National Aeronautics and Space Administration
Marshall Space Flight Center
Student Launch Proposal

Got Those Good Vibrations

November 3, 2017

5110 Walzem Road, San Antonio, Texas, 78218
Christina Moreno

Submitted To:

NASA/George C. Marshall Space Flight Center
Huntsville, Alabama 35812

Ian Bryant, Jacobs ESSSA Group
Katie Wallace, NASA MSFC
Julie Clift, NASA MSFC

Submitted By:

Northeast Independent School District
Roosevelt School
5110 Walzem Rd
San Antonio, TX 78218
(210) 356-2200

TABLE OF CONTENTS

Academic Affairs Office
NASA/George C. Marshall Space Flight Center HS30
Huntsville, Alabama 35812

Dear NASA,

The Engineering and Technologies Academy (ETA) is a merit based high school magnet program that is centered around providing students education and opportunities that will make them successful in various engineering fields. We engage students in specialized courses where they learn how to use various applications that are relevant to their desired careers. We have been active participants in the Technology Student Association (TSA) in which our students excel. In recent years we have opened up a rocketry club due to the significant amount of interest our students show for the field of Aerospace. The students that are part of the club dedicate significant amounts of time to designing and constructing rockets for the annual Team America Rocketry Challenge.

Our school is excited for the chance to participate in the Student Launch for their second year. This will no doubt be an invaluable learning experience for not only our students, but for our school as we continually strive to improve our students' education.

We would like to thank you for giving us this opportunity to participate in this amazing competition. We hope you enjoy this proposal and will eagerly await your reply.

Sincerely,

Robert Lozano Jr.
Director of Engineering & Technologies Academy @ Roosevelt H.S.
5110 Walzem Rd., San Antonio, TX 78218
rlozan1@neisd.net
210.356.2317

Administrative / Mentor Staff	Student Participants

Robert Lozano rlozan1@neisd.net (210) 356-2317	Director, Magnet Programs	Ana awilson4953@gmail.com	Team Captain, Rocksim
Christina Moreno cmoren1@neisd.net alexandra3511@outlook.com (210) 867-6911	Team Official / Lead Educator	Xiangyu	Co-Captain, Website Manager, Rocksim
David Abmyr dwabmayrjr@gmail.com	Rocket and Payload Mentor	Cameron	Safety Captain, Construction
		Fernanda	Safety, Social Media Manager
		Katie	Chief Financial Officer, Progress Manager
		Madeline	Construction Manager, Recovery
		JR	Electronics Manager and Recovery
		James	Progress Manager, Construction
		Lucas	Construction
		Ricky	Electronics, Social Media Manager
		Elvis	Safety Officer, Construction
		Sean	Construction
		Kristian	Construction

Mentor Biographies

Mr. Robert Lozano:

Robert Lozano Jr. was raised in a small town in Texas, Santa Rosa, where he graduated number three with a whopping graduating class of fifty students. The upside of growing up in a small school environment was that he was able to participate in many activities. There, he was quarterback of his football team, starting guard and captain of his basketball team, participant in the Fellowship Christian Athletes, grand champion in welding construction at the RGV Livestock Show, and was on the casting team of his One Act Play. He left Santa Rosa to come to San Antonio to pursue his college career where he received his Bachelor's Degree in Architecture from the University of Texas San Antonio in 1993. From there, he worked with a few local architectural firms and then decided to go into the education field where he began as a first year Computer Drafting & Design Teacher teaching at a the Career & Technology Academy at South San High School. While he was there, his principal saw potential leadership skills in him and encouraged him to go back to school to further his education in school administration. So he went back to UTSA and received his Master's Degree in Educational Leadership in 1997. He then applied for an administrator's position and was hired as an assistant principal in the Judson Independent School District where he remained as an administrator until 2006. He then went back to South San Antonio ISD where he had an opportunity to advance in a role at central office and was there until June 2015. His role at South San Antonio ISD helped prepare him for the role he's in today as their Director of STEM and Advanced Academics. There, he oversaw the entire district K-12 with all STEM activities such as Project Lead The Way, PREP-USA (Pre-Freshman Engineering Program) and our district-wide Science Fair. Today, he's proud and honored to represent Northeast ISD as the Engineering & Technologies Academy's Director that services approximately 380 students.

Mentor Biographies (Cont.)

Ms. Christina Moreno:

Mrs. Moreno is ETA's ninth through twelfth grade Aerospace Engineering, Engineering Design & Presentation Level I and Advanced Engineering Design instructor. She obtained her Bachelor's of Technology Education from Valley City State University 2010. Ms. Moreno continued her education and received her Master's in Educational Leadership at the University of Texas at Arlington in 2013. Ms. Moreno has been teaching at ETA for six years and loves what she does. Her first year of teaching was at Winston Churchill High School teaching Animation and Video Game Design which she likes, but her passion was set on ETA (Engineering Technologies Academy). Ms. Moreno has had a passion for aerospace/flight since she was kid she lived on base at Luke Air Force in Glendale, AZ where she got up close and personal as she watched those F-16 rockets. Ms. Moreno has a senior in college majoring in Aeronautical Engineering at Embry-Riddle Aeronautical University. This past summer she received her NAR level 1 Rocketry certification and will be working on her NAR level II Rocketry certification next month. Also this summer she saw two Falcon 9 launches at Cape Canaveral, Fl. The Spacex launch was the most wonderful experience and to be so close to the site was even more enjoyable. Ms. Moreno thanks her son for all his hard work to get her so close to the launch. Ms. Moreno started the after school Team America Rocketry Club when she met three amazing girls four years ago and had just one team which has now grown to over 15 plus teams this year.

Mentor Biographies (Cont.)

Dr. Dave Abmayr, Jr.:

Dave began flying model rockets in his youth, Estes rocket kits powered by Estes black powder motors. He moved on to other things for many years, but in 2010 came back to rocketry as a born again rocketeer. He started flying models similar to what he had flown before, but soon discovered larger rockets and composite motors. Dave flew mid-power E-G models for a couple years before moving to high power rocketry. He achieved his Level 1 certification on a Madcow Phoenix with a CTI H225WT motor in May of 2012. A few months later he built a Madcow Prion, which would become his first dual-deploy rocket as well as his Level 2 rocket. He achieved his Level 2 on the Prion in May of 2013 on a CTI J381SK, using a combination of a Raven2 and an AltusMetrum Telemetrum 1.2 for flight electronics. After that, he expanded his fleet into a mix of rockets in both size and composition, as he continued to refine his construction and flying techniques. Dave finally decided to go for Level 3 certification in 2015 using a scratch-built 137.5% upscale of the Prion. He achieved that in July of 2015 with a Loki M1650TC and a Raven3/TeleMega 1.0 electronics combination. Since then, Dave has continued to fly many different types and sizes of rockets, from A to M powered. He has built several scale or semi-scale rockets, in addition to many sport kits and scratch-built rockets. His favorites are the military missiles, especially Hawk and Phoenix rockets, and the Black Brant II sounding rocket. He flies predominantly Aerotech and Loki power, but occasionally CTI as well. David now has over 60 dual-deploy flights, and he is now focusing on more complex flights, such as clusters, airstarts, and staging. Dave's favorite part of the hobby, though, will always be design and building, particularly lightweight composite structures and compact avionics bays.

Student Biographies

Ricky:

From a young age, Ricky has been fascinated by engineering, math, science, and entrepreneurship. He attended the Krueger School of Applied Technologies magnet program, where he had the opportunity to participate in the 2014 - 2015 NASA SL team. Having been inspired by his experience with NASA, he decided to further delve into the realm of engineering by applying to the Engineering and Technologies academy, where he once again participated in the Student Launch program. This previous summer, Ricky attended the Massachusetts Institute of Technology as part of the MIT Launch summer program, where he spent a month with fellow young entrepreneurs from all over the world, creating and launching their own startups. He is currently a Junior in High School, a percussionist in the Roosevelt band, a member of the Technology Student Association, and co-founder of an MIT Launch clubs chapter at his school, a club in association with MIT which seeks to teach students about entrepreneurship by creating their own startups. He plans on continuing to further his knowledge in order to pursue a future in the STEM field.

Fernanda:

Ever since a young age Fernanda has shown a real interest in math, science, and engineering. From sixth to eighth grade she attended KSAT middle school and her eighth grade year was part of the 2014-2015 SL rocketry team. She has been a member of the varsity tennis and cross-country team since her first year in high school. Fernanda is currently in her third year of high school at ETA.She hopes to pursue a career in the STEM field.

Madeline:

It was during her middle school years in Krueger School of Applied Technologies (KSAT) that Madeline learned about her high interest in the aerospace field. In her eighth grade year, she participated in the 2015-2016 KSAT SLI team and in her freshman year, she was a part of the ETA's 2016-2017 SL team. After a lot of time spent in SLI, she was able to build a rocket by herself in a span of three days that would get her a level one certification with NAR. She is now a sophomore at the Engineering and Technology Academy (ETA), aiming only to continue her streak of a 4+ GPA. She is also currently attending several clubs that include

Robotics, TSA, Cyberpatriot, and SLI. After high school, she hopes to major Aerospace Engineering and attend Massachusetts Institute of Technology (MIT).

Ana:

Ana had joined the Krueger Middle School of Applied Technologies (KSAT) in her 6th grade year because of her high interest in aerospace and engineering. She is presently a junior at Roosevelt High School in the Engineering and Technology Academy (ETA), expanding her horizon in the field of engineering as well as the field of science. She is the Rocketry Club president, is an officer in JROTC and is a member of the JROTC varsity rifle team, president of the Forensics Science Club and a member of the German Club. Two years ago, as a freshman, her Team America Rocketry Challenge team qualified for Nationals in Washington D.C., and they placed 20th out of 100 competing teams. She plans to major in Aerospace Engineering at either Embry Riddle School of Aeronautics or at the University of Texas in Austin.

JR:

JR has always had a love for aerospace. He was a member of the 2014-2015 SL team at Krueger middle school, as well as the 2016-2017 SL team at Roosevelt HS. He currently attends the ETA program at Roosevelt HS and is a part of the varsity tennis, soccer, and cross country teams. JR has obtained his NAR Junior High Power Certification and often launches home-built rockets. He has achieved the rank of eagle scout and remains an active member of his troop. JR maintains a 4.0+ throughout all of his classes and aspires to receive his masters degree in Aerospace Engineering.

Cameron:

Cameron has always had an interest in Rocketry. He was a member of the 2014-2015 SL KSAT team at Krueger Middle School. He currently attends the ETA program at Roosevelt high school, and is a part of Robotics, TSA, and Has been in SL for two years within ETA. He is an active member in his school varsity orchestra, also taking private lessons for violin. He is also an Eagle Scout. Cameron also has a job at Bahama Bucks, has attended an internship at Southwest Research institute (Summer of 2017) and has been in the camp SOAR aerospace program at A&M college station (Summer of 2017).

Xiangyu:

Xiangyu is a bright young man who has been fascinated by space since an early age. He attended KSAT because of this high interest in rocketry, where he was a member of the 2014-2015 Student Launch team. While he was there, he also built a level 1 rocket, but was too young to obtain his certification. He is now a junior attending the Engineering and Technology Academy (ETA), where he was part of last year's SL team, is an active member of TSA, and has been an officer at CyberPatriot for two years,. He keeps a 4.0+ GPA, and hopes to major in planetary science or astrophysics.

Katie:

Katie has always loved the aerospace field, especially during her middle school career at KSAT (Krueger School of Applied Technologies). She was part of the 2015-2016 SL Team from KSAT. She is a member of NAR, and has her NAR Junior High Power Level 1 Certification which she gained in May of 2016. Katie is currently a sophomore in the ETA program (Engineering and Technologies Academy) at Roosevelt High School. Last year, she was a part of the 2016-2017 SL team from ETA and is looking forward to her third year in the SL program. She maintains a 4+ GPA in her GT, AP and Pre-AP classes, and is a member of TSA (Technology Student Association). Last year in TSA she received numerous first place awards at the regional and state levels. She also enjoys playing flute in the Roosevelt Wind Ensemble, the top concert band, as well as piccolo in the Roosevelt Marching Band. This year Katie is also the flute section leader. She hopes to pursue a degree in either aerospace engineering or music in the future.

Lucas:

Lucas has always been interested in all branches of engineering, such as mechanical, electrical, chemical and especially in robotics. Lucas really peaked in middle school where he attended Tex Hill Middle School. He joined their early engineering program and worked with model rockets and CO2 cars. After middle school he joined the robotics team and competed in many competitions. Lucas was also a cadet in1 JROTC at Johnson High school. Lucas is now currently attending ETA as a junior where he now takes IT courses to expand his horizon.

James:

Since a young age, James has loved engineering and math. He joined KSAT, Krueger School of Applied Technology, a magnet program with an emphasis on engineering, math, and technology. During his 8th grade year, he was a part of the 2015-2016 KSAT SLI team. Currently, he is a sophomore in ETA, Engineering and Technology Academy, and a member of the Roosevelt band.

Sean:

Sean Flores has been pursuing high levels of education and leadership in the engineering field since entering high school. He has applied himself in a multitude of ways to distinguish himself. His distinctions include essential fundamentals such as leadership, academics, and perseverance. These are exemplified by being the TR Drum Captain and pursuing engineering education.

Elvis:

Elvis has been pursuing Aerospace Engineering aspirations since middle school. He has pursued leadership positions in his community and rocketry, such as becoming an NHS officer and the Rocketry Vice President. He is pursuing a higher education in the field and will continue on his path to success with a strong work ethic and perseverance.

Kristian:

Kristian is a senior in ETA at Roosevelt High School, Parliamentarian of Rocketry at Roosevelt and Master Builder for FTC Robotics at Roosevelt. He has attended ETA all 4 years of high school and has stuck with the program to further his passion for engineering. He enjoys rocketry and excels in the aerospace class taught by Ms. Moreno, the head of the rocketry club. Kristian plans on attending Rochester University to become an Aerospace Engineer to further his interest in rocketry and the aeronautical field.

Facilities / Equipment

Facility	Hours of Accessibility	Purpose
Roosevelt High School - Saber Building*	Monday-Friday: 8:45 a.m. -6:00 p.m.	Rocket Design & Manufacture Payload Design & Manufacture Ejection Charge Test Payload Test
Garrett's Launch Site	Pre-Scheduled NAR Flights	Scale Model Rocket Flight Test Rocket & Payload Flight Test
The Space Park at the Johnson Space Center	Pre-Scheduled NAR flights	Rocket and payload flight tests

Saber Building Rooms*	Specifications
Engineering Workshop E113	This workshop has computers available, large work tables and a Smartboard. All tools necessary for the construction of our rocket are accessible such as a belt sander, drill presses, drills, and a band saw.
ETA Computer Lab E206	This computer lab has 18 computers installed with various software programs such as AutoCAD Inventor, Rocksim, and Adobe editing programs. Various poster printers, and two printers are also available, along with a projector that can be used to display information in meetings. This computer lab also has an integrated workshop with a bandsaw that can be used when necessary.
ETA Computer Lab E209	This computer lab has 24 computers installed with various software programs such as AutoCAD Inventor, Rocksim, and Adobe editing programs. One 3D printer, and two printers are also available, along with a projector that can be used to display information in meetings.

Phase	Required Personnel
Design and Construction of Rocket	Christina Moreno, David Abmayr, Robert Lozano, and all SL students.
Flight Test	Christina Moreno, David Abmayr, Robert Lozano, and all SL students.

***All team members will participate in each phase as needed**

Rocket Components and Equipment

Equipment	
Band Saw	Wire Cutters/ Wire Strippers
Drill Press	Scissors
Drill Bits	Screwdrivers
Pliers	Sandpaper

Part Name	Manufacturer	Quantity
Body Tube (BT 98)	Balsa Machining	4
4:1 Fiberglass Ogive Nosecone	Apogee	2
24” Nylon Parachute	Apogee	1
72” Parachute	Apogee	1
Coupler BT 8” long	Apogee	3
Rail Buttons	Apogee	4
West System Epoxy and Hardener	West Marine	2
5 min. Epoxy	Pitsco	6

Custom Fins Aircraft 1/2 Plywood (Birch)	Balsa Machining	3 Sheets
Forged Eyebolt	Crown Bolts	6
Body Tube 54mm BT 48"	Balsa Machining	1
Shock Cord (tubular kevlar 1/4 in.)	Giant Leap	9 yards
Parachute Protector	Balsa Machining	5
Black Powder Charge Canisters	Apogee	8

Components for Payload

Part Name	**Manufacturer**	**Quantity**
PerfectFlite Stratologger CF	Apogee	3
Through Mount Slotted Switch	Aerocon Systems	2
BRB 900 GPS & Transmitter	Big Red Bee	1
9V Batteries	Home Depot	2 packs

I) Summary of PDR Report

Team Summary

Engineering & Technologies Academy at Roosevelt High School

5110 Walzem Road

San Antonio, TX 78218

Lead Teacher:

Christina Moreno

NAR# 101793

Level 1 Certified

Mentor:

David Abmayr

NAR #90215/TRA #13238

Level 3 Certified

Launch Vehicle Summary

Our rocket consists of three parts and will rely on a dual deployment recovery system in order to ensure that our rocket lands safely and is easy to retrieve. The motor we have chosen accounts for the extra weight added by epoxy, paint, or payload and will help us guarantee that our rocket reaches the altitude of 5280 ft.

Size: Length: 105.7500 in.

Mass: 324.1154 oz.

Motor Choice: Cesaroni Technology [K660]- No Delay

Recovery System: Dual Deployment and Redundant

Payload Summary

Got Those Good Vibrations: ETA SL's objective is to design and build a rocket that will reach 5,280ft in altitude, while holding a payload of piezoelectric generators in the nose and fincan of the rocket. Our goal is to collect electricity and data to where we can see which portion of the rocket creates the most energy from vibration, how much energy in total the rocket can collect, and retrieve this data unharmed with a successful landing

.

II) Changes made since the Proposal and Reasons for the Changes

Changes Made to Vehicle Criteria

We have decided to decrease the size of our fins to reduce drag and to decrease weight in order to increase our altitude and make our rocket more stable. We also changed

the material of our motor tube to blue tube for better durability and general safety. We have also removed the aft bulkhead, and will instead be attaching the rear shock cord to the motor mount. We have also adjusted the thickness of our nose cone and payload bulkheads, while moving the rear centering ring to rest against the thrust plate. We have also adjusted our nose cone and parachutes, readjusting the erroneous 100 oz parachute to roughly 12 oz. This sharp decrease in weight meant that with our previous motor, we would now be going up to 9583 ft, so we changed our motor to the Aerotech J800T.

Changes Made to Payload Criteria:

We decided to change our electronics design to better fit the piezo sensors and recorder by simply rearranging our electronics bay.

Changes Made to Project Plan:

We have increased the amount of fundraiser events we host in order to raise money, as well as increase educational outreach events throughout middle and elementary schools in our area.

III) Safety

Safety

Safety will prioritized in order to ensure the wellbeing of everyone involved in this project. Every member of the team will receive a copy of the NAR safety procedures and will be continually briefed on them throughout the duration of the project. All team members will follow the safety rules and procedures when building, testing, and flying the rocket.

Cameron, Fernanda, and Elvis are our safety officers. They will oversee the compliance of the safety procedures among the team members, and ensure that team members have a proper understanding of how to handle equipment. Each team member must pass a safety test over the NAR High Powered Rocketry Code and the use of power tools. The safety officers are also responsible for informing team members of launch safety procedures before each launch.

Christina Moreno and David Abmayr will be their mentors and make sure all safety procedures are followed. David Abmayr has his level 3 certification and will attend all launches.

Our safety procedures include:

- At least two team members will be working together at all times.
- Team members will be required to take a mandatory safety test
- Team members will wear safety gear while building and testing.
- Electronic devices will have multiple switches to prevent accidental firing.
- All black powder and ejection charge preparation will be handled by David Abmayr.
- Students will review safety procedures and checklists multiple times.
- The Safety Officers will make sure to remind the team daily of the safety concerns for each particular task.

Safety regulations and codes to be followed:

Cognizance of Federal, State, and Local Laws Regarding Unmanned Rocket Launches and Motor Handling

To insure proper cognizance of federal, state, and local laws regarding unmanned rocket launches and motor handling the safety officers will brief the team on how to properly follow these laws and regulations:

-Title 27, Code of Federal Regulations PART 55 -- COMMERCE IN EXPLOSIVES:

Title 27, Code of Federal Regulations part 55 covers the purchasing and handling of explosives. Up until March 2009 APCP (Ammonium perchlorate composite propellant) rocket motors were regulated as an explosive by the ATF. Though in 2009 TRA filed a lawsuit against ATF over the ATF's ruling of APCP as an explosive. TRA won the lawsuit which resulted in APCP no longer being regulated by the ATF and instead being regulated by NAR and TRA. Though APCP is no longer regulated as an explosive we will still treat it as a hazardous substance and proper procedures will be taken to insure safety.

-Federal Aviation Regulations 14 CFR, Subchapter F, Part 101, Subpart C - Amateur Rockets

The Federal Aviation Administration (FAA) has regulations for air space usage. Model Rockets enjoy relief from FAA regulations via Federal Aviation Regulations Part 101; see FAR 101 at www.access.gpo.gov. It states the following:

Rockets weighing less than one pound and flying on less than 4 ounces of propellant, FAR 101 rockets, do not require notification of the FAA. Large Model Rockets, weighing between 1 and 3.3 lbs and flying on not more than 4.4 ounces of propellant, while not requiring a waiver from the FAA, require a phone call to the nearest FAA tower or airport for notification of the planned activity. Model Rockets are also considered toys by the federal government and as such must meet Consumer Product Safety Commission's safety requirements.

Waivers from the FAA are required to fly High Power Rockets weighing more than 3.3lbs and/or flying on greater than 4.4 ounces of propellant. While anyone may apply to the FAA for a waiver, this process is normally handled by a rocketry club officer, often the Launch Director. When granting waivers, the FAA reviews the normal use of the airspace for which a waiver has been requested to determine the feasibility of rerouting airplanes while launches are being held. Waivers to high altitudes are most readily granted for airspace that is not heavily used therefore, launch sites with high waivers are often many miles from large cities and airline traffic patterns. Waivers are granted in MSL or altitude above mean sea level. Waivers are often referred to in AGL, above ground level, a figure determined by subtracting the elevation of the launch site from the MSL altitude. For more information on the FAA see www.faa.gov.

National Fire Prevention Act 1127

I will use only rocket motors that are commercially made and certified by NAR safety laws, I will in no way tamper with the motors or use them for any purpose other except those recommended by the manufacturer.I will not allow smoking, open flames, or heat sources within 25 feet of these motors.

National Association of Rocketry- High Power Rocket Safety Code:

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, or 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. Our rocket will not contain any combination of motors that total more than 40,960 N-sec (9,208 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 1,500 feet, whichever is greater, or 1,000 feet for rockets with a combined total impulse of less than 160 N-sec, a total liftoff weight of less than 1,500 grams, and a maximum expected altitude of less than 610 meters (2,000 feet).

11. Launcher Location. My launcher will be 1,500 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 only flame-resistant or fireproof recovery system wadding in my rocket.

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.

NAR Safe Distance Chart

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

Use of Airspace

§ 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. [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.

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

§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]

Code of Regulation Part 55

-High power rocket motors, as defined above, must be stored in a Type IV or equivalent magazine (See 27 CFR 55.210).

-These magazines may be located in an attached garage of a single family residence provided that the magazine is separated by a wall and is not part of the living quarters. Indoor storage will not be permitted in multi-family dwellings such as condominiums, apartments, duplexes, etc.

Code of Regulation Part 55 cont.

Indoor storage of low explosives must not exceed a quantity of 50 pounds as required by 27 CFR 55.210(b) (1).

-Any person who stores explosive materials shall notify the authority having jurisdiction for fire safety in the locality in which the explosive materials are being stored of the type, magazine capacity, and location of each site where such explosive materials are stored. Such notification shall be made orally before the end of the day on which storage of the explosive materials commenced and in writing within 48 hours from the time such storage commenced.

-The Consumer Product Safety Commission has define toy model rocket motors under 16 CFR 1500.85(a) (8), as those motors containing a propellant weight of 62.5 grams or less and which produce less than 80 Newton-seconds (17.92 pound seconds) of total impulse. ATF will consider any model rocket motor containing a propellant weight greater than 62.5 grams and producing a total impulse of more than, or equal to, 80 Newton-seconds, a high power rocket motor, placing it under the provisions of the Federal explosives laws, 18 U.S.C. Chapter 40. Furthermore, motors containing a total propellant weight of 62.5 grams or less, intended to be used as a segment for installation into larger motors, and which cannot be used individually, will also be regulated.

NFPA 1127-Motors.

I will use only rocket motors that are commercially made and certified by NAR safety laws, I will in no way tamper with the motors or use them for any purpose other except those recommended by the manufacturer.I will not allow smoking, open flames, or heat sources within 25 feet of these motors.

PROCEDURES FOR NAR/TRA PERSONNEL TO PERFORM

The NAR/TRA mentor Donald Cosgrove will be in charge of all handling of motors. Donald Cosgrove currently has a level three in rocketry. This includes purchasing, storage, transportation, and use of motors on the launch site. He will be in charge of the assembly and ownership of the motor until the installation of the motor in the rocket. The NAR/TRA mentor will also be in charge of the electronic launch system and the correct installation of the motor ignitor at the launch pad or the designated launch prepping area along with the handling of hazardous materials such as black powder and will be in charge of overseeing hazardous operations at launch sites.

Hazard Recognition

To insure that materials and tools are safely used by team members we will brief all team members with a hazard recognition and accident avoidance which will go over the proper use and handling of tools and materials along with safety guidelines in the workspace in order to prevent accidents. To insure safety at launch sites we will conduct pre-launch briefings where we will cover the standard procedures and the safety of a high powered rocket launch along with launch site safety codes.

The hazard recognition presentation will cover the following along with general safety:

-Keep work space clean and organized. Put away all materials and tools when finished working with them.
-If you are unsure about the proper handling and procedures of the following:
    a)Tools
    b)Materials
    c)Equipment

-When you are working with tools or chemicals be sure to wear proper safety equipment such as:

a)Closed Toe Shoes

b)Gloves and safety glasses when necessary

Chemicals)

-When using chemicals you subject to the following risks:

a)Irritation of skin from contact with chemicals

b)Irritation of eyes from contact with chemicals

c)Throat from inhaling hazardous fumes

-Ways to mitigate these risks:

a)Ensure you are handling the chemicals properly

b)Wear proper clothing

c)Wear proper safety gear such as gloves and/or safety Glasses when needed

Tools)

-When using tools you are subject to the following risks:

a)Cuts

b)Burns

c)Bruises

d)Other general injuries

-Way to mitigate the risks

a)Wear proper clothing when working with tools

b)Make sure you are using tools properly

c)Ask if you are unsure about the proper use of tools

Caution Statements

Any document pertaining to risk level activities will include caution statements to ensure safety of all those involved. Each statement will include: checklists, correct operating procedures, chemical-handling procedures, and lay-up procedures.

Purchasing and Handling Rocket Motors

Motor casings and reloads will be purchased by the certified NAR/TRA mentor. The NAR/TRA mentor with the proper certification will make sure the reload(s) are stored correctly and- when needed- transported in an appropriate container. In addition, the NAR/TRA mentor will oversee the construction of motors and reloads.

Safety Agreement

A safety agreement was created to ensure that all members understand the safety hazards and had read the safety regulations.

Pre-Launch Briefings

To insure safety at launch sites, we will conduct pre-launch briefings in order to cover the standard procedures, the safety of a high powered rocket launch, launch site safety codes and

the NAR high powered safety code. We will also go over the risks and hazards of a rocket launch as listed below:

Table 1: Failure Modes

POTENTIAL FAILURE MODE	POTENTIAL EFFECT OF FAILURE	FAILURE PREVENTION
Motor Explodes	Can injure anyone within 400 feet of the rocket from debris or the overall explosion.	The launch station needs to be at least 400 feet away from the launch pad, spectators must be at least 500 feet away from the launch pad and keep eyes on the rocket at all times while it is in the air.
Recovery system does not deploy	Will cause the rocket to descend rapidly and increase the risk of injury.	The launch station needs to be at least 400 feet away from the launch pad, spectators need to be at least 500 feet away from the launch pad and keep eyes on the rocket at all times while it is in the air.
Engine explodes in the air	Can injure anyone within 400 feet of the rocket from debris or the overall explosion.	The launch station needs to be at least 400 feet away from the launch pad, spectators need to be at least 500 feet away from the launch pad and keep eyes on the rocket at all times while it is in the air.
Payload explodes on the launch pad or in the air	Can injure anyone within 400 feet of the rocket from debris or the overall explosion.	The launch station needs to be at least 400 feet away from the launch pad, spectators need to be at least 500 feet away

		from the launch pad and keep eyes on the rocket at all times while it is in the air.
Payload fails	Rocket becomes unstable	Bolt/tie all components down in payload drawer-test all components separately first
Recovery system on our rocket does not deploy.	Can come down very fast, land on someone and cause major injuries.	Do ejection test with calculated black powder prior to launch. The launch station needs to be at least 400 feet away from the launch pad, spectators need to be at least 500 feet away from the launch pad, keep your eyes on the rocket at all times while it is in the air.
Electrical shock from malfunction of batteries or altimeters	Minimal burn injuries, electrocution injuries	Team members will work in dry areas and will not open the electronics (casing stays closed).

Table 2: Equipment Hazards

HAZARD	**EFFECT OF HAZARD**	**MITIGATION**
Bandsaw	Laceration, Dismemberment, Discharge of Sawdust, Electric Shock	Every team member will be properly trained on how to use the machine, will wear proper eye wear and clothing. Mentor must always be present when machine is being operated.
Belt Sander	Sawdust Discharge, Laceration, Abrasion, Electric Shock	Team members will be properly informed and the procedures and dangers associated with the

		equipment. Protective eye wear will be used at all time. The machine will only be operated in the presence of a mentor.
Drill Press	Puncture Wounds, Laceration, Electric Shock	Members will wear eye protection equipment and not have any loose clothing. Hair will be tied up and jewelry will not be worn.
Dremel	Abrasion, Laceration, Saw dust, Discharge, Electric Shock	Members must wear masks and have proper clothing in addition to.
Black powder	Chance of Ignition, Eye Contamination	The material will be handled with care only by members with a level 2 certification or higher in rocketry. They will execute necessary safety procedures to avoid any danger to themselves or other members.
Epoxy	Binding Together, Skin and Eye Irritation	Gloves will be used while handling. A proper workspace will be provided and managed as to avoid contamination or the unwanted binding of objects.
Double Compound Miter Saw	Lacerations, Dismemberment, Sawdust Discharge, Electrical Shock	Members will be trained in both use and safety of equipment. Property safety wear will be worn with dangling jewelry and hair being tied back or removed while the machine is in operation. The machine will only be operated while a mentor is present.
Scissors	Lacerations	Team members will handle scissors carefully, and in a safe manner, taking precautions to avoid injuring other members.
Screwdriver	Lacerations, Puncture wound	The tool will be handled with care, and not used in any manner that would put a team member at risk of injury.

Clamp	Dismemberment	The tool will be handled with care, and not used in any manner that would put a team member at risk of injury.
Wire cutters	Lacerations, Puncture wounds	The tool will be handled with care, and not used in any manner that would put a team member at risk of injury.
Laser Cutter	Electrical shock, Burns, laceration	Only members who are trained to use this device are allowed to operate it. Team members will use the machinery respectively and will make sure that by using it no team member will be harmed.
3D-printer	Electrical shock, Burns, Chemical burns, deadly inhalation of chemicals	Only members who are trained to use this device are allowed to operate it. When around the device, member will wear safety goggles and gloves when around this device. When lifting the device there is a minimum of two people. Members will wear masks when chemicals are released.

Table 3: Risk Assessment

RISK	PROBABILITY	IMPACT	MITIGATION
Burn Bans	High	Unable to launch, Will not be able to collect data	Have multiple launch dates available
Students have other demands on time	Medium	Schedule/timeline gets behind	Break team members into groups so there are multiple opportunities to complete a task.
Bad weather	Medium	Unable to Launch,	Have rain dates scheduled for

on launch day		will not be able to collect data	every launch
Unavailability of equipment/ supplies	Low	Schedule/timeline gets behind	Order parts in advance well before they are needed

How the Vehicle Affects the Environment:	**How the Environment Can Affect the Vehicle:**
Black Carbon: Black Carbon emitted by hydrocarbon-fueled rockets- like carbon dioxide- adds heat to the atmosphere.	**Wind Speeds:** Wind speeds can affect the performance/direction of the rocket and if wind speeds are over 20 mph, then the vehicle launch will be cancelled.
Stratospheric Changes: Soot from many launches will accumulate in the stratosphere to absorb sunlight that would otherwise reach Earth's surface.	**Rain:** Bad weather conditions- including precipitation- can affect the materials used to construct the vehicle and alter flight trajectory.
Ammonium Perchlorate Composite Propellant(APCP): In the plumes of rockets that use solid perchlorate propellant(Black Powder is considered perchlorate propellant), ozone is completely destroyed in the narrow column of the plume.	**Projectiles:** Projectiles such as aviary creatures could collide with the vehicle mid-flight.
	Drought: A drought could increase the risk of a fire when the vehicle is launched.

Flight Readiness Checklist

Visual Check:

____Is the rocket symmetrical?

____Are the fins congruent to each other?

____Are the fins securely attached?

____Are the launch lugs/rail buttons aligned?

____Is the workmanship suited for the flight?

____If applicable, are all repairs/changes made from prior flights?

Mechanics:

____Is the CP marked (with motor-from Rocksim)?

____Is the CP ">" greater than one (1) caliper aft of the CG (give distance between) ____inches

____Is the CG marked (with motor-from Rocksim)?

____Does the rocket balance at CG point (must have motor in)?

____Does the nose cone fit properly? Hold the nose cone firmly and jiggle the rocket.

____The nose cone should move but not come off. Use masking tape to adjust the fit if it is to loose.

____Do sections (forward, payload, and fin can) slide on/off easily?

____Are shear pins installed or marked?

____Are drilled switch holes aligned with internal altimeters?

____Are fins secure and parallel to rocket centerline?

Payload:

____Do the payload electronics work properly?

____If there are holes drilled for turning on/off, are the hole(s) aligned to do so?

____For dual deployment, does the altimeter make 3 quick beeps when switch battery and trip wires set up?

____Check altimeter mounting.

____Check battery mounting.

____Check wiring

Propulsion:

____Is the motor selected right for the rocket? The average thrust should be five (5) times the weight of the rocket.

Motor: _____

Avg. thrust in N=_____

Rocket plus motor weight in oz.=_____

T/W after converted to pounds=_____

____Expected altitude=_____

____Time to apogee=_____

____Time to landing=_____

____Does motor case fit into rocket easily?

____If adapter, does adapter fit into rocket easily?

Recovery System:

____ Is the harness (or harnesses) 4 to 5 times the length of the vehicle.

____The material should be nylon or kevlar.

____The harness should have the nose cone/fin can attached at the 1/3 point leaving 2/3 thirds attached to the main airframe of the rocket.

____Are parachutes attached with blankets and quick links correctly?

____Are they folded properly?

____Size of main?_____

____Size of drogue?_____

Requirements Compliance

ETA SL Compliance Promise

All team members understand and will abide by the following safety regulations:

-There will be a flight readiness review and range safety inspection of each rocket before it is flown.

-The team shall comply with the determination of the safety inspection.

-The Senior Safety Officer has the final say on all rocket safety issues.

-The Senior Safety Officer has the right to deny the launch of any rocket for safety reasons.

-If any member of the ETA SL team does not comply we will not be allowed to fly.

IV) Vehicle Criteria

Mission Statement:

The ETA SL team will launch a mile high in order to measure the energy which can be gained using piezoelectric generators on the ascent and descent, as well as to determine the validity and efficiency of harnessing this electricity on flights. This information could be scaled up and applied to flights by NASA air/spacecraft to harness and generate energy on the flight into space and beyond.

Success Criteria:

If the ETA Roosevelt SL rocket travels the required height (one mile), is recovered safely, is able to be relaunched and if the team is able to retrieve accurate data then, and only then, can the mission be declared a success.

Technical Design:

Systems in Rocket	**Alternative Designs**	**Pros and Cons of Each Alternative**
Structural System- The structural system we are currently using consists of a blue tube frame and ¼ in. birch aircraft plywood fins.	**Frame Alternatives**- Fiberglass, LOC, High Quality Kraft Paper **Fin Alternatives** (Material)- Aircraft Plywood (Birch), Fiberglass **Nose Cone Alternatives-** Ogive, Parabola, Cone	**Frame Alternatives:** **Fiberglass:** **Pros:** Just as strong as Blue Tube **Cons:** Heavier than BlueTube, changing the margin stability, and almost three times more expensive. **LOC:** **Pros:** Consists of spiraled Kraft Paper, easy to work with, can be fiberglassed as need be **Cons:** Not as durable and lightweight as BlueTube **High Quality Kraft Paper:** **Pros:** Can be fiberglassed to increase durability, inexpensive **Cons:** Weaker than BlueTube, not durable for high powered rockets, fiberglass adds weight **Fin Alternatives:** **Aircraft Plywood:** **Pros:** Easy to work with, allows us to fiberglass the fins to the rocket making a strong connection between the rocket and fins. **Cons:** Not strong enough for our rocket alone **Fiberglass:** **Pros:** Very strong material **Cons:** Heavy Material **NC Alternatives:** **Ogive:** **Pros:** Not much drag, this shape allows us the mobility to adjust our rocket to reach

		the desired altitude. **Cons:** More drag than a parabola. **Parabola:** **Pros:** Least drag **Cons:** This cone would do better with a heavier rocket as it is less drag,it brings us over the desired altitude. **Cone:** **Pros:** No pros specifically to our rocket design. **Cons:** This shape produces excessive drag and with other components of the rocket will not get us to the desired altitude.
Payload System- Since the goal of our payload is to collect pollution particles at a specific level, we will use a reefing ring (ram air canopy type reefing ring) in order to help close the parachute after 1000ft.	**Alternative Reefing Systems-** Giant Leap Rocketry Sliders: 3 & 4 Rings	**Slider 3:** **Pros:** Reduces strain **Cons:** Designed for parachutes with an odd number of shroud lines, meant to reduce strain on parachute rather than help close the parachute **Slider 4:** **Pros:** Offers more stability, designed for parachutes with an even number of shroud lines **Cons:** Meant to reduce strain on parachute rather than help close the parachute
Recovery System- Our rocket will use a dual deployment parachute system that will rely on the StratoLogger SL100 Altimeter	**Parachute Alternatives-** Iris Ultra 72" Compact Parachute, Estes 002261 - Pro Series II™ 24 inch, Apogee Angel parachute	**Parachutes:** **Pros:** this specific size allows for the decent ate to fall as desired and any larger size would increase the descent rate causing our rocket to drift above limit. **Cons:**

	Altimeter Alternatives- PerfectFlite Pnut Altimeter, Jolly Logic Altimeter Two, & Jolly Logic Altimeter Three	**Altimeters:** **Perfectflite:** **Pros:** Stores 31 flights, close in price to StratoLogger **Cons:** Not as accurate as the StratoLogger **Altimeter Two:** **Pros:** Simple to Use, Doesn't Require a Separate Payload Bay, Small and Lightweight **Cons:** More expensive, Not as precise as the Stratologger **Altimeter Three:** **Pros:** Simple to Use, Doesn't Require a Separate Payload Bay, Small and Lightweight, Can Connect to Smartphone **Cons:** More expensive, Not as precise as the Stratologger

Frame Alternatives	**Why the Alternative Should/Should Not be Chosen**
Fiberglass	Fiberglass is a composite material, meaning that it takes the advantage of the properties of all the constituents and therefore produces a material that is stronger than any of the components separately. While fiberglass is incredibly strong it is also heavier than materials such as Blue Tube, especially if fiberglassed manually. Working with fiberglass can provide health hazards when sanding due to the tiny particles of glass fibers and epoxy resin.
High Quality Kraft Paper	Strong material that consists of spiraled Kraft Paper, and can be fiberglassed if needed. Low in cost in comparison to both Fiberglass and LOC Body Tube. This material is also very easy to work with. High quality kraft paper is not strong enough by itself for high powered rockets. Fiberglassing the body tube manually can lead to a heavier than desired body tube and requires more time.

LOC Body Tube	Strong material that consists of spiraled White-Kraft Paper, and can be fiberglassed if needed. This material is easy to work with. LOC Body tube is stronger and beefier than High Quality Kraft Paper, but is still not up to par.

Nose Cone Length and Shape:

Alternative Designs	**Why the Alternative Should/Should Not be Chosen**
Ogive	Medium amount of drag,this amount of drag balances the weight of the rocket along with being able to reach the desired altitude.
Parabola	Producing the least amount of drag, this shape would do better with a rocket with more weight.
Cone	This shape produces most drag.This amount of drag is too excessive for the altitude we need to reach. Combined with other factors this alternative will not allow us to reach the desired altitude of 5,280.

Fin Number and Shape:

Alternatives	**# of fins**	**Why the Alternative Should/Should Not be Chosen**
¼" Aircraft Plywood (Birch)	3	This thickness is strong however generally too think and causes an excessive amount of drag.
⅛" Custom Fins Aircraft Plywood (Birch)	4	Thickness provides sufficient stability for rockets and specifically those with "c" or larger motors.
⅛" Fiberglass	4	Less liable to break having a high strength to weight ratio however for our needs the added weight is unnecessary as we plan to fiberglass the fins to the rocket.

Leading Alternatives:

Body Tube: A fiberglass tube has a smooth finish, increased durability compared to just the cardboard tubes, is perfect for heavy-duty flights, and is extremely strong.

Nose Cone: An Ogive shape only has a medium amount of drag.

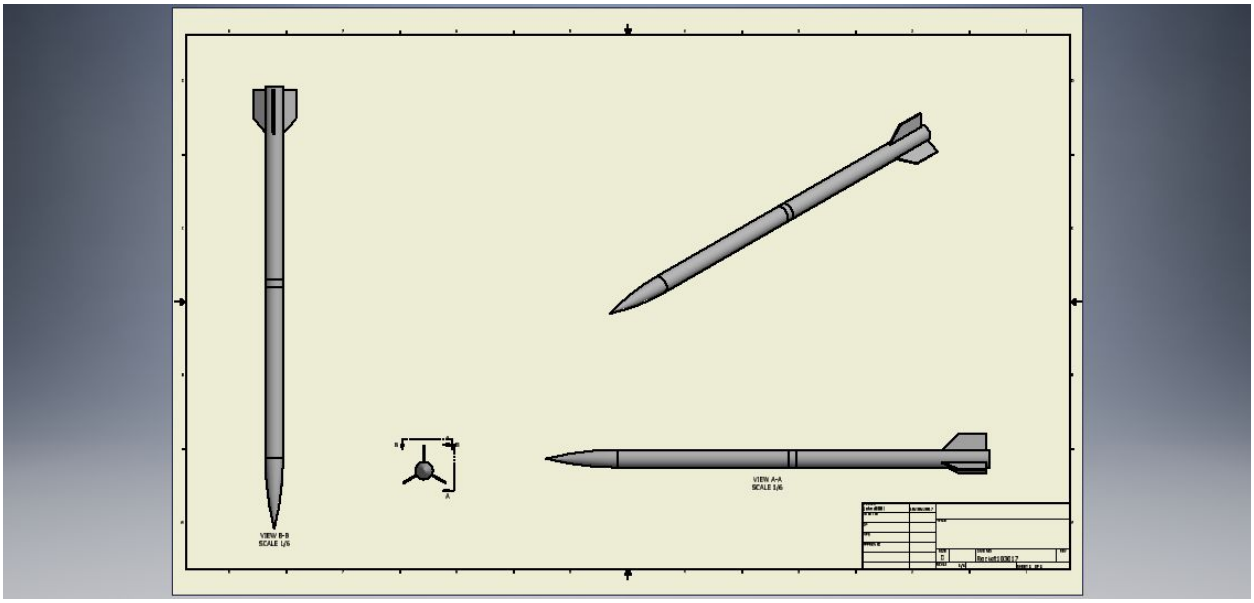
Fins: ⅛" Aircraft Plywood is sufficient for our mass and motor selection. ⅛" Aircraft Plywood is also the ideal size and material for fiberglassing.

Recovery System: The Iris Ultra 72" Compact Parachute is compact and lightweight.

Subsystems

Main Airframe Subsystem:

The main airframe system, Jacques Curie will be propelled by the K555SK motor and will contain our scientific experiment, to see if piezoelectricity can be produced on the ascent and descent of a rocket..



134.9763 Oz

Rocket Motor:

The rocket motor, K555SK, is what propels the main airframe system with our scientific experiment to accomplish our task of collecting piezoelectric energy harvested from the flights vibrations .

61.270872 Oz

Fin Section:

The fin section holds the motor tube as well as the drogue parachute,deployment charge, and the fins.

52.3374 Oz

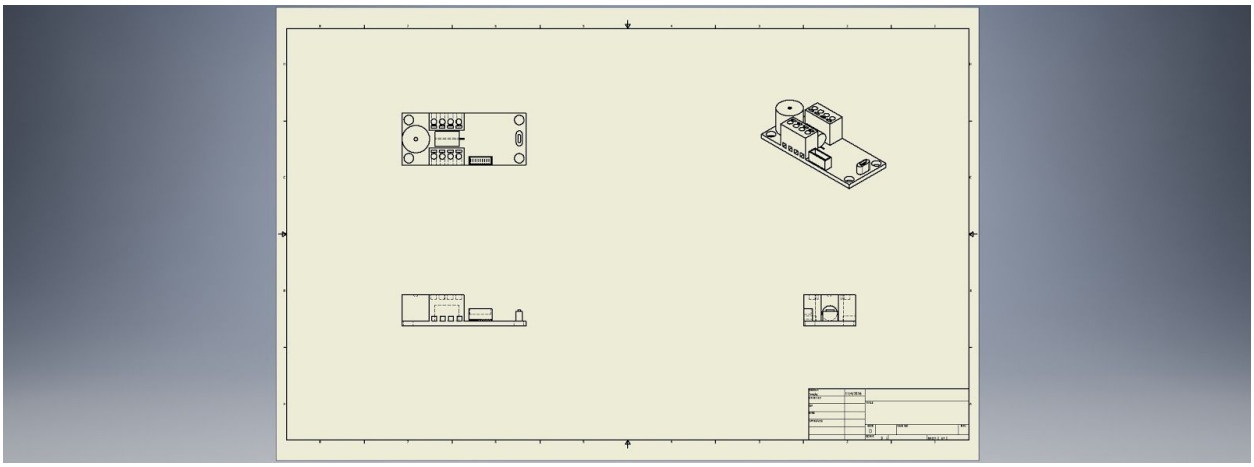
Top Section:

The top section attaches the nose cone and contains the main parachute, deployment charge,and teather and quicklinks.

35.2441 Oz

Payload Subsystem:

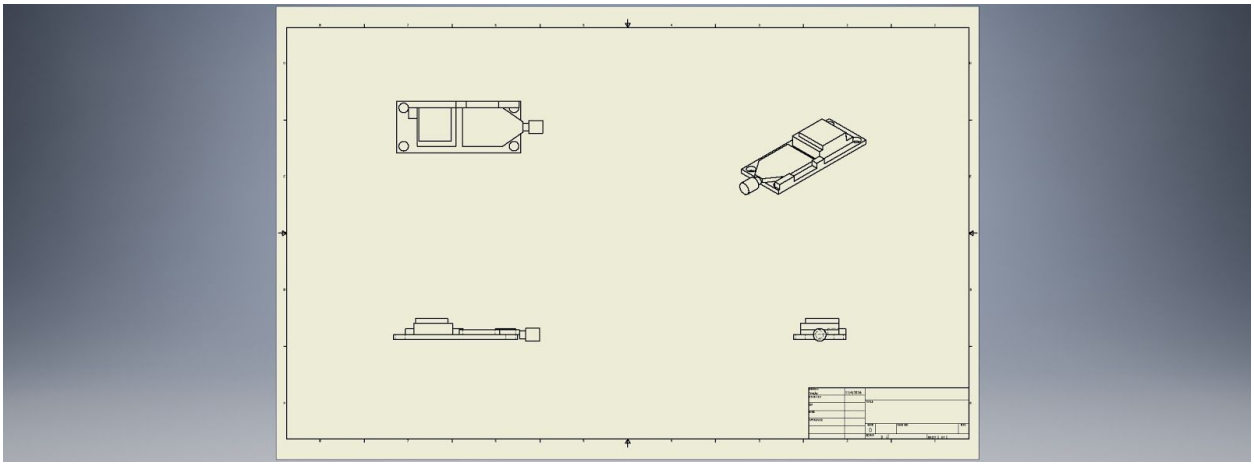
Our altimeter the, PerfectFlite StratoLogger, will sense altitude based on air pressure to deploy both the drogue, main and smog collection parachutes.



5.5 Oz

GPS: Big Red Bee 900 Transmitter

The Big Red Bee 900 transmitter consists of a GPS receiver and a 250mw 900 Mhz spread spectrum transmitter for the device being tracked.



2.5 Oz

Vibration Sensors

Piezo Product: PPA-1001

Piezo Energy harvester:Our piezo energy harvester will collect the energy generated during flight by the vibrations and will be places on the inner tube in a predetermined location.

TE Connectivity measurement Specialties 2-1002908-0

Recovery Subsystem

Dual Deployment charges - Deploys the parachute at apogee and 1000 feet

Drogue parachute - Deploys when the altimeter senses an increase in barometric pressure consistent with reaching apogee

Main parachute - Deploys at 1000 ft to slow the rocket for a safe recovery and landing

Motor Alternatives:

Motor	Altitude(Ft): Calm Wind	Altitude(Ft): Light Wind	Altitude(Ft): Slightly Breezy	Altitude(Ft):	Manufacturer
K695R	5751.51	6037.3	6012.80	6056.14	Aerotech
K555SK	5328.31	5319.42	5224.77	5331.27	AMW (Cesaroni)
J415W	5301.38	5266.57	5254.40	5319.06	Aerotech
J540R	5024.77	5018.70	4969.78	5059.78	Aerotech
K513FJ	6022.57	5994.36	5975.98	6035.60	Aerotech

Recovery System:

Recovery System Alternatives	**Why the Alternative Should/Should Not be Chosen**
Iris Ultra 72" Compact Parachute	Compact and lightweight/Not ideal material
Estes 002261 - Pro Series II™ 24 inch	Good For visibility/ Does not come in correct size
Apogee Angel parachute	Creates more drag/More expensive and not correct shape

- For a safe descent the best size for the parachute would be 72”

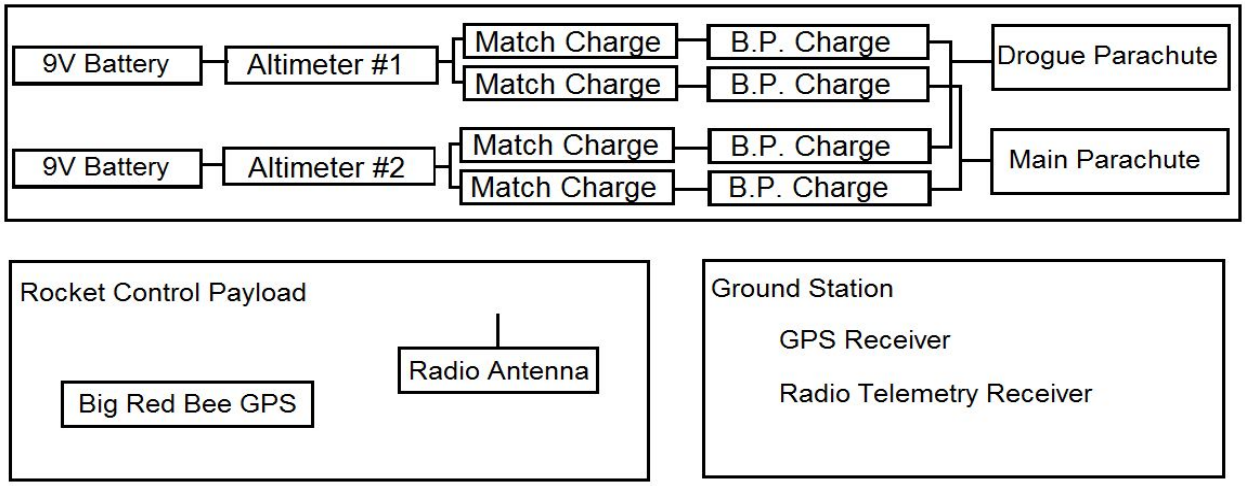
Leading Components

Body Tube: Blue tube is the leading material because it is as durable as fiberglass but significantly lighter and cost effective.

Fins: ¼ inch aircraft plywood was selected because it is both light and durable. This material also allows for controlled cutting as birch aircraft plywood does not splinter as well as plywood with multiple woods.

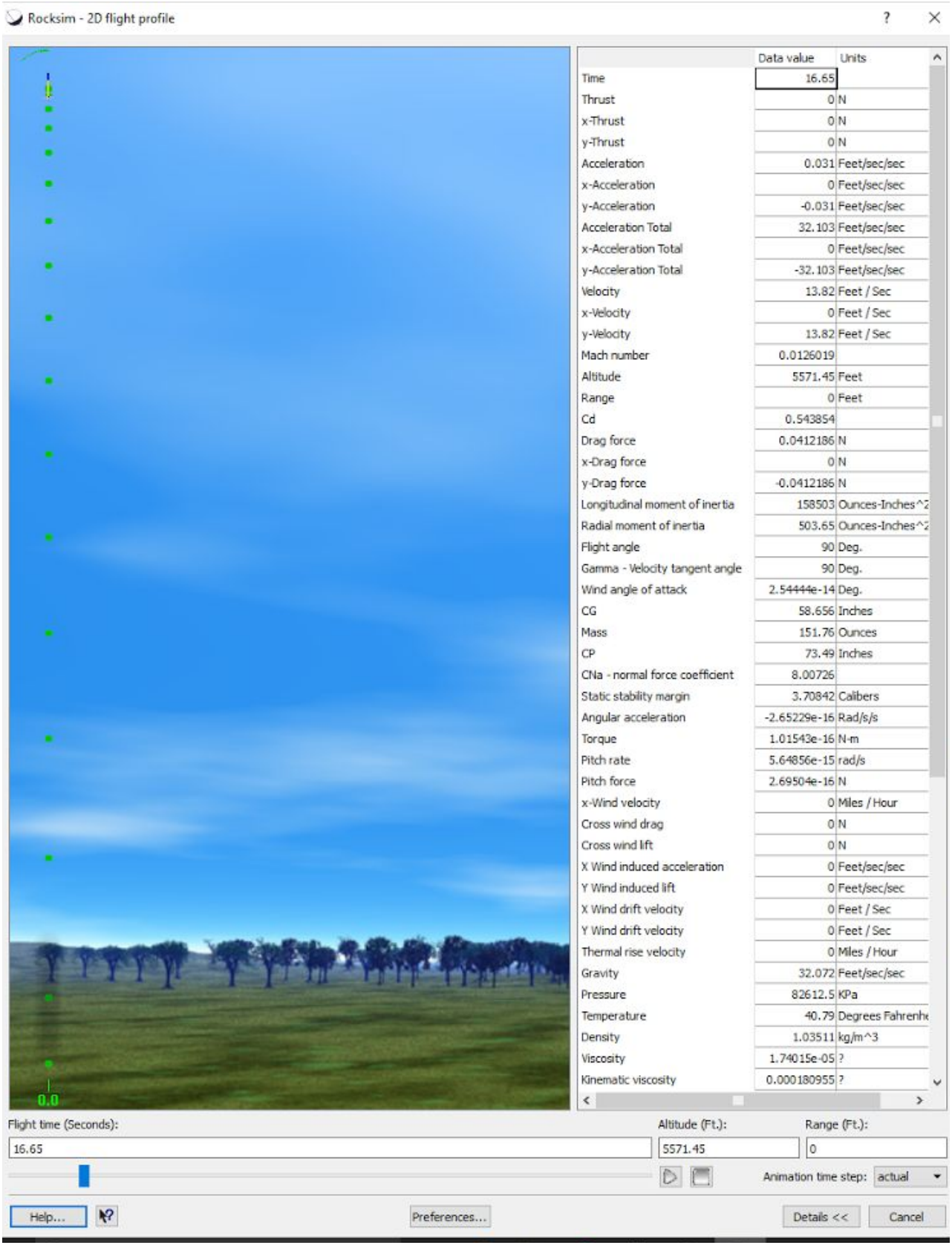
Recovery System

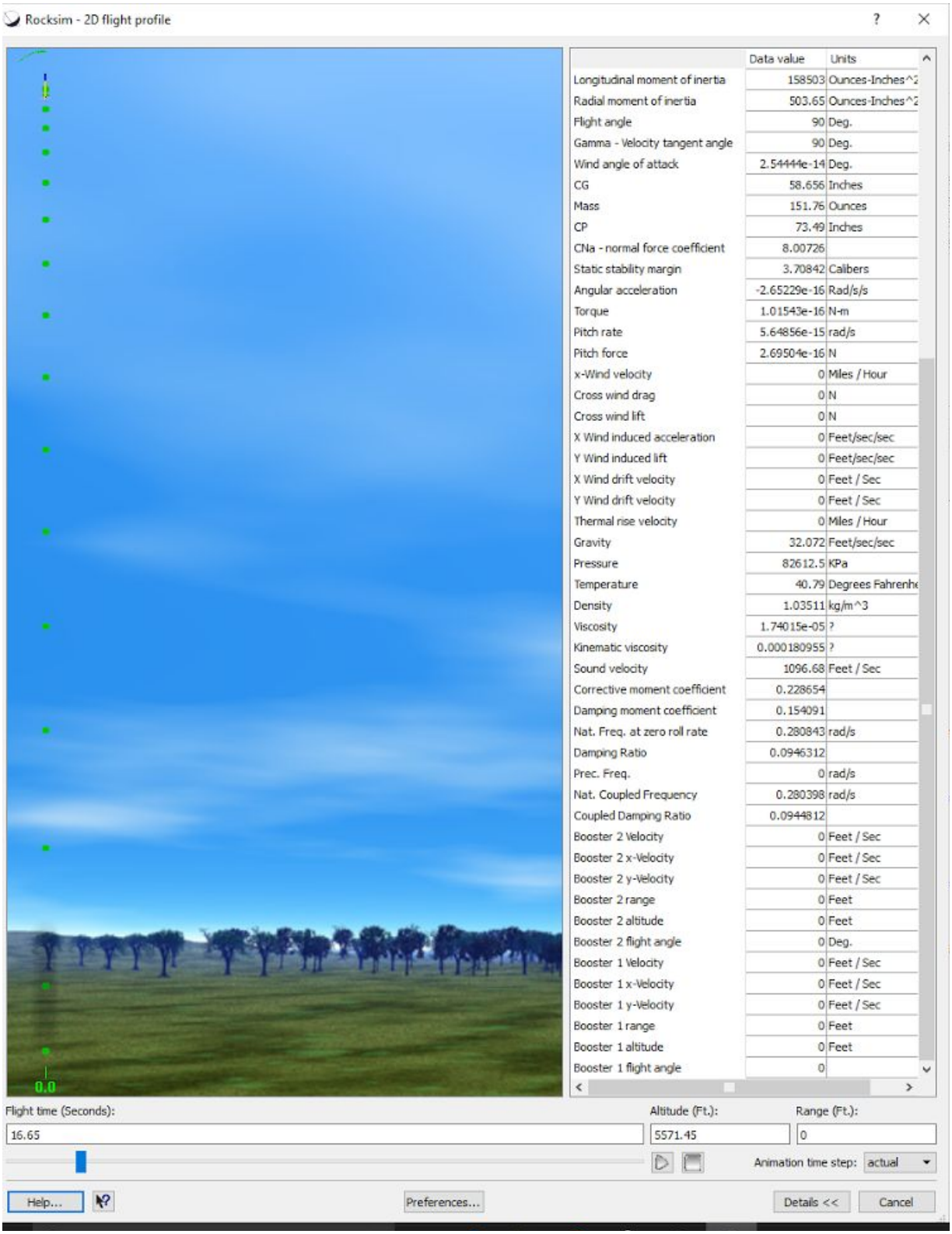
Our recovery system uses two, completely independent,redundantly wired, dual-deployment systems, each with their own power sources, altimeters and charges. If one altimeter should fail, the other will ensure a safe and successful parachute deployment.



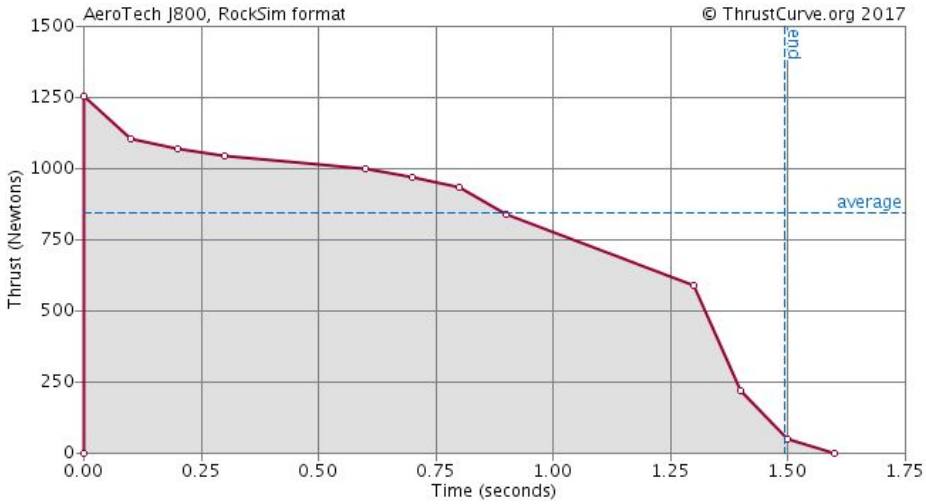
Mission Performance Prediction

	Simulation	Results	Engines loaded	Max. altitude Feet	Max. velocity Feet / Sec	Max. acceleration Feet/sec/sec	Time to apogee	Velocity at deploym Feet / Sec	Altitude at deploym Feet
1	0		[J415W-None]	5163.45	657.38	1607.95	17.45	0.01	5163.45
2	1		[J800T-None]	5580.61	795.08	1607.55	17.11	0.01	5580.61
3	2		[J800T-None]	5574.44	796.71	1478.99	17.08	0.01	5574.44
4	3		[J800T-None]	5574.41	796.71	1479.21	17.08	0.02	5574.42


Rocksim - 2D flight profile
Data value
Units
Time 16.65
Thrust 0 N
x-Thrust 0 N
y-Thrust 0 N
Acceleration 0.031 Feet/sec/sec
x-Acceleration 0 Feet/sec/sec
y-Acceleration -0.031 Feet/sec/sec
Acceleration Total 32.103 Feet/sec/sec
x-Acceleration Total 0 Feet/sec/sec
y-Acceleration Total -32.103 Feet/sec/sec
Velocity 13.82 Feet / Sec
x-Velocity 0 Feet / Sec
y-Velocity 13.82 Feet / Sec
Mach number 0.0126019
Altitude 5571.45 Feet
Range 0 Feet
Cd 0.543854
Drag force 0.0412186 N
x-Drag force 0 N
y-Drag force -0.0412186 N
Longitudinal moment of inertia 158503 Ounces-Inches^2
Radial moment of inertia 503.65 Ounces-Inches^2
Flight angle 90 Deg.
Gamma - Velocity tangent angle 90 Deg.
Wind angle of attack 2.54444e-14 Deg.
CG 58.656 Inches
Mass 151.76 Ounces
CP 73.49 Inches
CNa - normal force coefficient 8.00726
Static stability margin 3.70842 Calibers
Angular acceleration -2.65229e-16 Rad/s/s
Torque 1.01543e-16 N-m
Pitch rate 5.64856e-15 rad/s
Pitch force 2.69504e-16 N
x-Wind velocity 0 Miles / Hour
Cross wind drag 0 N
Cross wind lift 0 N
X Wind induced acceleration 0 Feet/sec/sec
Y Wind induced lift 0 Feet/sec/sec
X Wind drift velocity 0 Feet / Sec
Y Wind drift velocity 0 Feet / Sec
Thermal rise velocity 0 Miles / Hour
Gravity 32.072 Feet/sec/sec
Pressure 82612.5 KPa
Temperature 40.79 Degrees Fahrenh
Density 1.03511 kg/m^3
Viscosity 1.74015e-05 ?
Kinematic viscosity 0.000180955 ?
0.0
Flight time (Seconds):
16.65
Altitude (Ft.):
5571.45
Range (Ft.):
0
Animation time step:
actual
Help...
Preferences...
Details <<
Cancel


Rocksim - 2D flight profile
Data value
Units
Longitudinal moment of inertia 158503 Ounces-Inches^2
Radial moment of inertia 503.65 Ounces-Inches^2
Flight angle 90 Deg.
Gamma - Velocity tangent angle 90 Deg.
Wind angle of attack 2.54444e-14 Deg.
CG 58.656 Inches
Mass 151.76 Ounces
CP 73.49 Inches
CNa - normal force coefficient 8.00726
Static stability margin 3.70842 Calibers
Angular acceleration -2.65229e-16 Rad/s/s
Torque 1.01543e-16 N-m
Pitch rate 5.64856e-15 rad/s
Pitch force 2.69504e-16 N
x-Wind velocity 0 Miles / Hour
Cross wind drag 0 N
Cross wind lift 0 N
X Wind induced acceleration 0 Feet/sec/sec
Y Wind induced lift 0 Feet/sec/sec
X Wind drift velocity 0 Feet / Sec
Y Wind drift velocity 0 Feet / Sec
Thermal rise velocity 0 Miles / Hour
Gravity 32.072 Feet/sec/sec
Pressure 82612.5 KPa
Temperature 40.79 Degrees Fahrenhe
Density 1.03511 kg/m^3
Viscosity 1.74015e-05 ?
Kinematic viscosity 0.000180955 ?
Sound velocity 1096.68 Feet / Sec
Corrective moment coefficient 0.228654
Damping moment coefficient 0.154091
Nat. Freq. at zero roll rate 0.280843 rad/s
Damping Ratio 0.0946312
Prec. Freq. 0 rad/s
Nat. Coupled Frequency 0.280398 rad/s
Coupled Damping Ratio 0.0944812
Booster 2 Velocity 0 Feet / Sec
Booster 2 x-Velocity 0 Feet / Sec
Booster 2 y-Velocity 0 Feet / Sec
Booster 2 range 0 Feet
Booster 2 altitude 0 Feet
Booster 2 flight angle 0 Deg.
Booster 1 Velocity 0 Feet / Sec
Booster 1 x-Velocity 0 Feet / Sec
Booster 1 y-Velocity 0 Feet / Sec
Booster 1 range 0 Feet
Booster 1 altitude 0 Feet
Booster 1 flight angle 0
0.0
Flight time (Seconds):
16.65
Altitude (Ft.):
5571.45
Range (Ft.):
0
Animation time step:
actual
Help...
Preferences...
Details <<
Cancel

Motor Thrust Curve



Without the Motor

CG: 53.04 in.

CP: 73.49 in.

Static Stability Margin: 5.11 overstable

With the Motor

CG: 63.42 in.

CP: 73.49 in.

Static Stability Margin: 2.52 overstable

V) Payload Criteria

Payload Objective

ETA SL's objective is to design and build a rocket that will reach 5,280ft in altitude, while holding a payload of piezoelectric generators in the nose and fincan of the rocket. Our goal is to collect electricity and data to where we can see which portion of the rocket creates the most energy from vibration, how much energy in total the rocket can collect, and retrieve this data unharmed with a successful landing. We can consider our experiment a success if we are able to collect a measurable amount of energy and can conclude which parts of our rocket experience the most vibrations at different durations of the flight.

Budgeting

Full Scale Rocket Parts and Supplies

	= parts we have		
Part Name	**Unit Price ($)**	**Quantity**	**Total Price ($)**
Body Tube (BT-98) 48” long	38.95	4	155.80
Coupler (for BT-98) 8” long	10.95	3	32.85
Nose Cone (4” Fiberglass) Ogive	37.95	2	75.90
72” Parachute	224.70	1	224.70
1/2” Tubular Kevlar	4.34	9	39.06
Standard Rail Buttons	3.22	2	6.44
54mm LOC Motor Tube	8.09	2	16.18
Centering Rings 54mm to 98mm	8.51	2	17.02
Coupler Bulkhead Disk 98mm	4.25	4	17.00
Tube Bulkhead 98mm	4.25	4	17.00
¼” Custom Fins Aircraft Plywood (Birch)	56.83	1	56.83
Chute Protector	11.01	2	22.02
18” Parachute (Nylon)	9.01	1	9.01
¼” x 3” Eye Bolt	.50	10	5.00
Black Powder Charge Canisters	10.00	5 pck.	10.00
5 Min. Epoxy	7.95	6	47.70
West System Epoxy and Hardener	309.99	1	309.99
Fiberglass Cloth	7.5/sq.m.	3	22.50

3/16”x2” Quick Links	29.99	1pk.(20 each)	29.99
Aerotech J800T	85.49	1	85.49
54/1280 Casing	171.00	1	171.00
		Total:	**$1,371.48**

Full Scale Payload Parts and Supplies

Piezoelectricity Experiment Components	8.06	10	80.64
PerfectFlite Stratologger	58.80	3	176.40
Big Red Bee GPS System	298.00	1	298.00
Through Mount Slotted Switch	5.00	2	10.00
9V batteries	7.98	2 pck.	7.98
		Total:	**$573.02**

Scale Model Rocket Parts

Part Name	Unit Price	Quantity	Total Price
Body Tube (BT-75) 48” long	29.95	3	89.85
Coupler (for BT-) 48” long	31.95	1	31.95
Nose Cone 12.5” Plastic Ogive	17.95	1	17.95
½” Tubular Kevlar	.97	20	19.40

12” Drogue Parachute	7.48	1	7.48
58” Main Parachute	35.60	1	35.60
¼” Custom Fins Aircraft Plywood (Birch)	112.75	1	112.75
38mm Motor Tube	13.56	2	13.56
H148 Motor	25.19	1	25.19
38/240 Motor Casing	90.00	1	90.00
38mm-75mm Centering Rings	7.30	2	14.60
		Total:	**$458.33**

Travel To Huntsville Alabama:

Air Travel for 13 team members + 3 mentors	**$500 per person**	**$8,000**
5 Hotel Rooms @ Embassy Suites	**$150 per room, per night**	**$3,750**
	Total:	**$11,750**

Grand Total: $14,152.83

Funding:

We have received a $14,000 grant from Rackspace. We will also collect donations from various sponsors, one being Mide Technology who have graciously donated the energy harvesting piezo sensors. Furthermore, we are planning fundraisers throughout the year, the first of which has been completed. We sold buckets of candy with messages called “Spookygrams.” We made over $350.00, and look for this total to grow as we do it in the future. We also are planning to do a similar fundraiser in February, but with flowers for Valentine's Day. Our upcoming fundraiser includes selling hot beverages during November and December.

Outreach

The ETA students will be involved in the instruction of elementary, middle school, and high school students within the community, as well as the request of monetary/material support from targeted companies in the San Antonio area. The students will follow-up with calls to the targeted businesses and universities asking for their support.

For our outreach activity, we will be going to numerous schools within our district. We also plan to have interactive lessons for the science day/night and summer camps at different locations. In our district there are almost fifty elementary schools to contact for outreach opportunities. Students will email schools inquiring about traditional science days. An activity will be planned depending on the grade level. We will choose an appropriate lesson for the age group we are teaching. The student will be accompanied by mentor teachers for these events. They will give a short lesson on the different components of a rocket and model a hands-on activity. This activity will be a “make and take” activity, where the students will alter their designs based of of their results. These sessions will last approximately 45 minutes.

We have recently gotten involved in the San Antonio Botanical Gardens 2017 Scarecrow Competition, where various groups develop a reusable scarecrow based on their particular interests. We will be constructing a scarecrow out of old rocket materials, and materials that can be made to highlight aerospace. We also plan to attend National Night Out at Roosevelt High School as well, where we will set up a booth introducing basic rocketry to a varied audience. We will be participating in the Girls Inc science fair, and the Barnes and Noble Mini Maker Fair. At these events we will set up an experiment in which participants will create and test paper rockets. We will continue to seek similar opportunities.

Once the team finishes each outreach activity, they will reflect on the day's learning event and determine how the student audience perceived the information (through an informal survey), how the lesson affected student understanding and interest, and how to improve the lesson for the next time.

Outreach Letter

To Prospective Supporter,

The Engineering and Technologies Academy (ETA) is a merit based high school magnet program that is centered around providing students education and opportunities that will make them successful in any engineering field of their choice.

A few years ago, we opened up a rocketry club inspired by the significant amount of interest our students' have shown for the field of Aerospace. The students that are part of the club dedicate significant amounts of time to the club and to designing and constructing rockets for the annual Team America Rocketry Challenge.

Over the last four years of competing at the national level, we have placed in the top 100 two times. As a result of these great accomplishments, we were offered an opportunity to participate in the NASA Marshal Space Flight Center Student Launch Initiative Program. The students are asked to design and build a retrievable rocket that will carry a science payload one mile high.

This year, by testing the electricity produced by the vibrations of a rocket throughout flight, we hope to record the amount of electricity produced, and determine if it is a viable alternative energy source for powering internal components of a vehicle, or spacecraft. The students are very enthusiastic about the competition. The ETA SL project will need your help in getting them to the finals. We would be grateful for any donations that would help us send our ETA Rocketry team to Huntsville, Alabama in April and to Washington DC. in May if we qualify. If you are interested in our students cause please send us a letter of intent with the amount of your sponsorship. In return, your company's logo will be represented on our rocket.

Thank you in advance for supporting our future engineers and scientists in this great challenge. Should you have any questions please contact me directly at cmoren1@neisd.net.

Robert Lozano
Director, Engineering and Technology Academy

Christina Moreno
Aerospace Instructor
Lead Sponsor

Project Plan/Calendar

TASK	September	October	November	December	January	February	March	April
Proposal- due September 20								
SL Daily Meetings (3:25pm-4:15pm)								
Rocket Design and Engine Selection								
Awarded Proposals announced - October 6th								
Ordering Parts for both Rockets - September and Early October								
Develop Website - due October 31								
Build Rocket - October through Early December								
Design Recovery System - October through Early December								
Design Payload System - October through Early December								
PDR- due November 3rd								

PDR Video Teleconferences November 6th to 29th								
CDR- due January 12th								
Build and Fly Scale Model Rocket - October through Early December								
CDR reports, presentation slides and flysheet - January 12th								
CDR Video Teleconferences - January 16th to 31st								
FRR - due March 5th								
FRR Video Teleconferences - March 6th to 22nd								
Teams go to Alabama to Compete - April 4th to 8th								
PLAR due April 27th								

MSDS Sheets

Table of Contents

MATERIAL SAFETY DATA SHEET
West System Inc.

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: WEST SYSTEM® 105 Epoxy Resin
PRODUCT CODE: 105
CHEMICAL FAMILY: Epoxy Resin.
CHEMICAL NAME: Bisphenol A based epoxy resin.
FORMULA: Not applicable.

MANUFACTURER:
West System Inc.
102 Patterson Ave.
Bay City, MI 48706, U.S.A.
Phone: 866-937-8797 or 989-684-7286
www.westsystem.com

EMERGENCY TELEPHONE NUMBERS:
Transportation
CHEMTREC: 800-424-9300 (U.S.)
703-527-3887 (International)
Non-transportation
Poison Hotline: 800-222-1222

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

WARNING May cause skin irritation. May cause eye irritation. May cause allergic reaction. Clear, viscous liquid with mild odor.

PRIMARY ROUTE(S) OF ENTRY: Skin contact.

POTENTIAL HEALTH EFFECTS:

ACUTE INHALATION: If product is heated, vapors generated can cause headache, nausea, dizziness and possible respiratory irritation if inhaled in high concentrations.

CHRONIC INHALATION: Repeated exposure to high vapor concentrations may cause irritation of pre-existing lung allergies and increase the chance of developing allergy symptoms to this product.

ACUTE SKIN CONTACT: May cause allergic skin response in certain individuals. May cause moderate irritation to the skin such as redness and itching.

CHRONIC SKIN CONTACT: May cause sensitization in susceptible individuals. May cause moderate irritation to the skin.

EYE CONTACT: May cause irritation.

INGESTION: Low acute oral toxicity.

SYMPTOMS OF OVEREXPOSURE: Possible sensitization and subsequent allergic reactions usually seen as redness and rashes.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing skin and respiratory disorders may be aggravated by exposure to this product. Pre-existing lung and skin allergies may increase the chance of developing allergic symptoms to this product.

3. COMPOSITION/INFORMATION ON HAZARDOUS INGREDIENTS

INGREDIENT NAME	CAS #	CONCENTRATION (%)
Propane, 2,2-bis[p-(2,3-epoxypropoxy)phenyl]-, polymers	25085-99-8	60-100
Benzyl alcohol	100-51-6	10-30
Phenol-formaldehyde polymer glycidyl ether	28064-14-4	1-10

4. FIRST AID MEASURES

FIRST AID FOR EYES Flush immediately with water for at least 15 minutes. Consult a physician.

FIRST AID FOR SKIN Remove contaminated clothing. Wipe excess from skin. Apply waterless skin cleaner and then wash with soap and water. Consult a physician if effects occur.

FIRST AID FOR INHALATION Remove to fresh air if effects occur.

FIRST AID FOR INGESTION No acute adverse health effects expected from amounts ingested under normal conditions of use. Seek medical attention if a significant amount is ingested.

5. FIRE FIGHTING MEASURES

FLASH POINT: ..... >200°F (Tag Closed Cup)

EXTINGUISHING MEDIA: ..... Foam, carbon dioxide (CO_2), dry chemical.

SPECIAL FIRE FIGHTING PROCEDURES: ..... Wear a self-contained breathing apparatus and complete full-body personal protective equipment. Closed containers may rupture (due to buildup of pressure) when exposed to extreme heat.

FIRE AND EXPLOSION HAZARDS: ..... During a fire, smoke may contain the original materials in addition to combustion products of varying composition which may be toxic and/or irritating. Combustion products may include, but are not limited to: phenolics, carbon monoxide, carbon dioxide.

6. ACCIDENTAL RELEASE MEASURES

SPILL OR LEAK PROCEDURES: ..... Stop leak without additional risk. Dike and absorb with inert material (*e.g.*, sand) and collect in a suitable, closed container. Warm, soapy water or non-flammable, safe solvent may be used to clean residual.

7. HANDLING AND STORAGE

STORAGE TEMPERATURE (min./max.): ..... 40°F (4°C) / 120°F (49°C)

STORAGE: ..... Store in cool, dry place. Store in tightly sealed containers to prevent moisture absorption and loss of volatiles. Excessive heat over long periods of time will degrade the resin.

HANDLING PRECAUTIONS: ..... Avoid prolonged or repeated skin contact. Wash thoroughly after handling. Launder contaminated clothing before reuse. Avoid inhalation of vapors from heated product. Precautionary steps should be taken when curing product in large quantities. When mixed with epoxy curing agents this product causes an exothermic, which in large masses, can produce enough heat to damage or ignite surrounding materials and emit fumes and vapors that vary widely in composition and toxicity.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EYE PROTECTION GUIDELINES: ..... Safety glasses with side shields or chemical splash goggles.

SKIN PROTECTION GUIDELINES: ..... Wear liquid-proof, chemical resistant gloves (nitrile-butyl rubber, neoprene, butyl rubber or natural rubber) and full body-covering clothing.

RESPIRATORY/VENTILATION GUIDELINES: ..... Good room ventilation is usually adequate for most operations. Wear a NIOSH/MSHA approved respirator with an organic vapor cartridge whenever exposure to vapor in concentrations above applicable limits is likely.

Note: West System, Inc. has conducted an air sampling study using this product or similarly formulated products. The results indicate that the components sampled for (epichlorohydrin, benzyl alcohol) were either so low that they were not detected at all or they were significantly below OSHA's permissible exposure levels.

ADDITIONAL PROTECTIVE MEASURES: ..... Practice good caution and personal cleanliness to avoid skin and eye contact. Avoid skin contact when removing gloves and other protective equipment. Wash thoroughly after handling. Generally speaking, working cleanly and following basic precautionary measures will greatly minimize the potential for harmful exposure to this product under normal use conditions.

OCCUPATIONAL EXPOSURE LIMITS: ..... Not established for product as whole. Refer to OSHA's Permissible Exposure Level (PEL) or the ACGIH Guidelines for information on specific ingredients.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL FORM: ..... Liquid.
COLOR: ..... Clear.
ODOR: ..... Mild.
BOILING POINT: ..... > 400°F
MELTING POINT/FREEZE POINT: ..... No data.
VISCOSITY: ..... 1000 (cP)
pH: ..... No data.
SOLUBILITY IN WATER: ..... Slight.
SPECIFIC GRAVITY: 1.15
BULK DENSITY: ..... 9.6 (pounds/gallon)
VAPOR PRESSURE: ..... < 1 mmHg @ 20°C.
VAPOR DENSITY: ..... Heavier than air.
% VOLATILE BY WEIGHT: ..... ASTM D 2369-07 was used to determine the Volatile Content of mixed epoxy resin and hardener. Refer to the hardener's MSDS for information about the total volatile content of the resin/hardener system.

10. STABILITY AND REACTIVITY

STABILITY: ..... Stable.

HAZARDOUS POLYMERIZATION: ..... Will not occur by itself, but a mass of more than one pound of product plus an aliphatic amine will cause irreversible polymerization with significant heat buildup.

INCOMPATIBILITIES: ..... Strong acids, bases, amines and mercaptans can cause polymerization.

DECOMPOSITION PRODUCTS: ..... Carbon monoxide, carbon dioxide and phenolics may be produced during uncontrolled exothermic reactions or when otherwise heated to decomposition.

11. TOXICOLOGICAL INFORMATION

No specific oral, inhalation or dermal toxicology data is known for this product. Specific toxicology information for a bisphenol-A based epoxy resin present in this product is indicated below:

Oral: ..... LD_{50} >5000 mg/kg (rats)
Inhalation: ..... No Data.
Dermal: ..... LD_{50} = 20,000 mg/kg (skin absorption in rabbits)

TERATOLOGY: ..... Diglycidyl ether bisphenol-A (DGEBPA) did not cause birth defects or other adverse effects on the fetus when pregnant rabbits were exposed by skin contact, the most likely route of exposure, or when pregnant rats or rabbits were exposed orally.

REPRODUCTIVE EFFECTS: ..... DGEBPA, in animal studies, has been shown not to interfere with reproduction.

MUTAGENICITY: ..... DGEBPA in animal mutagenicity studies were negative. In vitro mutagenicity tests were negative in some cases and positive in others.

CARCINOGENICITY:

NTP ..... Product not listed.
IARC ..... Product not listed.
OSHA ..... Product not listed.

No ingredient of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA, NTP or IARC.

Many studies have been conducted to assess the potential carcinogenicity of diglycidyl ether of bisphenol-A. Although some weak evidence of carcinogenicity has been reported in animals, when all of the data are considered, the weight of evidence does not show that DGEBPA is carcinogenic. Indeed, the most recent review of the available data by the International Agency for Research on Cancer (IARC) has concluded that DGEBPA is not classified as a carcinogen.

Epichlorohydrin, an impurity in this product (<5 ppm) has been reported to produce cancer in laboratory animals and to produce mutagenic changes in bacteria and cultured human cells. It has been established by the International Agency for Research on Cancer (IARC) as a probable human carcinogen (Group 2A) based on the following conclusions: human evidence – inadequate; animal evidence – sufficient. It has been classified as an anticipated human carcinogen by the National Toxicology Program (NTP). Note: It is unlikely that normal use of this product would result in measurable exposure concentrations to this substance.

12. ECOLOGICAL INFORMATION

In the non-cured liquid form this product may cause long-term harm if released to the environment. Prevent entry into sewers and natural waters.

Movement and Partitioning:
Bioconcentration potential is moderate (BCF between 100 and 3000 or Log Kow between 3 and 5).

Degradation and Transformation:
Theoretical oxygen demand is calculated to be 2.35 p/p. 20-day biochemical oxygen demand is <2.5%.

Ecotoxicology:
Material is moderately toxic to aquatic organisms on an acute basis. LC50/EC50 between 1 and 10 mg/L in most sensitive species.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: ..... Evaluation of this product using RCRA criteria shows that it is not a hazardous waste, either by listing or characteristics, in its purchased form. It is the responsibility of the user to determine proper disposal methods.

Incinerate, recycle (fuel blending) or reclaim may be preferred methods when conducted in accordance with federal, state and local regulations.

14. TRANSPORTATION INFORMATION

DOT Non-Bulk
SHIPPING NAME: ..... Not regulated.
TECHNICAL SHIPPING NAME: ..... Not applicable.

HAZARD CLASS: ..... Not applicable.
U.N./N.A. NUMBER: ..... Not applicable.
PACKING GROUP: ..... Not applicable.

IMDG
SHIPPING NAME: ..... Environmentally hazardous substance, liquid, n.o.s.
TECHNICAL SHIPPING NAME: ..... Epoxy Resin.
HAZARD CLASS: ..... Class 9.
U.N. NUMBER: ..... UN3082.
PACKING GROUP: ..... PG III.
EmS Number: ..... F-A, S-F
MARINE POLLUTANT ..... Yes

ICAO/IATA
SHIPPING NAME: ..... Environmentally hazardous substance, liquid, n.o.s.
TECHNICAL SHIPPING NAME: ..... Epoxy Resin.
HAZARD CLASS: ..... Class 9.
U.N. NUMBER: ..... UN3082.
PACKING GROUP: ..... PG III.
MARINE POLLUTANT: ..... Yes

15. REGULATORY INFORMATION

OSHA STATUS: ..... Irritant.
TSCA STATUS: ..... All components are listed on TSCA inventory or otherwise comply with TSCA requirements.

Canada WHMIS Classification: ..... D2B - Toxic material causing other toxic effects.
CEPA Chemical Inventory Status: ..... All components are listed or are otherwise compliant with CEPA requirements.

SARA TITLE III:
SECTION 313 TOXIC CHEMICALS ..... None (deminimus).

STATE REGULATORY INFORMATION:
The following chemicals are specifically listed or otherwise regulated by individual states. For details on your regulatory requirements you should contact the appropriate agency in your state.

COMPONENT NAME /CAS NUMBER	CONCENTRATION	STATE CODE
Epichlorohydrin 106-89-8	< 5ppm	[1]CA
Benzyl alcohol 100-51-6		MA, PA, NJ

[1] These substances are known to the state of California to cause cancer or reproductive harm, or both.

16. OTHER INFORMATION

REASON FOR ISSUE: ..... Changes made in Section 14 and 15.
PREPARED BY: ..... G. M. House
APPROVED BY: ..... G. M. House
TITLE: ..... Health, Safety & Environmental Manager
APPROVAL DATE: ..... April 26, 2013
SUPERSEDES DATE: ..... March 9, 2012
MSDS NUMBER: 105-13a

This information is furnished without warranty, expressed or implied, except that it is accurate to the best knowledge of West System Inc. The data on this sheet is related only to the specific material designated herein. West System Inc. assumes no legal responsibility for use or reliance upon these data.

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.

HAZARDOUS COMPONENTS				
Material or Component	**%**	**CAS No.**	**TLV**	**PEL**
Potassium nitrate[1]	70-76	007757-79-1	NE	NE
Sodium nitrate[1]	70-74	007631-99-4	NE	NE
Charcoal	8-18	N/A	NE	NE
Sulfur	9-20	007704-34-9	NE	NE
Graphite[2]	Trace	007782-42-5	15 mppct (TWA)	2.5 mg/m^3
N/A = Not assigned NE = Not established				

[1] Black Powder contains either potassium nitrate ***or*** sodium nitrate in the percentages indicated. Black powder ***does not contain both***.

[2] Not contained in all grades of black powder.

PHYSICAL DATA	
Boiling Point	N/A
Vapor Pressure	N/A
Vapor Density	N/A
Solubility in Water	Good
Specific Gravity	1.70 - 1.82 (mercury method) • 1.92 - 2.08 (pycnometer)
PH	6.0 - 8.0
Evaporation Rate	N/A
Appearance and Odor	Black granular powder. No odor detectable.

HAZARDOUS REACTIVITY	
Instability	Keep away from heat, sparks, and open flame. Avoid impact, friction, and static electricity.
Incompatibility	When dry, black powder is compatible with most metals; however, it is hygroscopic, and when wet, attracts all common metals except stainless steel. Black powder must be tested for compatibility with any material not specified in the production/procurement package with which they may come in contact. Materials include other explosives, solvents, adhesives, metals, plastics, paints, cleaning compounds, floor and table coverings, packing materials, and other similar materials, situations, and equipment.
Hazardous decomposition	Detonation produces hazardous overpressures and fragments (if confined). Gases produced may be toxic if exposed in areas with inadequate ventilation.
Polymerization	Polymerization will not occur.

FIRE AND EXPLOSION DATA	
Flashpoint	Not applicable
Auto ignition temperature	Approx. 464°C (867°F)
Explosive temperature (5 sec)	Ignites @ approx. 427°C (801°F)
Extinguishing media	Water
Special fire fighting procedures	**ALL EXPLOSIVES: DO NOT FIGHT EXPLOSIVES FIRES.** Try to keep fire from reaching explosives. Isolate area. Guard against intruders. Division 1.1 Explosives (heavily encased): Evacuate the area for 5000 feet (1 mile) if explosives are heavily encased. Division 1.1 Explosives (not heavily encased): Evacuate the area for 2500 feet (½ mile) if explosives are not heavily encased. Division 1.1 Explosives (all): Consult the *2000 Emergency Response Guidebook, Guide 112* for further details.
Unusual fire and explosion hazards	Black powder is a deflagrating explosive. It is very sensitive to flame and spark and can also be ignited by friction and impact. When ignited unconfined, it burns with explosive violence and will explode if ignited under even slight confinement.

HEALTH HAZARDS	
General	Black powder is a Division 1.1 Explosive, and detonation may cause severe physical injury, including death. All explosives are dangerous and must be handled carefully and used following approved safety procedures under the direction of competent, experienced persons in accordance with all applicable federal, state, and local laws, regulations, and ordinances.
Carcinogenicity	None of the components of Black powder are listed as a carcinogen by NTP, IARC, or OSHA.

FIRST AID	
Inhalation	*Not a likely route of exposure.* If inhaled, remove to fresh air. If not breathing, give artificial respiration, preferably by mouth-to-mouth. If breathing is difficult, give oxygen. Seek prompt medical attention.
Eye and skin contact	*Not a likely route of exposure.* Flush eyes with water. Wash skin with soap and water.
Ingestion	*Not a likely route of exposure..* If ingested, induce vomiting immediately by giving two glasses of water and sticking finger down throat.
Injury from detonation	Seek prompt medical attention.

SPILL OR LEAK PROCEDURES	
Spill/leak response	Use appropriate personal protective equipment. Isolate area and remove sources of friction, impact, heat, low level electrical current, electrostatic or RF energy. Only competent, experienced persons should be involved in cleanup procedures. Carefully pick up spills with non-sparking and non-static producing tools.
Waste disposal	Desensitize by diluting in water. Open train burning, by qualified personnel, may be used for disposal of small unconfined quantities. Dispose of in compliance with federal regulations under the authority of the *Resource Conservation and Recovery Act* (40 CFR Parts 260-271).

SPECIAL PROTECTION INFORMATION	
Ventilation	Use only with adequate ventilation.
Respiratory	None
Eye	None
Gloves	Impervious rubber gloves.
Other	Metal-free *and* non-static producing clothes

SPECIAL PRECAUTIONS
• Keep away from friction, impact, and heat. Do not consume food, drink, or tobacco in areas where they may become contaminated with these materials.
• Contaminated equipment must be thoroughly water cleaned before attempting repairs.
• Use only non-spark producing tools.
• No smoking.

STORAGE CONDITIONS
Store in a cool, dry place in accordance with the requirements of *Subpart K, ATF: Explosives Law and Regulations* (27 CFR 55.201-55.219).

SHIPPING INFORMATION		
Proper shipping name	Black powder	
Hazard class	1.1D	
UN Number	UN0027	
DOT Label & Placard	DOT Label	EXPLOSIVE 1.1D
	DOT Placard	EXPLOSIVES 1.1
Alternate shipping information	Limited quantities of black powder may be transported as "Black powder for small arms", NA0027, class 4.1 pursuant to U.S. Department of Transportation authorization EX-8712212.	

The information contained in this Material Safety Data Sheet is based upon available data and believed to be correct; however, as such has been obtained from various sources, including the manufacturer and independent laboratories, it is given without warranty or representation that it is complete, accurate, and can be relied upon. OWEN COMPLIANCE SERVICES, INC. has not attempted to conceal in any manner the deleterious aspects of the product listed herein, but makes no warranty as to such. Further, OWEN COMPLIANCE SERVICES, INC. cannot anticipate nor control the many situations in which the product or this information may be used; there is no guarantee that the health and safety precautions suggested will be proper under all conditions. It is the sole responsibility of each user of the product to determine and comply with the requirements of all applicable laws and regulations regarding its use. This information is given solely for the purposes of safety to persons and property. Any other use of this information is expressly prohibited.

For further information contact: David W. Boston, President
OWEN COMPLIANCE SERVICES, INC.
12001 County Road 1000
P.O. Box 765
Godley, TX 76044
Telephone number: 817-551-0660
FAX number: 817-396-4584

MSDS prepared by: David W. Boston
Original publication date: 12/08/93
Revision date: 12/12/05
12/03/03

SAFETY DATA SHEET

PACER TECHNOLOGY
INDUSTRIAL • PRIVATE LABEL

Date Prepared : 10/10/2014
MSDS No : SUPER GLUE-GHS
Date-Revised : 6/23/2015
Revision No : 9

1. PRODUCT AND COMPANY IDENTIFICATION

GENERAL USE: Cyanoacrylate adhesive product.
PRODUCT DESCRIPTION: SUPER GLUE (SGH2B,SGH2J,SGH22,SGH22J,SGH23,SGH24J,SGH3,SGM2,SGM22,SGM22JS

MANUFACTURER

Pacer Technology
3281 E. Guasti Rd., Suite 260
Ontario, CA 91761
Emergency Contact: CHEMTREC
Emergency Phone: 800-424-9300
Alternate Emergency Phone: 703-527-3887
Product Stewardship: 909-987-0550

2. HAZARDS IDENTIFICATION

GHS CLASSIFICATIONS

Health:

Eye Irritation, Category 2A
Skin Irritation, Category 2
Target Organ Toxicity (Single exposure), Category 3
Skin Sensitization, Category 1

Physical:

Flammable Liquids, Category 4

GHS LABEL ELEMENTS

Exclamation mark

SIGNAL WORD: WARNING

HAZARD STATEMENTS

H315: Causes skin irritation.
H319: Causes serious eye irritation.
H317: May cause an allergic skin reaction.
H335: May cause respiratory irritation.
H227: Combustible liquid.

PRECAUTIONARY STATEMENT(S)

Prevention:

P264: Wash skin and hands thoroughly after handling.
P280: Wear protective gloves/protective clothing/eye protection/face protection.
P261: Avoid breathing dust/fume/gas/mist/vapours/spray.
P271: Use only outdoors or in a well-ventilated area.

SAFETY DATA SHEET

PACER TECHNOLOGY
INDUSTRIAL • PRIVATE LABEL

Date Prepared : 10/10/2014
MSDS No : SUPER GLUE-GHS
Date-Revised : 6/23/2015
Revision No : 9

P210: Keep away from heat/sparks/open flames/hot surfaces. – No smoking.

Response:

P370: In case of fire: Use dry chemical, foam or carbon dioxide to extinguish.
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337+P313: If eye irritation persists: Get medical advice/attention.
P313: Get medical advice/attention.
P302+P352: IF ON SKIN: Wash with plenty of soap and water.
P333+P313: If skin irritation or rash occurs: Get medical advice/attention.
P362: Take off contaminated clothing and wash before reuse.
P304+P340: IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.
P312: Call a POISON CENTER or doctor/physician if you feel unwell.

Storage:

P403+P233: Store in a well-ventilated place. Keep container tightly closed.
P403+P235: Store in a well-ventilated place. Keep cool.
P405: Store locked up.

Disposal:

7944L5O1: Dispose of in a manner consistent with federal, state, and local regulations.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	Wt.%	CAS
ETHYL-2-CYANOACRYLATE	85 - 100	7085-85-0
Polymethyl methacrylate	10 - 30	9011-14-7

4. FIRST AID MEASURES

EYES: Immediately flush eyes with plenty of water for at least 15 minutes. Get immediate medical attention.

SKIN: Wash with soap and water. Peel or roll skin apart.

INGESTION: Peel or roll skin apart. Adhesive becomes solid in contact with saliva and may adhere to inside of mouth. Saliva will lift adhesive in 1-2 days. Avoid swallowing solid adhesive after detachment. Not a toxic product.

INHALATION: Remove to fresh air. Prolonged or repeated elevated exposure may cause allergic reactions with asthma-like symptoms in sensitive individuals.

SIGNS AND SYMPTOMS OF OVEREXPOSURE

EYES: Causes serious eye irritation. Will bond eyelids. Will cause excessive tearing.

SKIN: Bonds skin in seconds. May cause skin irritation. May cause sensitization by skin contact. Cyanoacrylates generate heat on polymerization, so very large amounts will burn the skin.

INGESTION: Adhesive becomes solid in contact with saliva and may adhere to inside of mouth. Saliva will lift adhesive in 1-2 days. Not a toxic product.

INHALATION: Prolonged or excessive inhalation may cause respiratory tract irritation.

ACUTE TOXICITY: Avoid exposure to vapor concentration in confined areas.

CHRONIC EFFECTS: Frequent or prolonged contact may irritate the skin and cause a skin rash (dermatitis).

SAFETY DATA SHEET

PACER TECHNOLOGY
INDUSTRIAL • PRIVATE LABEL

Date Prepared : 10/10/2014
MSDS No : SUPER GLUE-GHS
Date-Revised : 6/23/2015
Revision No : 9

5. FIRE FIGHTING MEASURES

GENERAL HAZARD: Combustible liquid and vapor.Product polymerized to solid by water.

EXTINGUISHING MEDIA: Use dry chemical extinguisher or flush with large amounts of water.

HAZARDOUS COMBUSTION PRODUCTS: Can burn in fire, releasing irritanting vapors

EXPLOSION HAZARDS: None Known.

FIRE FIGHTING PROCEDURES: Evacuate area and fight fire from a safe distance.

FIRE FIGHTING EQUIPMENT: As in any fire, wear self-contained breathing apparatus pressure-demand, (MSHA/NIOSH approved or equivalent) and full protective gear.

FIRE EXPLOSION: None Known.

SENSITIVE TO STATIC DISCHARGE: None Known.

SENSITIVITY TO IMPACT: None Known.

HAZARDOUS DECOMPOSITION PRODUCTS: Combustible by-products of carbon monoxide/dioxide.

6. ACCIDENTAL RELEASE MEASURES

SMALL SPILL: Polymerize with water. Solid material may be scraped from surface.

LARGE SPILL: Polymerize with water. Increase ventilation to area. Solid material may be scraped from surface.

ENVIRONMENTAL PRECAUTIONS

WATER SPILL: This material is a water pollutant and should be prevented from contaminating soil or from entering sewage and drainage systems and bodies of water.

7. HANDLING AND STORAGE

GENERAL PROCEDURES: Use with adequate ventilation. Avoid contact with eyes, skin and clothing.

HANDLING: Avoid breathing (dust, vapor, mist, gas). Avoid contact with skin, eyes and clothing. Keep container closed when not in use.

STORAGE: Store in a cool place in original container and protect from sunlight. Keep away from sources of ignition.

STORAGE TEMPERATURE: Ideal storage: 41-50F (5-10C)

SHELF LIFE: One year from the date of shipment from Pacer Technology, unless otherwise noted.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE GUIDELINES

OSHA HAZARDOUS COMPONENTS (29 CFR1910.1200)							
		EXPOSURE LIMITS					
		OSHA PEL		ACGIH TLV		SupplierOEL	
Chemical Name		ppm	mg/m³	ppm	mg/m³	ppm	mg/m³
ETHYL-2-CYANOACRYLATE	TWA	[1]	[1]	0.2	1.0	0.2 ppm	

OSHA TABLE COMMENTS:
1. NL = Not Listed

SAFETY DATA SHEET

PACER TECHNOLOGY
INDUSTRIAL • PRIVATE LABEL

Date Prepared : 10/10/2014
MSDS No : SUPER GLUE-GHS
Date-Revised : 6/23/2015
Revision No : 9

ENGINEERING CONTROLS: Use only in a well ventilated area. Local exhaust ventilation may be necessary to control any air contaminants to within their TLVs during the use of this product.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: For normal conditions, wear safety glasses. Where there is reasonable probability of liquid contact, wear splash-proof goggles.

SKIN: Use Nitrile gloves and aprons to prevent contact. Do not use PVC, Nylon or Cotton materials.

RESPIRATORY: Use only in a well-ventilated area. In case of insufficient ventilation, wear suitable respiratory equipment. Recommended: Full-face NIOSH-approved respirator with organic vapor cartridge.

WORK HYGIENIC PRACTICES: Avoid direct contact and breathing vapor. Use with adequate ventilation. Wash hands with soap and water after use.

OTHER USE PRECAUTIONS: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: Liquid

ODOR: Characteristic odor, intensely irritating.

ODOR THRESHOLD: Odor Threshold = 1 ppm

APPEARANCE: Transparent, colorless liquid.

pH: Not Applicable.

PERCENT VOLATILE: Not Available

FLASHPOINT AND METHOD: 80°C (176°F) to 93.4°C (200°F) TAG CC

FLAMMABLE LIMITS: Not Available

AUTOIGNITION TEMPERATURE: 485°C (905°F)

VAPOR PRESSURE: < 0.2 mm Hg

VAPOR DENSITY: Not Available

BOILING POINT: > 149°C (300°F)

FREEZING POINT: Not Available

MELTING POINT: Not Determined

THERMAL DECOMPOSITION: Not Available

SOLUBILITY IN WATER: Insoluble

EVAPORATION RATE: Not Established

DENSITY: Not Available

SPECIFIC GRAVITY: 1.06 g/mL at 25°C

VISCOSITY #1: 25 to 50 Centipoise at 22°C(72°F)

MOLECULAR WEIGHT: Not Available

(VOC): < 20.000 g/L Per SCAQMD Method 316B.

COEFF. OIL/WATER: Partition coefficient (octanol/water): Not applicable.

10. STABILITY AND REACTIVITY

SAFETY DATA SHEET

PACER TECHNOLOGY
INDUSTRIAL • PRIVATE LABEL

Date Prepared : 10/10/2014
MSDS No : SUPER GLUE-GHS
Date-Revised : 6/23/2015
Revision No : 9

STABLE: Yes

HAZARDOUS POLYMERIZATION: No

CONDITIONS TO AVOID: Avoid temperatures above 176 °F (80 °C), moisture and alkalines.

POSSIBILITY OF HAZARDOUS REACTIONS: Possible polymerization reaction in the presence of water, amines, alkalis and alcohols.

HAZARDOUS DECOMPOSITION PRODUCTS: Carbon Dioxide, Carbon Monoxide and other toxic or irritating compounds may form when heated to decomposition.Oxides of nitrogen and probably hydrogen cyanide are also possible.

INCOMPATIBLE MATERIALS: Polymerized by water, alcohol, amines, alkaline materials.

COMMENTS: REACTIVITY: Rapid exothermic polymerization will occur in the presence of water, amines, alkalis and alcohols.

11. TOXICOLOGICAL INFORMATION

ACUTE

Chemical Name	ORAL LD_{50} (rat)	DERMAL LD_{50} (rabbit)
ETHYL-2-CYANOACRYLATE	> 5000 mg/kg	> 2000 mg/kg

DERMAL LD_{50}: > 2000 mg/kg

Notes: (Estimated)

ORAL LD_{50}: > 5000 mg/kg

Notes: (Estimated)

INHALATION LC_{50}: Vapors may be irritating. Recommended TWA 0.2ppm.

EYE EFFECTS: Bonds skin and eyes in seconds. Eye irritant.

SKIN EFFECTS: Irritating to skin. May cause allergic skin reaction with prolonged contact.

CARCINOGENICITY

IARC: None known

NTP: None known

OSHA: None known

SENSITIZATION: Possible skin sensitizer.

TARGET ORGANS:

Ingredient	Health Effect/ Target Organ
Ethyl cyanoacrylate	Irritant, Allergen/ Respiratory, Skin

12. ECOLOGICAL INFORMATION

SAFETY DATA SHEET

PACER TECHNOLOGY
INDUSTRIAL • PRIVATE LABEL

Date Prepared : 10/10/2014
MSDS No : SUPER GLUE-GHS
Date-Revised : 6/23/2015
Revision No : 9

ENVIRONMENTAL DATA:

This material is a water pollutant and should be prevented from contaminating soil or from entering sewage and drainage systems and bodies of water.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Dispose of following all Local Authority requirements for disposal.

14. TRANSPORT INFORMATION

DOT (DEPARTMENT OF TRANSPORTATION)

PROPER SHIPPING NAME: Not restricted

ROAD AND RAIL (ADR/RID)

PROPER SHIPPING NAME: Not restricted

AIR (ICAO/IATA)

SHIPPING NAME: AVIATION REGULATED LIQUID, N.O.S. (ETHYL CYANOACRYLATE), UN3334, 9

VESSEL (IMO/IMDG)

SHIPPING NAME: Not restricted

CANADA TRANSPORT OF DANGEROUS GOODS

SHIPPING NAME: Not restricted

15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

311/312 HAZARD CATEGORIES: Immediate Health, Delayed Health, Fire, Reactive.

313 REPORTABLE INGREDIENTS: None above reporting de minimus.

302/304 EMERGENCY PLANNING

EMERGENCY PLAN: None above reporting de minimus.

TSCA (TOXIC SUBSTANCE CONTROL ACT)

Chemical Name	CAS
ETHYL-2-CYANOACRYLATE	7085-85-0
Polymethyl methacrylate	9011-14-7

TSCA STATUS: All components are listed on or are exempt from listing on the Toxic Substances Control Act.

CLEAN AIR ACT

40 CFR PART 68---RISK MANAGEMENT FOR CHEMICAL ACCIDENT RELEASE PREVENTION: Not applicable.

CALIFORNIA PROPOSITION 65: No California Proposition 65 ingredients are known to be in this product.

CANADA

WHMIS HAZARD SYMBOL AND CLASSIFICATION

SAFETY DATA SHEET

PACER TECHNOLOGY
INDUSTRIAL • PRIVATE LABEL

Date Prepared : 10/10/2014
MSDS No : SUPER GLUE-GHS
Date-Revised : 6/23/2015
Revision No : 9


Combustible Liquid


Toxic

Class B3 - Combustible, D2B - Irritant.

WHMIS CLASS: B3 - combustible, D2B - irritant.

DOMESTIC SUBSTANCE LIST (INVENTORY): All components are listed on or are exempt from listing on the Domestic Substances List.

16. OTHER INFORMATION

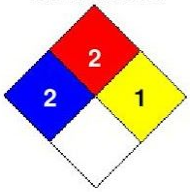
PREPARED BY: Samantha Stouffer **Date-Revised:** 6/23/2015

REVISION SUMMARY: This MSDS replaces the 4/30/2015 MSDS. Revised: **Section 5:** FLAMMABLE CLASS.

HMIS RATING

HEALTH	2
FLAMMABILITY	2
PHYSICAL HAZARD	1
PERSONAL PROTECTION	

NFPA CODES



MANUFACTURER DISCLAIMER:

To the best of our knowledge, the information contained herein is accurate. However, Pacer Technology does not assume any liability for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards which exist.

MATERIAL SAFETY DATA SHEET
West System Inc.

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: ..... WEST SYSTEM® 205 Fast Hardener
PRODUCT CODE: 205
CHEMICAL FAMILY: ..... Amine.
CHEMICAL NAME: ..... Modified aliphatic polyamine.
FORMULA: ..... Not applicable.

MANUFACTURER:
West System Inc.
102 Patterson Ave.
Bay City, MI 48706, U.S.A.
Phone: 866-937-8797 or 989-684-7286
www.westsystem.com

EMERGENCY TELEPHONE NUMBERS:
Transportation
CHEMTREC: ..... 800-424-9300 (U.S.)
703-527-3887 (International)
Non-transportation
Poison Hotline: 800-222-1222

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

DANGER Causes burns to eyes and skin. Harmful if swallowed. Harmful if absorbed through the skin. May be harmful if inhaled. May cause allergic reaction. Amber colored liquid with ammonia odor.

PRIMARY ROUTE(S) OF ENTRY: ..... Skin contact, eye contact, inhalation.

POTENTIAL HEALTH EFFECTS:

ACUTE INHALATION: ..... May cause respiratory tract irritation. Coughing and chest pain may result.

CHRONIC INHALATION: ..... May cause respiratory tract irritation, coughing, sore throat, shortness of breath or chest pain.

ACUTE SKIN CONTACT: ..... May cause strong irritation, redness. Possible mild corrosion.

CHRONIC SKIN CONTACT: ..... Prolonged or repeated contact may cause an allergic reaction and possible sensitization in susceptible individuals. Large dose skin contact may result in material being absorbed in harmful amounts.

EYE CONTACT: ..... Moderate to severe irritation with possible tissue damage. Concentrated vapors can be absorbed in eye tissue and cause eye injury. Contact causes discomfort and possible corneal injury or conjunctivitis.

INGESTION: ..... Single dose oral toxicity is moderate. May cause gastrointestinal tract irritation and pain. Aspiration hazard.

SYMPTOMS OF OVEREXPOSURE: ..... Respiratory tract irritation. Skin irritation and redness. Possible allergic reaction seen as hives and rash. Eye irritation. Possible liver and kidney disorders upon long term skin absorption overexposures.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: ..... Chronic respiratory disease, asthma. Eye disease. Skin disorders and allergies.

3. COMPOSITION/INFORMATION ON HAZARDOUS INGREDIENTS

INGREDIENT NAME	CAS #	CONCENTRATION (%)
Reaction products of triethylnetetramine with phenol/formaldehyde	32610-77-8	40-70
Polyethylenepolyamines	68131-73-7	10-30
Triethylenetetramine	112-24-3	5-20
Hydroxybenzene	108-95-2	1-10
Reaction products of triethylenetetramine and propylene oxide	26950-63-0	1-10
Tetraethylenepentamine	112-57-2	1-10

4. FIRST AID MEASURES

FIRST AID FOR EYES: ..... Immediately flush with water for at least 15 minutes. Get prompt medical attention.

FIRST AID FOR SKIN: ..... Remove contaminated clothing. Immediately wash skin with soap and water. Do not apply greases or ointments. Get medical attention if severe exposure.

FIRST AID FOR INHALATION: ..... Move to fresh air and consult physician if effects occur.

FIRST AID FOR INGESTION: ..... Give conscious person at least 2 glasses of water. Do not induce vomiting. If vomiting should occur spontaneously, keep airway clear. Get medical attention.

5. FIRE FIGHTING MEASURES

FLASH POINT: ..... >270°F (PMCC)

EXTINGUISHING MEDIA: ..... Dry chemical, alcohol foam. carbon dioxide (CO_2), dry sand, limestone powder.

FIRE AND EXPLOSION HAZARDS: ..... During a fire, smoke may contain the original materials in addition to combustion products of varying composition which may be toxic and/or irritating. Combustion products may include, but are not limited to: oxides of nitrogen, carbon monoxide, carbon dioxide, volatile amines, ammonia, nitric acid, nitrosamines. When mixed with sawdust, wood chips, or other cellulosic material, spontaneous combustion can occur under certain conditions. Heat is generated as the air oxidizes the amine. If the heat is not dissipated quickly enough, it can ignite the sawdust.

SPECIAL FIRE FIGHTING PROCEDURES: ..... Use full-body protective gear and a self-contained breathing apparatus. Use of water may generate toxic aqueous solutions. Do not allow water run-off from fighting fire to enter drains or other water courses.

6. ACCIDENTAL RELEASE MEASURES

SPILL OR LEAK PROCEDURES: ..... Stop leak without additional risk. Wear proper personal protective equipment. Dike and contain spill. Ventilate area. Large spill - dike and pump into appropriate container for recovery. Small spill - recover or use inert, non-combustible absorbent material (*e.g.*, sand, clay) and shovel into suitable container. Do not use sawdust, wood chips or other cellulosic materials to absorb the spill, as the possibility for spontaneous combustion exists. Wash spill residue with warm, soapy water if necessary.

7. HANDLING AND STORAGE

STORAGE TEMPERATURE (min./max.): ..... 40°F (4°C) / 90°F (32°C).

STORAGE: ..... Store in cool, dry place away from high temperatures and moisture. Keep container tightly closed.

HANDLING PRECAUTIONS: ..... Use with adequate ventilation. Do not breath vapors or mists from heated material. Avoid exposure to concentrated vapors. Avoid skin contact. Wash thoroughly after handling. When mixed with epoxy resin this product causes an exothermic reaction, which in large masses, can produce enough heat to damage or ignite surrounding materials and emit fumes and vapors that vary widely in composition and toxicity.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EYE PROTECTION GUIDELINES: ..... Chemical splash-proof goggles or face shield.

SKIN PROTECTION GUIDELINES: ..... Wear liquid-proof, chemical resistant gloves (nitrile-butyl rubber, neoprene, butyl rubber or natural rubber) and full body-covering clothing.

RESPIRATORY/VENTILATION GUIDELINES: ..... Use with adequate general and local exhaust ventilation to meet exposure limits. In poorly ventilated areas, use a NIOSH/MSHA approved respirator with an organic vapor cartridge.

Note: West System, Inc. has conducted an air sampling study using this product or similarly formulated products. The results indicate that the components sampled for (phenol, formaldehyde and amines) were either so low that they were not detected at all or they were well below OSHA's permissible exposure levels.

ADDITIONAL PROTECTIVE MEASURES: ..... Use where there is immediate access to safety shower and emergency eye wash. Wash thoroughly after use. Contact lens should not be worn when working with this material. Generally speaking, working cleanly and following basic precautionary measures will greatly minimize the potential for harmful exposure to this product under normal use conditions.

OCCUPATIONAL EXPOSURE LIMITS: ..... Not established for product as whole. Refer to OSHA's Permissible Exposure Level (PEL) or the ACGIH Guidelines for information on specific ingredients.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL FORM ..... Liquid.
COLOR ..... Amber.
ODOR ..... Ammonia-like.
BOILING POINT ..... > 440°F.
MELTING POINT/FREEZE POINT ..... Approximately 23°F.
pH ..... Alkaline.