.74 Overstable
Engines: [J395RT]

Our rocket is 1.79 meters long, and the pre-burn mass is 4046.8g. The main material we decided to use is Fiberglass because it is lighter, less brittle and more cost effective. According to Rocksim our rocket achieved an altitude of 5402 feet. Based on our experience with Rocksim, it achieves a height of around 20 percent higher than the rocket actually flies during tests so the goal height in Rocksim is 6,000 feet.

The main parachute has a 36in diameter, a 2in spill hole diameter, and 73in shroud lines. Our drogue parachute has a 18in diameter, and a 1in spill hole diameter.

The motor we chose to use is the J395RT made by gorilla motor works. Its moderately high initial thrust and long burn serves the needs of our rocket well (chart below).

To reduce drag and add stability we are using a conical nose cone shape. We are using 4 triangular fins instead of three for stability, creating a long thin rocket.

The vehicle:

- will have a polished outer surface
- reaches an altitude of 5402.5 feet in Rocksim with our specified payload
- carries redundant altimeters capable of reading our altitude while using a redundant commercially available source of powers
- contains redundant recovery circuit boards, and deployment systems are powered by a redundant commercially available source of power
- will be ready for a new launch within 2 hours of the Vehicle recovery of the previous launch
- is comprised of three sections all tethered together by Kevlar shock cord. Consisting of the nose cone, the middle body tube and end body tube
- is propelled by a one single stage K motor
- can remain in a launch ready status for no less than one hour and up to four hours
- will meet all other ancillary requirements of the PDR

VEHICLE INFORMATION

For our rocket propulsion selection, we choose the J395RT to get us to the specified height. We ruled out about 4 other motors/engines and rocket designs either because they did not leave enough margin to get us to the target height and still be able to adapt to weather conditions, or because they did not meet all the requirements including target altitude. This motor has an unusually long burn time which allows for more impulse enabling the rocket to get to its destination more easily even if we are face harsh weather conditions such as rain, sleet, elevated wind speeds, and extreme humidity.

For our recovery system we are currently using redundant black powder charges for the drogue parachute, and additionally redundant black powder charges for the main parachute, driven by 2 separate circuit boards, batteries and systems to avoid failure of parachute deployment.

Our dimensions are 162.89cm long, and 15.87cm in diameter. According to Rocksim the rocket goes exactly 6,000 feet, but from our experience and knowledge Rocksim height estimate is about 20 percent low so according to our calculations the rocket should reach our target height, 5,280 feet. If the rocket does exceed the target height during initial testing, mass can be added to reduce the altitude of apogee.

PAYLOAD

The payload we chose focuses on a futuristic technology: using magnetic levitation for G-force damping. G-force damping is useful in that manned and unmanned space vehicles can only go at a speed which is safe for astronauts and equipment. With g-force damping technology called Magnetic Levitation, rockets in the future can reach greater speeds, allowing for inter-planetary travel faster than ever before. Magnetic levitation is a method by which an object is suspended with no support other than magnetic fields. Magnetic forces are used to counteract the effects of the G-forces and shocks. The two primary issues involved in magnetic levitation are lifting forces - providing magnetic repulsion sufficient to successfully oppose gravity, and stability - ensuring that the system does not spontaneously slide or flip into a position where the levitation is rendered impossible. Another way to do it is to use diamagnetism. Diamagnetism is the property of an object which causes it to create a magnetic field in opposition to an outer magnetic field, thus causing the material to be repelled by magnetism. Diamagnetic materials cause magnetic fields to curve away from the material. Specifically, an outer magnetic field changes the orbital speed of electrons around their nuclei, thus changing the magnetic dipole moment. Diamagnetism is a form of magnetism that is only exhibited by a substance in the area of an outer magnetic field. It is generally quite weak in most materials, although bismuth and superconductors exhibit a strong effect.

The idea is that magnets on an object being used as a payload will repel each other, thereby causing that object to float in midair inside the payload bay, which, we hope, will dampen sudden accelerations in that given object. The payload will be a hollow sphere with three bar magnets inside running crosswise, lengthwise, and height wise. The sphere is within another sphere with six small bar magnets, one in each direction, all pointed at the payload. The outer sphere will be attached to the inside of the payload bay with screws in four places spaced evenly around the outside of the rocket There will be two accelerometers mounted within the spheres, one in the middle of the interior sphere to measure the supposedly dampened forces and another accelerometer mounted within the outer sphere to measure the undamped forces. There will also be a camera mounted on the inside of the outer sphere to observe the payload during flight. The spheres will be made out of plastic, and the accelerometers will come from Sparkfun.com. We will analyze the experiment by watching the video and uploading the results from the accelerometers. We will report the results of the experiment to NASA in the PLAR.

BACKUP PAYLOAD

Just in case there is some unforeseen problem with the magnetic levitation experiment, we have come up with a backup experiment. The experiment would be the impact of

high g-forces on a slime mold's growth pattern and rate. The first step of the experiment would be to send the slime mold sclerotium up in a rocket, and letting them experience high g-forces. Next would be to take the sclerotium from the rocket and grow it next to a control, both in the exact same conditions and time. The final step would be to measure growth rates and observe growth patterns to see if there are any differences between the two slime molds. The slime molds would be grown in separate petri dishes with food placed in the same locations for each. The slime molds' behavior would then be compared to see if there is any difference between the two. Comparing the growth rate would be as simple as using a ruler to measure the distance traveled over a certain time interval, like one day. The slime mold used will be *Physarum polycephalum*, a slime mold that likes wet, cool, and shady areas.

One of the reasons to test the effects of a rocket launch on slime mold is possible infection of extraterrestrial objects. If a rocket launch stops growth then there will be less to worry about, but if it doesn't affect or if it even speeds up growth then that would be something to be much more concerned about. The slime mold could hitch a ride to Mars in a manned capsule, and if it does, it is important to know how to prevent it from infecting Mars and ruining many possible experiments having to do with life on Mars.

Slime molds can also solve complex problems like the shortest path problem, transportation problems, and even the Euclidean Steiner tree problem. Problems that computers have trouble solving, because of the sheer amount of information that has to be processed. Because of this, slime molds could be used to compute resource allocation on the ISS and on spacecraft, or in satellites to find the most efficient communication network. If the launch of the slime mold changed its properties, then these bio computers wouldn't work as intended.

If the large amount of acceleration somehow changed the slime mold's behavior, it could also shed some light on the inner workings of this organism, and perhaps enable researchers to create a complete computer model of slime mold's logic systems, which would enable scientists to create computers that could solve complex problems, or even, in the distant future, emulate the human brain.

EDUCATIONAL/SOCIAL ENGAGEMENT

As far as community outreach is concerned, we have been able to identify several organizations that present an excellent opportunity for bringing our mission and its excitement to the public.

Initially, we intend to reach out to local middle and high schools through workshops and presentations, hopefully garnering an audience of 800+ individuals with ages ranging from 11-16 between the middle and high schools.

Also, several of our team members have connections in the local Boy and Cub Scout divisions, providing easy access to presentation opportunities to a wide age range of young men. These presentations will include pneumatic rockets and other such simple aerospace demonstrations: this will prevent any kind of malfunction from posing a serious threat to the viewers while simultaneously driving interest for the aerospace sciences. This could also provide as much as 300 audience members to help us spread the word.

Other venues to be explored are the area churches and homeschool groups; as homeschool students comprise the majority of the team, it may be greatly beneficial to reach out to the local co-ops and groups to establish a stronger connection and to bring in a younger generation of potential rocketeers for the years to come. As far as the churches are concerned, they may be made use of in a similar fashion: both to reach out to younger students and to help create a group of adults helpful to the project.

These endeavors will most likely be established by a team mentor (only due to a matter of seniority) and carried out by our team. We intend to present model rockets from various TARC missions and prototypes/scale models of our SLI rocket. Tri-folds will also assist us in teaching about the payload experiment, while mock set-ups will provide an active demonstration of our experiment, the methods we intend to approach it with, and of course, our hypothesis.

TEAM MEMBER INFO

List of all team members:

- **Joshua** 11th grade team leader, vehicle lead, technical design lead, educational engagement member, sustainability lead.
- **Elijah** 9th grade Planning lead. Website lead.
- **Ryan** 8th grade Safety Officer, educational engagement member, sustainability member.
- **Wilkes** 8th grade payload member, budget planning lead.
- **Noah** 8th grade payload lead, educational engagement lead.

THESE RISKS COULD PREVENT OUR PROJECT FROM SUCCEEDING

FACILITY RISKS

Workshop Unavailable

- If Machines in TechShop are all booked

- Tools and facility available at both Adams and Irey households
- Both can be used as backup. TechShop would be #1 choice

LAUNCH SITE

- Hutto could be only available site
- Weather dependent

PROJECT RISKS

TEAM MEMBER UNAVAILABLE, ON VACATION OR SICK

- No tasks are assigned to a single member so whenever someone is busy, things can still be done

PERSONAL ARGUMENTS

- If the students can't reach a solution their current progress in the project will be protected and, if necessary, the students will be separated
- Mentors will aid conflict resolution

PARTS SOLD OUT/UNAVAILABLE

- Purchasing will be done as soon as possible and we will check with multiple sellers
- We will buy all parts and supplies from trusted and experienced companies

CONTINUING TEST FLIGHT FAILURE

- Rocket design and performance prediction evaluation will be conducted before each flight
- Weather will be considered to increase the probability of a successful flight

ROCKET LOST/EXTREMELY DAMAGED

- Extra time will be put into the schedule to allow for vehicle replacement
- The rocket, while in the air, will be tracked using GPS positioning,

PAYLOAD RISKS

- The only thing that could go wrong with the payload we selected- using magnets to lower the G-forces effect on astronauts in a rocket - is if someone with a pacemaker, insulin pump, or something else nearby were susceptible to magnetic interference .

PERSONNEL RISKS

- Injury
- PPE (personal protection equipment) is required during all construction tasks and during prepping the rocket for flight
- Adult supervision at all times
- No electronics allowed while working, unless needed for the task

ROCKET RECOVERY FAILURES

Possible part failures	**Chance of occurrence/amount of damage done**	**Failures effect**	**How to prevent this**
Parachute tears apart	Low/medium	Rocket falls at high speed and breaks on impact with the ground	Check if the parachute is damaged pre-launch and tape over sharp edges in the rocket near the parachute
Rocket sections don't separate	Low/medium	Rocket falls at high speed and breaks on impact with the ground	Make sure the parts fit together smoothly, use the correct amount of black powder, use redundant charges.
Shock cord melt or combust	Low/medium	Rocket falls at high speed and breaks on impact with the ground	Wrap heat resistant material around nylon cords, develop a consistent procedure for packing

Parachute melt or combust	Low-Medium/medium	Rocket falls at high speed and breaks on impact with the ground	Heat resistant blanket, develop a consistent procedure for packing
Parachute tangles	Low/medium	Rocket falls at high speed and breaks on impact with the ground	Check lines before launch, develop a consistent procedure for packing

CONSTRUCTION FAILURES

Fin failure	Low/low-medium	Rocket becomes unstable and crashes	Do static tests on the fins, mount them through the body tube
Body tube bent	Low/low-medium	Rocket becomes unstable and crashes	Do static tests on the body tube, put square joints at the couplers
Damage from landing	Medium/low	Broken fins, body tube ends, or nose cone	Drop test the body tube, overbuild it, confirm that the parachute deploys
Motor mount failure	Low/high	The motor shoots through the body tube destroying the rocket	Check motor and mount before use, static test the motor mount

PAYLOAD FAILURES

Payload mounted wrong	Low/low-medium	Payload destroyed, rocket made unstable	Develop a consistent procedure for packing payload

Magnets attached wrong	Low-Medium/low	Payload inside and outside bounce around/stick together strangely	Carefully place each magnet in its correct position, double check every one of them
Batteries not charged/incorrectly installed	Low-Medium/low	G-forces levels sensors failure, rocket tracking failure	Develop a consistent procedure for packing batteries, always charge them fully and inspect them prior to launch
Magnetically floating inside pod breaks	Low/low	Payload tests being done fail	Make sure that the inside and outside pods are set correctly, develop a consistent procedure for packing them

MANAGEMENT FAILURES

Too much time and effort is required for the project	Low/high	too many team members quit to continue the project	Keep team large enough and split the work evenly so no one is overworked
Parts arrive late	Medium/low-medium	Rocket cannot be constructed until later on and we get to conduct less test flights	Order parts as early as possible and be ready to use the parts as soon as they arrive

Environmental Failures

Rocket cannot be Found after landing	Low/low-medium	Wild animals could attempt to eat part of	Use GPS location in the rocket and look closely for

		the rocket, harming themselves	any parts that may have come off
Rocket lands in tree	Medium/low	Difficult to retrieve, members are hurt attempting to recover the rocket	Make sure area near launch site has few trees
Parachute tears on something during landing	Low/medium	Have to replace or repair the parachute	Make sure area is open so this is less likely to happen, buy a stronger parachute that won't tear much
Motor and fins malfunction and the rocket shoots into a group of trees	Minimal-low/medium-high	Could cause a small fire and destroy the rocket	Make sure that all the fins and the motor are correctly set

LAUNCHING FAILURES

Rocket is too highly powered	Medium/low	Rocket flies higher than what our goal is	Select a motor that will better fit our rockets goal height
Rocket is to underpowered	Medium/low	Rocket flies lower than what our goal	Select a motor that will better fit our rockets goal height
Motor failures	Low/medium	Rocket cannot launch, motor can burn through casing, Rocket could become unstable or be destroyed	Bring spare ignitors, check that the motor is good, develop a consistent method for inserting motor

NAR/TRA

RANGE SAFETY

A range safety inspection will be performed on each rocket before it's flown, our team will abide by the ruling of the range safety inspection.

RSO RULING

The range Safety Officer has the last say on all rocket issues and has the right to stop the launch of any safety reason.

TEAM COMPLIANCE

If our team does not comply with the safety requirements they will not be allowed to fly.

PURCHASE, STORING, TRANSPORTING, AND USAGE OF ENERGETICS

Only one of our mentors: Alex Adams, Chuck Adams, or James Duffy are permitted to purchase or handle the energetics (motors, igniters, and ejection charges)

NAR MENTORS

Our Mentors, Chuck Adams and Alex Adams:

- are NAR Members HPR and certified level 1 almost level 2
- teach the team, keep us on track, and attend all our meetings
- will be at the launches and help the safety officer check that everything is ready and safe for launch

VEHICLE

The Rocket will:

- Be constructed only with reliable materials made by trusted manufacturers
- Be constructed with supervision by at least one of our mentors
- Only methods for recovery that are known to work well will be used during retrieval of the rocket
- Be propelled by motors within the NAR HPR level 2 power limits and restrictions stated by the SL program

- Will only be flown with permission from the FAA and will follow all instructions we receive from them
- Strict adherence to NAR and NFPA safety codes for model rockets and high power rockets will be followed at all launches

TEAM MEMBERS SAFETY

- Mentors and more experienced team members will teach new members rocket safety
- All team members will be taught about the hazards that rocketry presents and how to deal with them ex: fires, ballistic rockets, and environmental dangers
- Written Safety Statement
- Team members will read emails sent out to the team Google group
- During a launch, mentors/adult supervisors will make sure the launch area is clear and that all team members are watching carefully
- All hazardous materials like motors and black powder will be put into the rocket by a mentor
- Each launch will have a countdown as instructed by NAR safety codes
- Each launch will have at least two B-C Fire Extinguishers within arm's reach of designated team members during pre-launch prep and at launch

SAFETY DOCUMENTATION

Proper usage of hazardous materials will be used always when they are being handled including wearing the needed PPE (Personal Protective Equipment) like goggles, gloves, and long pants.

While cutting fiberglass the dust that comes off can imbed itself in your skin, or can be breathed in, which isn't fun, it also has a chance to cause cancer, so make sure that we are wearing long clothes and goggles during cutting.

All construction of the rocket will be closely watched over by a mentor who will make sure that the team member building it is using the proper protection and tools.

CHECKLIST OF FINAL ASSEMBLY AND LAUNCH PROCEDURES

FINAL ASSEMBLY

- ✓ Ensure PPE is worn as necessary. Face masks, gloves, and other skin protection while handling launch equipment.
- ✓ Check redundancy of safety systems, i.e. parachute deployment charges, motor ignition.
- ✓ Check structural integrity of fins, cone, and body.
- ✓ Check motor integrity and charge delay.
- ✓ Ensure payload is properly situated in rocket and ready for launch.
- ✓ Ensure parachutes are properly attached.
- ✓ Check fireproof wadding and adjust as needed.

LAUNCH

- ✓ Pick a launch site as far away from power lines, trees, and buildings as possible so it is easier to recover the rocket
- ✓ Place the launch pad in the center of the area on firm stable ground and keep spectators at least 30 feet back
- ✓ Make sure that the launch pad, controller, and rocket engine have no defects or damages
- ✓ Insert the wadding and the recovery system into the rocket from the top, install the igniter into the engine then put the engine in the engine mount
- ✓ Get back a safe distance and use the launch key then start a countdown, when you say zero hit the button
- ✓ If the rocket does not launch when pressed wait at least a minute before going up to it

MSDS INFORMATION

Many materials solvents and adhesives will be use in the construction of our rocket. The MSDS Sheets will be compiled and maintained in a Safety Binder by the Safety Officer for each material used in the construction of our rocket. This Safety Binder will be present at each construction event and each launch. The MSDS for relevant items are included here for reference only and are not deemed to be the complete MSDS sheet as will be maintained in our Safety Binder.

AEROTECH MSDS

AeroTech Division, RCS Rocket Motor Components, Inc.

Material Safety Data Sheet & Emergency Response Information

Prepared in accordance with 29 CFR § 1910.1200 (g)

Section 1. Product Identification

Model rocket motor, high power rocket motor, hobby rocket motor, composite rocket motor, rocket motor kit, rocket motor reloading kit, containing varying amounts of solid propellant with the trade names White Lightning™, Blue Thunder™, Black Jack™, Black Max™, Redline™, Warp-9™ or Mojave Green™. These products contain varying percentages of Ammonium Perchlorate, Strontium and/or Barium Nitrate dispersed in synthetic rubber with lesser amounts of proprietary ingredients such as burn rate modifiers and metal fuels. Rocket motor ejection charges contain black powder.

Section 2. Physical Characteristics

Black plastic cylinders or bags with various colored parts, little or no odor

Section 3. Physical Hazards

Rocket motors and reload kits are flammable; rocket motors may become propulsive in a fire. All propellants give off varying amounts of Hydrogen Chloride and Carbon Monoxide gas when burned, Mojave Green propellant also produces Barium Chloride.

Section 4. Health Hazards

Propellant is an irritant in the case of skin and eye contact, may be extremely hazardous in the case of ingestion, and may be toxic to kidneys, lungs and the nervous system. Symptoms include respiratory irritation, skin irritation, muscle tightness, vomiting, diarrhea, abdominal pain, muscular tremors, weakness, labored breathing, irregular heartbeat, and convulsions. Inhalation of large amounts of combustion products may produce similar but lesser symptoms as ingestion.

Section 5. Primary Routes of Entry

Skin contact, ingestion, and inhalation.

AeroTech Division, RCS Rocket Motor Components, Inc.

Material Safety Data Sheet & Emergency Response Information

Prepared in accordance with 29 CFR § 1910.1200 (g)

Section 1. Product Identification

Copperhead™ igniter, FirstFire™ igniter, FirstFire Jr.™ igniter. These products contain varying percentages of Ammonium or Potassium Perchlorate, carbon black and carbon fibers dispersed in a flammable binder with lesser amounts of proprietary ingredients such as burn rate modifiers and a metal fuel.

Section 2. Physical Characteristics

Narrow copper foil strips or yellow wires coated with a small amount of black igniter composition on one end, little or no odor

Section 3. Physical Hazards

Igniters are flammable and may give off varying amounts of Hydrogen Chloride and Carbon Monoxide gas, soot and carbon fibers when burned.

Section 4. Health Hazards

Igniter coating may be hazardous in the case of ingestion, and may be toxic to kidneys, lungs and the nervous system. Symptoms may include respiratory irritation, skin irritation, muscle tightness, vomiting, diarrhea, abdominal pain, muscular tremors, weakness, labored breathing, irregular heartbeat, and convulsions. Inhalation of large amounts of combustion products may produce similar but lesser symptoms as ingestion.

Section 5. Primary Routes of Entry

Ingestion, inhalation.

Section 6. Permitted Exposure Limits

None established for manufactured product.

EPOXY MSDS

Glenmarc Industries Inc. 2001 S. Blue Island Ave Chicago IL 60608
312-243-0800 fax 312-243-4670 email: info@glenmarc .com www.glenmarc.com

Material Safety Data Sheet

Date 04/01/2014
Section 1 PRODUCT INFORMATION

MANUFACTURER:
Glenmarc Industries Inc.
2001 S. Blue Island Ave.
Chicago IL 60608

Emergency Phone:
800-255-3924
Chemtel
Non-emergency Phone:
800-323-5350

Proper Shipping Name: Plastic Material Liquid NOI

PRODUCT NAME:
Rocket Poxy
Chemical Family:
HAZARD RATINGS:
Fire: 1
Health: 2
Reactivity: 0

Section II PRODUCT/COMPOSITION

No.	Component	CAS#	%(optional)
P	Epoxy resin based mixture	N.A.	<100
1	Triphenyl Phosphite	101-02-0	<15%

Note: contains material(s) regulated as dust hazard, dispersed in a non-hazard from if dust is recreated, appropriate respiratory and/or explosion precautions must still be used.

Section III HAZARD STATUS

Chemical listed as carcinogen or potential carcinogen in NTP, IARC or OSHA 1910(z): This material is neither carcinogenic or potentially carcinogenic

Occupational Exposure limits
OSHA limits have not been established for this product

ACGIH limits have not been established for this product

Section IV REGULATORY STATUS

A. CA Safe drinking water & toxic enforcement act of 1986.
This product may contain traces of or other prop 65 listed chemicals as impurities. However, none are listed as ingredients.

B. CERCLA 40 CFR 302
Releases exceeding the reportable quantity must be reported to the national response center (800)424-8802
RQ Not established or required for this product.

C. OSHA 29 CFR 1910
According to OSHA criteria, the following components are hazardous:

No.	Component	CAS#	%(optional)
P	Epoxy resin based mixture	NA	<100%
1	Triphenyl Phosphite	101-02-0	<15%

D. RCRA 40 CFR 261
Not a hazardous waste by RCRA criteria (40CFR261.20.24)

E. SARA Title III 52 CFR 13378, 52 CFR 21152

NO.	RQ (lbs) (*1)	TPQ(lbs) (*2)	SEC.313 (*3)	313 CAT. (*4)	311/312 (*5)
P	NONE	NOT LISTED	NOT LISTED	NONE	H1
1	NONE	NOT LISTED	NOT LISTED	NONE	H1

Other SARA substances if present are all below the de minimus concentrations
*1 = Reportable quantity of extremely hazardoussubstances sec 302
*2= Threshold planning quantity, extremely hazardous substance, sec 302
*3= Toxic chemical, sec 313 (individual chemical listed)
*4= Toxic release inventory form category sec 313 (40 CFR 372.65 C)
*5= Hazard category for SARA sec 311/312 reporting
H1= Immed (acute) health hazard H2- Delayed (chronic) health hazard. P3= Fire Hazard P4= Sudden pressure release hazard P5= Reactive hazard.

F. TSCA 44 CFR59764
All components listed.

G. VOC SCAQMD Rules

ACETONE MSDS

P.O. Box 864 • 135 Redstone Street
Southington, CT 06489 U.S.A

Toll Free: (800)-4-midsun (U.S.A. only)
(860) 378-0100 • (860) 378-0103 (Fax)
www.midsungroup.com

Acetone Material Safety Data Sheet (MSDS)

MANUFACTURER'S CONTACT INFORMATION:

Sunoco, Inc. (R&M)
1735 Market Street LL
Philadelphia, Pennsylvania 19103-7583

EMERGENCY
Sunoco: (800) 964-8861
Chemtrec: (800) 424-9300
Product Safety: (610) 859-1120

I. Product Identification	
Trade Name	Acetone
Product Use	Chemical Intermediate

II. Hazardous Ingredients of Material			
Components	**Amount (Vol. %)**	**CAS No.**	**ACGIH TLV**
Acetone	100	67-64-1	–
Exposure Limits (See Section VI for additional Exposure Limits)			
Governing Body	**CAS No.**		**Exposure Limits**
ACGIH	67-64-1		STEL 750 ppm
ACGIH	67-64-1		TWA 500 ppm
OSHA	67-64-1		TWA 1,000 ppm
Emergency Overview: Danger! Extremely flammable liquid and vapor. Vapors may cause flash fire or explosion. Harmful if inhaled. Vapor concentrations may cause drowsiness. Causes skin and eye irritation. Harmful if swallowed. May cause target organ or system damage to the following: Eye, skin, respiratory system, central nervous system.			

HAZARD RATINGS

Key: 0 = Least 1 = Slight 2 = Moderate 3 = High 4 = Extreme

	Health	Fire	Reactivity	PPI
NFPA	1	3	0	
HMIS	1	3	0	X

III. Physical/Chemical Data	
Appearance & Odor	Colorless liquid
Boiling Point	133° F
Melting Point	-137.2° F
Specific Gravity	0.79
Molecular Weight g/mole	58.08
pH	7
Odor	Sweet, pungent
Odor Threshold	62 ppm
Vapor Pressure (mm Hg @20° C)	181
Solubility in Water	Complete
Volatile (wt %)	100%

REACT-A-PACK MSDS

ND INDUSTRIES, INC.
1893 BARRETT ROAD
TROY, MICHIGAN 48084
(248) 288-0000 Fax: (248) 288-0022
24 hr. EMERGENCY CHEMTREC:
1-800-424-9300

PRODUCT: 210 React-A-Pack Single Use Epoxy
MSDS ID: ND1114
ORIG. DATE: 4-04-95
REV. DATE: 7/5/06
REV. DATE: 12/23/08 PREPARED BY: Chemical Safety

SECTION I -Material Identification and Information H: 3 F: 1 R: 0 PPE:C

COMPONENTS		CAS #	PERCENT %	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Epoxy Side:						
Bisphenol A Epoxy Resin (modified)	RP-00-05	proprietary	50-100	n.e.	n.e.	
Hardener Side:						
Epoxy curing agent	RP-00-415		90-100			
contains:						
Nonylphenol - >30% of mixture		25154-52-3		n.e.	n.e.	
Aminoethyl Piperazine- <50% mixture		140-31-8		n.e.	n.e.	

The remaining components of this product are not considered hazardous substances or are below reportable levels under OSHA's Hazard Communication Standard (29 CFR 1910.1200)

All ingredients are listed on the TSCA Inventory. n.a.= not applicable / n.e.=not established

SECTION II -Physical and Chemical Characteristics

BOILING POINT:	approx. >200°C	
VAPOR DENSITY:	n.e. air = 1	**VOC #/US gal. :**
VAPOR PRESSURE:	n.e.	**DENSITY OF COATING:**
MELTING POINT:	n.a.	
SPECIFIC GRAVITY:	1.17 water = 1	
EVAPORATION RATE:	negligible	
WATER REACTIVE:	No	
SOLUBILITY IN WATER:	slight	
APPEARANCE AND ODOR:	Clear or opaque sealed plastic pack with two discernible areas of light and dark amber translucent material, observable in clear packs. Slight acrylic odor when pack is opened.	

SECTION III - Fire and Explosion Hazard Data

FLASH POINT: 101°C closed cup
AUTOIGNITION TEMPERATURE: not determined
FLAMMABILITY LIMITS % IN AIR: LEL: not determined UEL: not determined
EXTINGUISHER MEDIA: Carbon dioxide, dry chemical powder or appropriate foam

SPECIAL FIREFIGHTING PROCEDURES: Wear a self-contained breathing apparatus with full face piece operated in the positive pressure demand mode with appropriate turnout gear and chemical resistant personal protective equipment.

UNUSUAL FIRE HAZARDS AND CONDITIONS TO AVOID: Water or foam used as an extinguishing media may cause violent frothing which can be violent and may further threaten life. Contact of liquid with skin must be prevented. Personnel in vicinity and downwind should be evacuated.

CESARONI MOTORS MSDS

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SAFETY DATA SHEET

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Pro-X® Rocket Motor Reload Kits & Fuel Grains

1.0 PRODUCT / COMPANY IDENTIFICATION

Product Name: Pro24, Pro29, Pro38, Pro54, Pro75, and Pro98 Rocket Motor Reload Kits
Synonyms: Rocket Motor, Hobby Rocket Motor, HPR Reload Kit
Part Numbers: Reload kits: P24R-Y-#G-XX, P29R-Y-#G-XX, P38R-Y-#G-XX, P54R-Y-#G-XX, P24R-Y-#GXL-XX, P29R-Y-#GXL-XX, P38R-Y-#GXL-XX, P54R-Y-#GXL-XX,
Propellant grains: P75AC-PG-XX, P98AC-PG-XX, P98AC-MB-PG-XX
Where: Y = reload type (A = adjustable delay, C = C-slot)
# = number of grains &
XX = propellant type

Product Use: Solid fuel motor for propelling hobby rockets

Manufacturer / Supplier: Cesaroni Technology Inc.
P.O. Box 246
2561 Stouffville Rd.
Gormley, Ont.
Canada L0H 1G0

Telephone Numbers:
Product Information: Tel: +1-905-887-2370 Fax: +1-905-887-2375
24 Hour Emergency Telephone Number: Tel: +1-613-996-6666 (CANUTEC)

2.0 HAZARDS IDENTIFICATION

Signal Word: **Warning** GHS Pictogram:  Hazard Statement: H204 Fire or Projection Hazard

Precautionary Statements

P210	**Keep away from heat/sparks/open flames/hot surfaces. No smoking**
P250	**Do not subject to grinding/shock/friction.**
P370+P380	**In case of fire: Evacuate Area.**
P372	**Explosion risk in case of fire.**
P373	**DO NOT fight fire when fire reaches explosives.**
P401	**Store in accordance with local/regional/national regulations.**
P501	**Dispose of in accordance with local/regional/national regulations.**

Emergency Overview:
There articles contain cylinders of ammonium perchlorate composite propellant, encased in inert plastic parts. The forward closure also contains a few grams of black powder. ProX Rocket motor reload kits are classified as explosives, and may cause serious injury, including death if used improperly. All explosives are dangerous and must be handled carefully and used following approved safety procedures under the direction of competent, experienced personnel in accordance with all applicable federal, state and local laws and regulations. Avoid inhaling exhaust products.

General Appearance:
Cardboard tubes contain various plastic parts. Inside the plastic tube are cylinders of composite propellant (rocket fuel). The forward closure also contains a small quantity of black powder. All parts are odourless solids.

Potential Health Effects:
Eye:
Not a likely route of exposure. May cause eye irritation.
Skin:
Not a likely route of exposure. Low hazard for usual industrial/hobby handling.
Ingestion:

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MATERIAL SAFETY DATA SHEET

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ProX Rocket Motor Reload Kits & Fuel Grains

1.0 PRODUCT / COMPANY IDENTIFICATION

Product Name: Pro29, Pro38, Pro54, Pro75, and Pro98 Rocket Motor Reload Kits
Synonyms: Rocket Motor
Proper Shipping Name: Articles, Explosive, N.O.S. (Ammonium Perchlorate)
Part Numbers: Reload kits: P29R-Y-#G-XX, P38R-Y-#G-XX, P54R-Y-#G-XX, P29R-Y-#GXL-XX, P38R-Y-#GXL-XX, P54R-Y-#GXL-XX,
Propellant grains: P75AC-PG-XX, P98AC-PG-XX, P98AC-MB-PG-XX
Where: Y = reload type (A = adjustable delay, C = C-slot)
# = number of grains &
XX = propellant type

Product Use: Solid fuel motor for propelling rockets

Manufacturer: Cesaroni Technology Inc.
P.O. Box 246
2561 Stouffville Rd.
Gormley, Ont.
Canada L0H 1G0

Telephone Numbers:
Product Information: 1-905-887-2370
24 Hour Emergency Telephone Number: 1-613-996-6666 (CANUTEC)

2.0 COMPOSITION / INFORMATION ON INGREDIENTS

Propellant

Ingredient Name	CAS Number	Percentage
Ammonium Perchlorate	7790-98-9	40-85 %
Metal Powders		1-45 %
Synthetic Rubber		10-30 %

Black Powder ignition pellet

Ingredient Name	CAS Number	Percentage
Potassium Nitrate	7757-79-1	70-76 %
Charcoal	n/a	8-18 %
Sulphur	7704-34-9	9-20 %
Graphite	7782-42-5	trace

3.0 HAZARDS IDENTIFICATION

Emergency Overview:
There articles contain cylinders of ammonium perchlorate composite propellant, encased in inert plastic parts. The forward closure also contains a few grams of black powder. ProX Rocket motor reload kits are classified as explosives, and may cause serious injury, including death if used improperly. All explosives are dangerous and must be handled carefully and used following approved safety procedures under the direction of competent, experienced personnel in accordance with all applicable federal, state and local laws and regulations. Avoid inhaling exhaust products.

FIBERGLASS MSDS

OWENS CORNING™

MATERIAL SAFETY DATA SHEET

Section 1: Product and Company Information

Product Name(s): Woven Unidirectional Fiberglass Fabric (A-Style Warp Unidirectional), Stitchbonded Fiberglass Fabric, Woven Fiberglass Fabric

Manufacturer: Owens-Corning, World Headquarters, One Owens-Corning Parkway
Attn. Product Stewardship, Toledo, OH, 43659,
Telephone: 1-419-248-8234 (8am-5pm ET weekdays).
OC Fabrics, 1851 S. Sequin Ave., New Braunfels, TX, 78130
Telephone: 1-210-629-4009 (8am-5pm CT weekdays).

Emergency Contacts:
Emergencies ONLY (after 5pm ET and weekends): 1-419-248-5330,
CHEMTREC (24 hours everyday): 1-800-424-9300,
CANUTEC (Canada- 24 hours everyday): 1-613-996-6666.

Health and Technical Contacts:
Health Issues Information (8am-5pm ET):1-419-248-8234,
Technical Product Information (8am-5pm ET): 1-800-GET-PINK.

Section 2: Composition and Ingredient Information

Common Name	Chemical Name	CAS No.	Wt. %
Non-Hazardous Ingredients			
Fiber Glass Continuous Filament (non respirable)	Fibrous Glass	65997-17-3	94-100
Size	Size	None	0-2
Polyester Yarn	Polyester Yarn	None	0-4

Note: See Section 8 of MSDS for exposure limit data for these ingredients.

Prepared: 25 February, 1997 Page: 1 of 11 MSDS No.:15-MSD-21555

http://web.mit.edu/rocketteam/www/usli/MSDS/Fiberglass%20(differnt%20supplier).pdf

MAGNETS MSDS

MATERIAL SAFETY DATA SHEET (MSDS)

Warning strong magnets can affect the operation of pace makers do not handle, seek medical advice.

SECTION 1- Product Identity

Company Name:Ican
Company Address: 2151 Louie drive, P.O.box 32036 west kelowna BC V4T3G2
Product Name: Nd-Fe-B Rare Earth Neodymium Magnet

SECTION 2 - INGREDIENTS

Nd: 27-31%,
Dy-Tb: 1.5-3.5%
Al: 0.1-0.8%
B: 1.0-1.2%
Fe: 61.5-66.8%
Nb: 0.3-1.4%
Co: 1.0-3.5%
Cu: 0.1-0.3%

SECTION 3 - PHYSICAL CHARACTERISTICS

Boiling Point: N/A
Vapor Pressure: (mm Hg.): N/A
Vapor Density: (air = 1): N/A
Solubility in Water: Not soluble
Appearance: As ground, silver-gray, as sintered, matte black
Specific Gravity: 7.4
Melting Point: Above 2500o F
Evaporation Rate: N/A
Odor: No odor

SECTION - FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A
FLAMMABLE LIMITS: N/A
LEL: N/A
UEL: N/A
Extinguishing Media: Dry chemical or sand
Special Fire Fighting Procedures: Do not use water on smoldering, burning powder.

UNUSUAL FIRE AND EXPLOSION HAZARD(S):
Dry powders of neodymium magnets will oxidize, smolder, and burn in

BLACK POWDER MSDS

OWEN COMPLIANCE SERVICES, INC.

Material Safety Data Sheet
(MSDS-BP)

PRODUCT IDENTIFICATION	
Product Name	BLACK POWDER
Trade Names and Synonyms	N/A
Manufacturer/Distributor	GOEX, Inc. (Doyline, LA) & various international sources
Transportation Emergency	**800-255-3924 (24 hrs — *CHEM - TEL*)**

PREVENTION OF ACCIDENTS IN THE USE OF EXPLOSIVES

The prevention of accidents in the use of explosives is a result of careful planning and observance of the best known practices. The explosives user must remember that he is dealing with a powerful force and that various devices and methods have been developed to assist him in directing this force. He should realize that this force, if misdirected, may either kill or injure both him and his fellow workers.

WARNING

All explosives are dangerous and must be carefully handled and used following approved safety procedures either by or under the direction of competent, experienced persons in accordance with all applicable federal, state, and local laws, regulations, or ordinances. If you have any questions or doubts as to how to use any explosive product, **DO NOT USE IT** before consulting with your supervisor, or the manufacturer, if you do not have a supervisor. If your supervisor has any questions or doubts, he should consult the manufacturer before use.

BATTERIES MSDS

MATERIAL SAFETY DATA SHEET
LEAD ACID BATTERY WET, FILLED WITH ACID
(US, CN, EU Version for International Trade)

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **Lead Acid Battery Wet, Filled With Acid**
OTHER PRODUCT NAMES: Electric Storage Battery, SLI or Industrial Battery, UN2794

MANUFACTURER: East Penn Manufacturing Company, Inc.
DIVISION: Deka Road
ADDRESS: Lyon Station, PA 19536 USA

EMERGENCY TELEPHONE NUMBERS: US: CHEMTREC 1-800-424-9300
CN: CHEMTREC 1-800-424-9300
Outside US: 1-703-527-3887

NON-EMERGENCY HEALTH/SAFETY INFORMATION: 1-610-682-6361

CHEMICAL FAMILY: This product is a wet lead acid storage battery. May also include gel/absorbed electrolyte type lead acid battery types.

PRODUCT USE: Industrial/Commercial electrical storage batteries.

This product is considered a Hazardous Substance, Preparation or Article that is regulated under US-OSHA; CAN-WHMIS; IOSH; ISO; UK-CHIP; or EU Directives (67/548/EEC-Dangerous Substance Labelling, 98/24/EC-Chemical Agents at Work, 99/45/EC-Preparation Labelling, 2001/58/EC-MSDS Content, and 1907/2006/EC-REACH), and an MSDS/SDS is required for this product considering that when used as recommended or intended, or under ordinary conditions, it may present a health and safety exposure or other hazard.

Additional Information
This product may not be compatible with all environments, such as those containing liquid solvents or extreme temperature or pressure. Please request information if considering use under extreme conditions or use beyond current product labelling.

SECTION 2: HAZARDS IDENTIFICATION

GHS Classification:

Health	Environmental	Physical
Acute Toxicity – Not listed (NL) Eye Corrosion – Corrosive* Skin Corrosion – Corrosive* Skin Sensitization – NL Mutagenicity/Carcinogenicity – NL Reproductive/Developmental – NL Target Organ Toxicity (Repeated) – NL	Aquatic Toxicity – NL	NFPA – Flammable gas, hydrogen (during charging) CN - NL EU - NL

*as sulfuric acid

GHS Label: Lead Acid Battery, Wet

Symbols: C (Corrosive)

Hazard Statements	Precautionary Statements
Contact with internal components may cause irritation of severe burns. Irritating to eyes, respiratory system, and skin.	Keep out of reach of children. Keep containers tightly closed. Avoid heat, sparks, and open flame while charging batteries. Avoid contact with internal acid.

EMERGENCY OVERVIEW: May form explosive air/gas mixture during charging. Contact with internal components may cause irritation or severe burns. Irritating to eyes, respiratory system, and skin. Prolonged inhalation or ingestion may result in serious damage to health. Pregnant

Material/Product Safety Data Sheet
(MSDS-PSDS)

MP/VL products	Rechargeable lithium-ion single cells and multi-cell battery packs	Simplified Advice Code
Revision 3 Date 06/2005		0

1. Identification of the Substance or Preparation and Company		
Product	Rechargeable lithium-ion cylindrical and medium prismatic single cells and multi-cell battery packs	
Production sites	Saft America Inc. 313 Crescent Street Valdese North Carolina 28690 USA Tel. No. +1 (828) 874 4111 Fax No. +1 (828) 874 2431	Saft Rue Georges Leclanché BP 1039 86060 Poitiers cedex 9 FRANCE +33 (0)5 49 55 46 46 +33 (0)5 49 55 48 50
Emergency contacts Within the USA	+1 (703) 527 3887 +1 (800) 424 9300	(CHEMTREC US Service Center)

2. Composition & Information on Ingredients					
Each cell consists of an hermetically sealed metallic container containing a number of chemicals and materials of construction of which the following could potentially be hazardous upon release.					
Ingredient	Content	CAS No.	CHIP Classification		
Lithium metal	0 *(In spite of their name, these batteries do not contain any lithium metal)*				
$LiCoO_2$ (Lithium cobaltite)	≈ 30%	12190-79-3			R22, R43 S2, S22, S24, S25, S36, S37, S45
Organic solvents	≈ 13% EA (Ethyl Acetate) EC (Ethyl Carbonate) DMC (DiMethyl Carbonate) *(Boiling Points: EA: -84°C; EC: +39°C DMC: +4°C)*	141-78-6 96-49-1 616-38-6			R21, R22, R41, R42, R43 S2, S24, S25, S36, S37, S45
$LiPF_6$ (Lithium hexafluoro phosphate)	≈ 1%		 		R14, R21, R22, R4, R43 S2, S8, S22, S24, S28, S36, S37, S45
Carbon (C_n)	≈ 16%	1333-86-4			NONE KNOWN
Amount varies depending on cell size					

SAWS MSDS

LENOX

MATERIAL SAFETY DATA SHEET

LENOX® Saw Blades

SECTION I: GENERAL INFORMATION

Manufacturer's Name:
Lenox Tools
Address:
301 Chestnut Street
East Longmeadow, MA 01028-0504
Product Name:
Lenox Saw Blades
Chemical Name and Synonyms:
Carbon Steel
Alloy Steel
High Speed Steel
Carbide

Emergency Telephone Number:
1-800-642-0010
MSDS Date:
October 11, 2012
Chemical Family:
Steel; Refractory Metal Carbide
Formula:
Metal and Carbide Materials, see Section 2 below

SECTION 2: HAZARDOUS INGREDIENTS

Lenox saw blades are manufactured from metals into solid, stable and inert blades, and are coated with a water-based paint(s). Under normal sawing conditions, the saw blades are considered to be articles in that they do not release more than very small quantities of hazardous chemicals and do not cause physical or health hazards as defined in the OSHA Hazard Communication Standard. Hazardous chemicals may be released if the blades are welded, cut, grinded, melted or otherwise physically altered.

This MSDS was prepared to address the potential for exposure to dust and/or fume generated from the saw blade. Beyond the scope of this MSDS, the material being cut may contain hazardous chemicals and therefore needs to be evaluated with effective controls instituted to prevent exposure.

The actual composition of the saw blades varies depending on the type of saw blade and the grade of steel it is made from each blade may contain any of the following ingredients:

SAW BLADE METAL COMPONENTS:

INGREDIENT	MAX %	CAS NUMBER	OSHA PEL (mg/M3)	2006 ACGIH TLV® (mg/M3)
Carbon	<2	7440-44-0	Not Established	Not Established
Chromium	<5	7440-47-3	1 (as metal)	0.5
Cobalt	<9	7440-48-4	0.1	0.02
Iron	<90	7439-89-6	10 (as oxide fume)	5 (as oxide dust or fume)
Manganese	<2	7439-96-5	5 Ceiling	0.2
Molybdenum	<10	7439-98-7	15 (insoluble)	10 (insoluble)
Nickel	<2	7440-02-0	1	1.5 (elemental)
Silicon	<2	7440-21-3	15	10
Tungsten	<7	7440-33-7	Not Established	5-TWA; 10-STEL (metal)
Vanadium	<3	7440-62-2	0.5 Ceiling, respirable	0.05 (as oxide)

The metal alloy may also contain less than one percent of sulfur, phosphorous, aluminum, copper, tin, calcium antimony, niobium, and arsenic.

1Occupational exposure limits are Time Weighted Average (TWA) values unless otherwise noted, and Total Particulate (OSHA) unless otherwise noted.

OBEYING FEDERAL, STATE, AND LOCAL LAWS

All team members and mentors will act responsibly and will build the rocket and payload following all applicable laws.

All team members and mentors will also make sure to minimize any disturbances to the environment

All waste that we can recover will be disposed of properly and we will try our hardest to locate and safely recover any parts of the rocket that drifted away

Each team member will agree, by signature and date, to adhere to the following safety codes in Team Safety and Procedure Adherence Contract.

HIGH POWER ROCKET SAFETY CODE, EFFECTIVE AUGUST 2012

1. Certification. I will only fly high power rockets or possess high power rocket motors that are within the scope of my user certification and required licensing.
2. Materials. I will use only lightweight materials such as paper, wood, rubber, plastic, fiberglass, or when necessary ductile metal, for the construction of my rocket.
3. Motors. I will use only certified, commercially made rocket motors, and will not tamper with these motors or use them for any purposes except those recommended by the manufacturer. I will not allow smoking, open flames, nor heat sources within 25 feet of these motors.
4. Ignition System. I will launch my rockets with an electrical launch system, and with electrical motor igniters that are installed in the motor only after my rocket is at the launch pad or in a designated prepping area. My launch system will have a safety interlock that is in series with the launch switch that is not installed until my rocket is ready for launch, and will use a launch switch that returns to the “off” position when released. The function of onboard energetics and firing circuits will be inhibited except when my rocket is in the launching position.
5. Misfires. If my rocket does not launch when I press the button of my electrical launch system, I will remove the launcher’s safety interlock or disconnect its battery, and will wait 60 seconds after the last launch attempt before allowing anyone to approach the rocket.
6. Launch Safety. I will use a 5-second countdown before launch. I will ensure that a means is available to warn participants and spectators in the event of a problem. I will ensure that no person is closer to the launch pad than allowed by the accompanying Minimum Distance Table. When arming onboard energetics and firing circuits I will ensure that no person is at the pad except safety personnel and those required for arming and disarming operations. I will check

the stability of my rocket before flight and will not fly it if it cannot be determined to be stable. When conducting a simultaneous launch of more than one high power rocket I will observe the additional requirements of NFPA 1127.

7. Launcher. I will launch my rocket from a stable device that provides rigid guidance until the rocket has attained a speed that ensures a stable flight, and that is pointed to within 20 degrees of vertical. If the wind speed exceeds 5 miles per hour I will use a launcher length that permits the rocket to attain a safe velocity before separation from the launcher. I will use a blast deflector to prevent the motor's exhaust from hitting the ground. I will ensure that dry grass is cleared around each launch pad in accordance with the accompanying Minimum Distance table, and will increase this distance by a factor of 1.5 and clear that area of all combustible material if the rocket motor being launched uses titanium sponge in the propellant.
8. Size. My rocket will not contain any combination of motors that total more than 40,960 N-sec (9208 pound-seconds) of total impulse. My rocket will not weigh more at liftoff than one-third of the certified average thrust of the high power rocket motor(s) intended to be ignited at launch.
9. Flight Safety. I will not launch my rocket at targets, into clouds, near airplanes, nor on trajectories that take it directly over the heads of spectators or beyond the boundaries of the launch site, and will not put any flammable or explosive payload in my rocket. I will not launch my rockets if wind speeds exceed 20 miles per hour. I will comply with Federal Aviation Administration airspace regulations when flying, and will ensure that my rocket will not exceed any applicable altitude limit in effect at that launch site.
10. Launch Site. I will launch my rocket outdoors, in an open area where trees, power lines, occupied buildings, and persons not involved in the launch do not present a hazard, and that is at least as large on its smallest dimension as one-half of the maximum altitude to which rockets are allowed to be flown at that site or 1500 feet, whichever is greater, or 1000 feet for rockets with a combined total impulse of less than 160 N-sec, a total liftoff weight of less than 1500 grams, and a maximum expected altitude of less than 610 meters (2000 feet).
11. Launcher Location. My launcher will be 1500 feet from any occupied building or from any public highway on which traffic flow exceeds 10 vehicles per hour, not including traffic flow related to the launch. It will also be no closer than the appropriate Minimum Personnel Distance from the accompanying table from any boundary of the launch site.
12. Recovery System. I will use a recovery system such as a parachute in my rocket so that all parts of my rocket return safely and undamaged and can be flown again, and I will use
13. Recovery Safety. I will not attempt to recover my rocket from power lines, tall trees, or other dangerous places, fly it under conditions where it is likely to

recover in spectator areas or outside the launch site, nor attempt to catch it as it approaches the ground.

MINIMUM DISTANCE FROM LAUNCH

Installed Total Impulse (Newton-Seconds)	Equivalent High Power Motor Type	Minimum Diameter of Cleared Area (ft.)	Minimum Personnel Distance (ft.)	Minimum Personnel Distance (Complex Rocket) (ft.)
0 — 320.00	H or smaller	50	100	200
320.01 — 640.00	I	50	100	200
640.01 — 1,280.00	J	50	100	200
1,280.01 — 2,560.00	K	75	200	300
2,560.01 — 5,120.00	L	100	300	500
5,120.01 — 10,240.00	M	125	500	1000
10,240.01 — 20,480.00	N	125	1000	1500
20,480.01 — 40,960.00	O	125	1500	2000

FAA 101, SUBPART C— AMATEUR ROCKETS

§101.21 - APPLICABILITY.

(a) This subpart applies to operating unmanned rockets. However, a person operating an unmanned rocket within a restricted area must comply with §101.25(b)(7)(ii) and with any additional limitations imposed by the using or controlling agency.

(b) A person operating an unmanned rocket other than an amateur rocket as defined in §1.1 of this chapter must comply with 14 CFR Chapter III.

From: http://www.ecfr.gov/cgi-bin/text-idx?rgn=div5&node=14:2.0.1.3.15#sp14.2.101.c

[Doc. No. FAA-2007-27390, 73 FR 73781, Dec. 4, 2008]

§101.22 - DEFINITIONS.

The following definitions apply to this subpart:

(a) *Class 1—Model Rocket* means an amateur rocket that:

(1) Uses no more than 125 grams (4.4 ounces) of propellant;

(2) Uses a slow-burning propellant;

(3) Is made of paper, wood, or breakable plastic;

(4) Contains no substantial metal parts; and

(5) Weighs no more than 1,500 grams (53 ounces), including the propellant.

(b) *Class 2—High-Power Rocket* means an amateur rocket other than a model rocket that is propelled by a motor or motors having a combined total impulse of 40,960 Newton-seconds (9,208 pound-seconds) or less.

(c) *Class 3—Advanced High-Power Rocket* means an amateur rocket other than a model rocket or high-power rocket.

§101.23 - GENERAL OPERATING LIMITATIONS.

(a) You must operate an amateur rocket in such a manner that it:

(1) Is launched on a suborbital trajectory;

(2) When launched, must not cross into the territory of a foreign country unless an agreement is in place between the United States and the country of concern;

(3) Is unmanned; and

(4) Does not create a hazard to persons, property, or other aircraft.

(b) The FAA may specify additional operating limitations necessary to ensure that air traffic is not adversely affected, and public safety is not jeopardized.

[Doc. No. FAA-2007-27390, 73 FR 73781, Dec. 4, 2008]

§101.25 - OPERATING LIMITATIONS FOR CLASS 2-HIGH POWER ROCKETS AND Class 3-Advanced High Power Rockets.

When operating *Class 2-High Power Rockets* or *Class 3-Advanced High Power* Rockets, you must comply with the General Operating Limitations of §101.23. In addition, you must not operate *Class 2-High Power Rockets* or *Class 3-Advanced High Power* Rockets—

(a) At any altitude where clouds or obscuring phenomena of more than five-tenths coverage prevails;

(b) At any altitude where the horizontal visibility is less than five miles;

(c) Into any cloud;

(d) Between sunset and sunrise without prior authorization from the FAA;

(e) Within 9.26 kilometers (5 nautical miles) of any airport boundary without prior authorization from the FAA;

(f) In controlled airspace without prior authorization from the FAA;

(g) Unless you observe the greater of the following separation distances from any person or property that is not associated with the operations:

(1) Not less than one-quarter the maximum expected altitude;

(2) 457 meters (1,500 ft.);

(h) Unless a person at least eighteen years old is present, is charged with ensuring the safety of the operation, and has final approval authority for initiating high-power rocket flight; and

(i) Unless reasonable precautions are provided to report and control a fire caused by rocket activities.

[74 FR 38092, July 31, 2009, as amended by Amdt. 101-8, 74 FR 47435, Sept. 16, 2009]

§101.27 - ATC NOTIFICATION FOR ALL LAUNCHES.

No person may operate an unmanned rocket other than a Class 1—Model Rocket unless that person gives the following information to the FAA ATC facility nearest to the place of intended operation no less than 24 hours before and no more than three days before beginning the operation:

(a) The name and address of the operator; except when there are multiple participants at a single event, the name and address of the person so designated as the event launch coordinator, whose duties include coordination of the required launch data estimates and coordinating the launch event;

(b) Date and time the activity will begin;

(c) Radius of the affected area on the ground in nautical miles;

(d) Location of the center of the affected area in latitude and longitude coordinates;

(e) Highest affected altitude;

(f) Duration of the activity;

(g) Any other pertinent information requested by the ATC facility.

[Doc. No. FAA-2007-27390, 73 FR 73781, Dec. 4, 2008, as amended at Doc. No. FAA-2007-27390, 74 FR 31843, July 6, 2009]

§101.29 - INFORMATION REQUIREMENTS.

(a) *Class 2—High-Power Rockets.* When a Class 2—High-Power Rocket requires a certificate of waiver or authorization, the person planning the operation must provide the information below on each type of rocket to the FAA at least 45 days before the proposed operation. The FAA may request additional information if necessary to ensure the proposed operations can be safely conducted. The information shall include for each type of Class 2 rocket expected to be flown:

(1) Estimated number of rockets,

(2) Type of propulsion (liquid or solid), fuel(s) and oxidizer(s),

(3) Description of the launcher(s) planned to be used, including any airborne platform(s),

(4) Description of recovery system,

(5) Highest altitude, above ground level, expected to be reached,

(6) Launch site latitude, longitude, and elevation, and

(7) Any additional safety procedures that will be followed.

(b) *Class 3—Advanced High-Power Rockets.* When a Class 3—Advanced High-Power Rocket requires a certificate of waiver or authorization the person planning the operation must provide the information below for each type of rocket to the FAA at least 45 days before the proposed operation. The FAA may request additional information if necessary to ensure the proposed operations can be safely conducted. The information shall include for each type of Class 3 rocket expected to be flown:

(1) The information requirements of paragraph (a) of this section,

(2) Maximum possible range,

(3) The dynamic stability characteristics for the entire flight profile,

(4) A description of all major rocket systems, including structural, pneumatic, propellant, propulsion, ignition, electrical, avionics, recovery, wind-weighting, flight control, and tracking,

(5) A description of other support equipment necessary for a safe operation,

(6) The planned flight profile and sequence of events,

(7) All nominal impact areas, including those for any spent motors and other discarded hardware, within three standard deviations of the mean impact point,

(8) Launch commit criteria,

(9) Countdown procedures, and

(10) Mishap procedures.

[Doc. No. FAA-2007-27390, 73 FR 73781, Dec. 4, 2008, as amended at Doc. No. FAA-2007-27390, 74 FR 31843, July 6, 2009]

PROJECT PLAN

Start	End	Action
08/01/16		Project Starts
08/09/16		Initial meetings, team formation
08/15/16		Request for Proposal (RFP) goes out to all teams.
09/30/16		Complete and submit proposal to project office by 4 p.m. CDT, 5 p.m. EDT, 9/30/2016
10/12/16		Awarded proposals announced
10/13/16		Detailed Project Plan Completed
10/13/16		Final Rocket Design Begins
10/14/16		Kickoff and Preliminary Design Review (PDR) Q&A
10/15/16		Web Site Begins
10/31/16		Team web presence established
10/31/16		Preliminary Design Review: PDR reports, presentation slides, and flysheet posted on the team
11/02/16	11/18/16	PDR video teleconferences
1/02/17		Scale Model Construction Begins At Mr. Adams
1/05/17		Scale Model Initial Launch, Hutto, TX AARG Launch Event
2/07/17		Initial Parts ordered for Full Scale Rocket

12/02/16		Critical Design Review (CDR) Q&A
12/03/16		Hutto, TX AARG Launch Event
01/07/17		First possible Full Scale Rocket Launch, Hutto, TX AARG Launch Event
01/13/17		Critical Design Review: CDR reports, presentation slides, and flysheet posted on the team
01/17/17	01/31/17	CDR video teleconferences
02/04/17		Possible Full Scale Rocket Launch, Hutto, TX AARG Launch Event
02/08/17		Flight Readiness Review (FRR) Q&A
03/04/17		Full Scale Rocket Launch, Hutto, TX AARG Launch Event
03/06/17		Flight Readiness Review: FRR reports, presentation slides, and flysheet posted to team Website
03/08/17	03/24/17	FRR video teleconferences
04/01/16		Hutto, TX AARG Launch Event
04/05/17		Teams travel to Huntsville, AL
04/05/17		Launch Readiness Reviews (LRR)
04/06/17		LRR's and safety briefing
04/07/17		Rocket Fair and Tours of MSFC
04/08/17		Banquet
04/08/17		Launch Day

04/09/17	Backup launch day
04/24/17	Post-Launch Assessment Review (PLAR) posted on the team Website by 8:00 a.m. Central Time

PRELIMINARY BUDGET/COSTS

$1519	Rocket parts and backups
$340	Motors and backups
$3,500	Airfare to Huntsville
$4,000	Hotels after arrival,
$1,250	Food while there,
$500	Payload development and construction,

Total Estimated project cost: $11109

FUNDING PLAN

- Register DBA – “Cedar Park Rocketry Club”
- Apply for non-profit status for Club to encourage donations from corporations
- Meet with Parents to encourage a personal fundraising pledge/match/commitment
- Contact major retailers
    - Target
    - Home Depot
    - TechShop
    - Aerotech
    - Cesaroni
    - Local Businesses
- Collect donations during “Educational Outreach” events

SUSTAINABILITY PLAN

This program is something that means a lot to us so we’ve decided to invest in keeping it moving forward and helping it grow for years to come. Rocketry is an amazing experience that is not only fun, but also a great chance to learn and grow. We want our team to help the excitement live on even after the older more experienced members age out and go on to become mentors and team leaders. So we have ensured the sustainability of the rocketry project by adopting younger members that are curious and bright individuals with a passion for rocketry. We also wanted to tell thousands of others about this great experience, so we decided to reach out to facilities, industries, and

educational programs they might have younger and older boys and girls alike whom might be interested in rocketry. While we continue to seek out other places in which there might be kids who could show interest in this wonderful program, we've identified contacts to propose outreach events in:

- Local schools; both middle and high school,
- Boy scout troops,
- Cub scout packs,
- Homeschool co-ops and conferences
- Science Fairs