

FIVE CLANS ROCKET TEAM

Presents:

“Gray Wolf 7, 7.5”

Designed to Detect and Predict Wolf Pack Population in Northern Montana

2007-2008 USLI CDR Report

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Changes since PDR:

1. The experimental launch vehicle is designed to fly at night. This requires an FAA waiver. The 144" main parachute is designed to deploy at apogee allowing for greatest length of IR/ thermal imaging of wolf pack territory; in the dark. It is the experimental design that inhibits the successful launch and recovery at the USLI launch competition. Therefore, the FCRT will launch Gray Wolf 7, with IR/ thermal imaging equipment before the USLI April 19, 2008 launch. With this in mind FCRT have designed Gray Wolf 7.5 with similar flight characteristics as Gray Wolf 7. A drogue parachute in GW7.5 replaces the IR/ thermal imaging equipment of GW7. .
2. Engine Change from Aerotech K1275 to Animal Motor Works 1300.
 - a. Reason for motor change.
 - i. The armor adds weight; therefore a larger motor is needed.
3. Activity Plan Changes.
 - a. A special cut of the wing is no longer planned to achieve a controlled propelled twist.
 - b. Laser is used to locate fin slots.
 - c. Laser is used to align and stabilize fins in a 90 degree angle.
 - d. Added USLI launch vehicle in addition to Experimental Launch Vehicle.
 - e. Added drogue parachute for USLI Launch Vehicle.
 - f. Experimental Launch Vehicle will not be deployed at USLI launch.
 - g. Parachute shroud lines were doubled and stitched separately; one on each side of every gore seam. Dual lines are backstitched together starting at 2" from gore to minimize tangling.
 - h. Launch pad is FCRT design, using an old lawnmower deck that allows for 360 degree rotation. The launch rail is 66" long and made from .1" steel bedrails.
 - i. Gray Wolf 7 uses a piston to protect the parachute at deployment.



- j. Gray Wolf 7.5 uses Nomex® shields to protect the main and drogue parachutes at deployment.
- k. No practice launch has taken place.

Team Summary:

1. The College of Menominee Nation is a two-year community college located in the state of Wisconsin.

Five Clans Rocket Team
College of Menominee Nation
Suite 3
2733 South Ridge Rd
Green Bay WI 54304
PH: 920-965-0070
Fax: 920-965-0071

2. The Five Clans Rocket Team (FCRT) has two mentors
 - a. Erin Thomas (math teacher)
 - b. Green Bay Campus Administrator, Norbert Hill Jr.
3. The Five Clans Rocket Team members are:
 - a. Lisa Annamitta
 - b. Dan Hawk
 - c. Sheila House
 - d. Lana Otradovec
 - e. Christine Skenandore
 - f. Shane Skenandore



Experimental Launch Vehicle Summary:

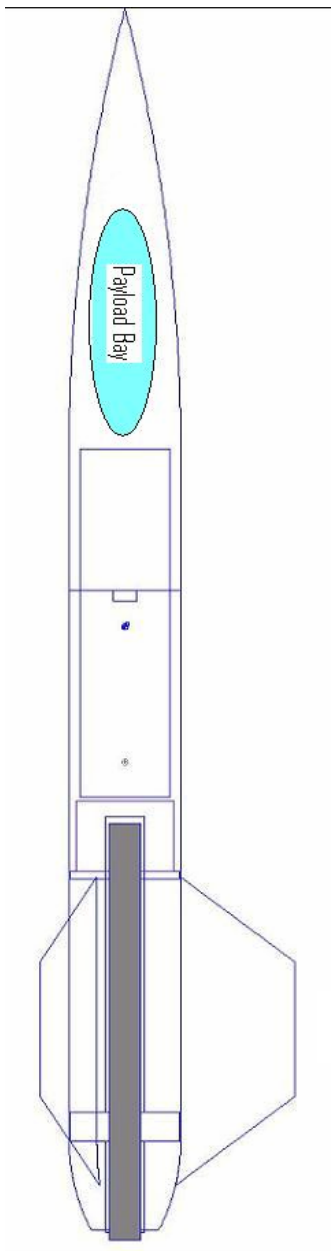


Figure 1

GRAY WOLF 7

LENGTH: 84.37"

DIAMETER: 7.67"

SPAN DIA.: 23.42"

MASS: 428.64 Oz.

CG: 42.63"

CP: 51.95"

MARGIN: 1.22

ENGINE: L1300

FINS: 3

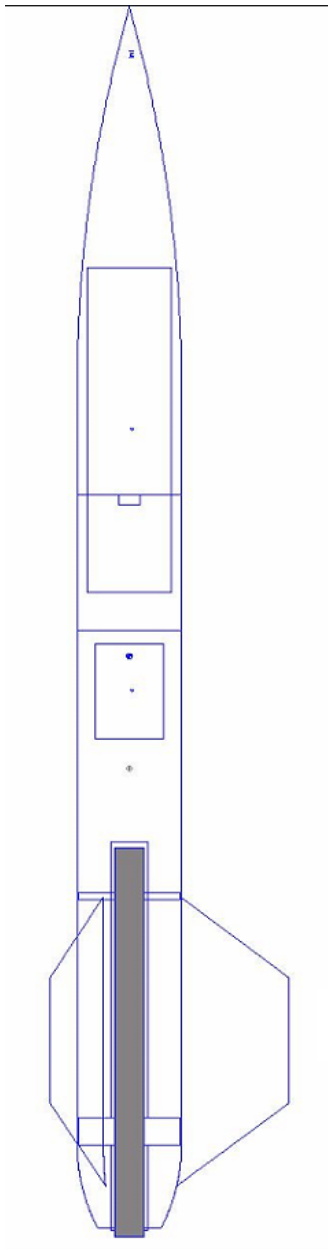
ARMOR: DOGSKIN™

PARACHUTE: 144"

- DEPLOYS @ APOGEE
- HAND SEWN
- 8 DUAL SHROUD LINES



USLI Launch Vehicle Summary:



GRAY WOLF 7.5

LENGTH: 90.25"

DIAMETER: 7.67"

SPAN DIA.: 23.42"

MASS: 428.64 OZ.

CG: 47.91"

CP: 56.21"

MARGIN: 1.08

ENGINE: L1300

FINS: 3

ARMOR: DOGSKIN™

PARACHUTES:

Figure 2

- 42" DROGUE @ APOGEE
- 144" MAIN @ 600'
- HAND SEWN
- 8 DUAL SHROUD LINES



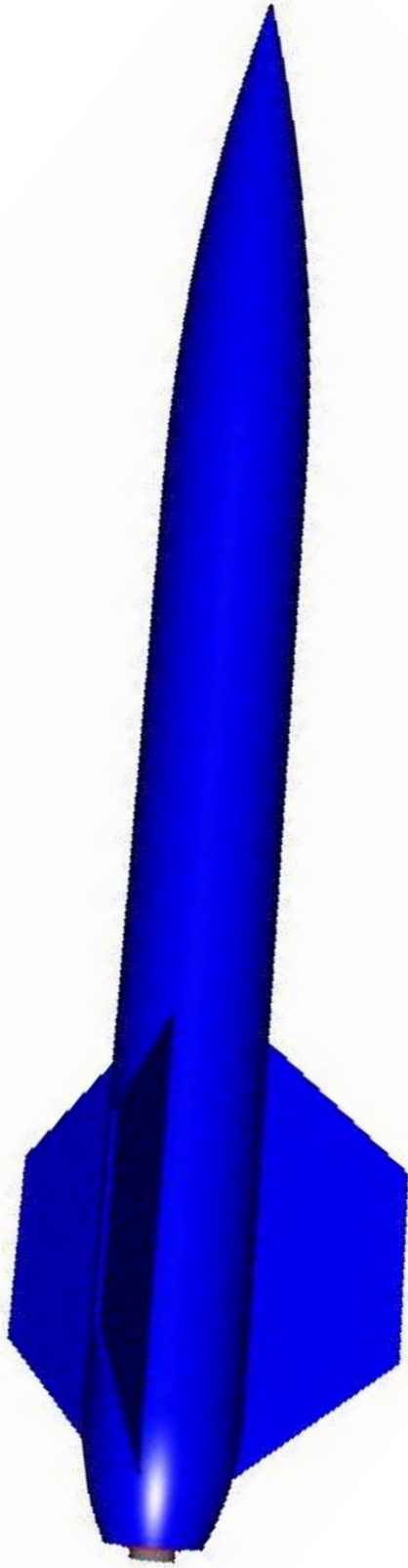


Figure 3
3D in Flight



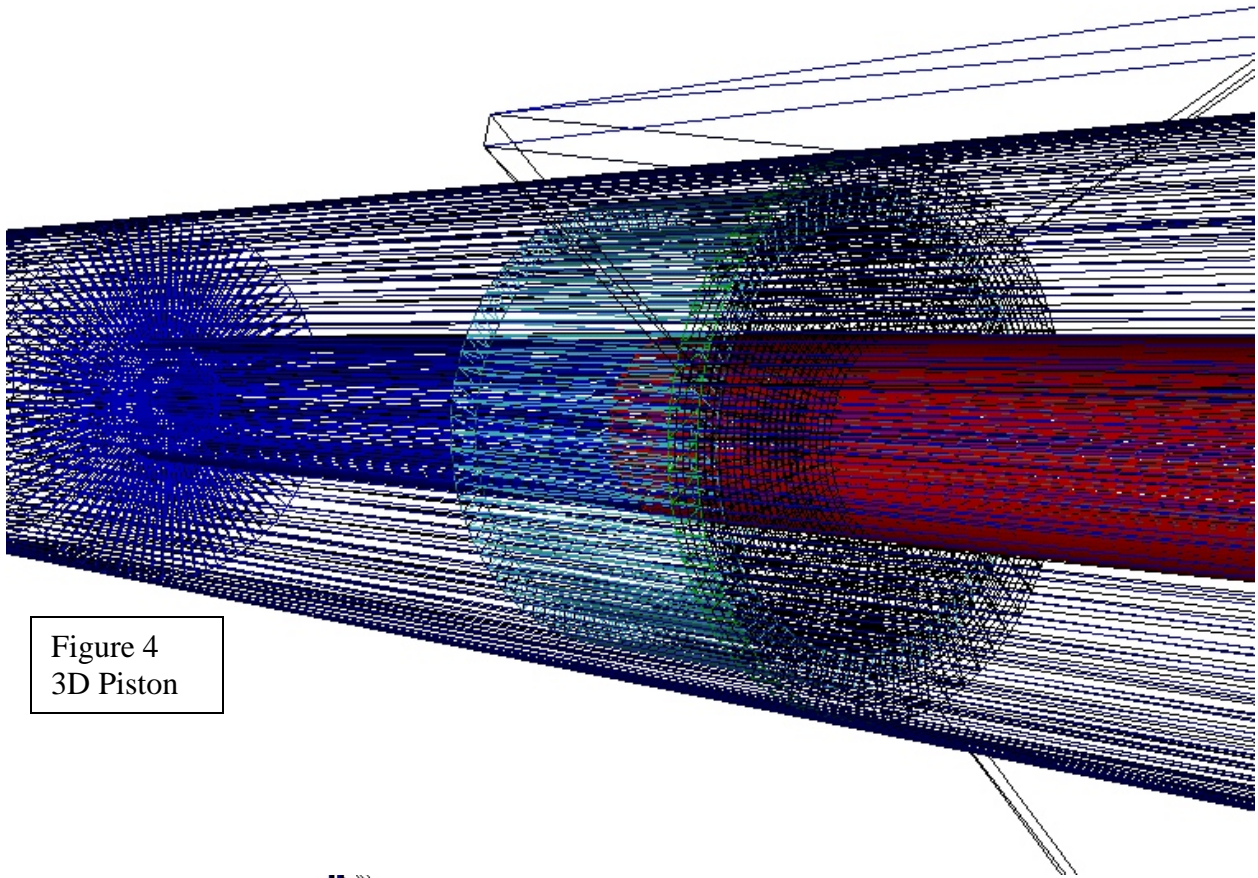


Figure 4
3D Piston

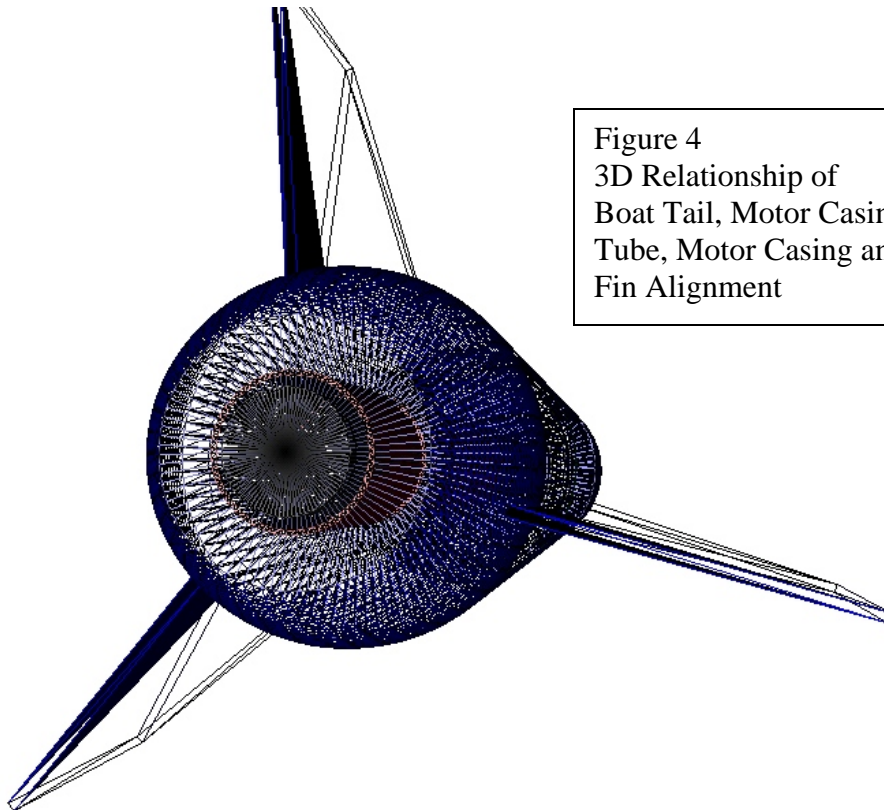


Figure 4
3D Relationship of
Boat Tail, Motor Casing
Tube, Motor Casing and
Fin Alignment



Payload Summary:

1. The payload is not yet fully designed. The approximate weight of the payload bay will be four pounds. The payload bay will house one or two altimeters, 3-D GPS, homing device, Infrared camera, thermal imager, and laser rangefinder. Gray Wolf 7 is designed to fly at night. The night vision equipment is designed to detect wolf packs, for the prediction of accurate wolf population counts. Photo 1 below shows an example of wolf pack activity.



(Reference:

<http://action.defenders.org/site/PhotoAlbumUser?view=UserPhotoDetail&PhotoID=21369&position=3&AlbumID=12715>)



Mission Success Criteria:

What is the Five Clans Rocket Team doing to make the USLI launch experience successful?

FCRT has been getting support from our Native American college. The College of Menominee Nation has provided us with space of our own to design and build rockets, for the benefit of students specifically for Math for Rockets - 299 and Business Internships. The College of Menominee Nation recognizes the hard work and determination of the FCRT as is looking for ways to incorporate FCRT into their new pre-engineering program.

FCRT offers a food sale every week to raise funds. The students are anxious to help us. Often our fellow classmates simply tell us to keep the change.

FCRT is successful because every one of our instructors is behind us. It is common to give tours of the rocket ready room to teachers on a regular basis. They just want to know what we're doing and how far we got, from the last tour. They seemed to be amazed at our capabilities and use of technology such as using lasers to align fins. It is common for instructors to invite FCRT into their classroom, to show students why they need to learn things such as math, physics, and business administration.

The College of Menominee Nation uses FCRT as a recruiting tool. That learning can go beyond bookwork and can actually be applied. The notion that Native American students can not learn STEM technology is dismissed when students see the rocket ready room and the FCRT at work. We offer everyone the opportunity to join in, to design and build rockets with us.

FCRT has an alliance with the local Brown County airport and their tower. FCRT has physically been to the airport to discuss FCRT proposals and respective launches.



FCRT has support from the Oneida tribal government, Oneida tribal police and fire support services.

The NAR level 2 certification written test has been ordered from NAR headquarters and they are working out a way for Dan Hawk and Shane Skenandore to take the written test by a college exam proctor or by a local NAR level 2 certified team. NAR-HQ notified Dan Hawk by email on January 25, 2008 that the tests have been mailed out. FCRT is waiting word as to who will proctor the level 2 exam.

FCRT is successful because we offer a Kids Rocket Program every Saturday from 1pm to 4pm. We offer a graduated skill level model rocket program for kids, where they progress from a skill level 1 to designing and making their own rocket from scratch. FCRT is active in outreach as well; we manned a booth with college recruiters at the 2007 Shopko Hall career expo where 5,000 high school kids attended. Several of the kids picked up and played with our rocket parts. FCRT also participates in Family Math and Science Night where we teach kids about rockets, we plan rocket related activities. The kids are excited about this program and we get excellent participation. We have attended Bowler and Gresham schools.

In summary FCRT is performing as well as can be expected. We are meeting and exceeding our outreach goals to teach others about STEM technology. We are getting the kids interested in rockets and the sciences related to rockets. Our mission success criterion continues to evolve as we build our FCRT, but in the mean time we can see steady progress. We are getting better, faster, and doing things cheaper than before. We are learning to be successful.



A Note about Safety:

FCRT has an excellent safety program. When we moved into our new space we immediately put in an order to recharge our fire extinguishers, they hadn't been inspected since 2005. We obtained a first aid kit (inventoried and stocked) that is wall mounted, which can be removed so we can take it to the launch site. We have purchased a face shield, several pairs of vented goggles; several pairs of different types of safety glasses so that our team members can chose what is most comfortable for them to wear. We always have on hand boxes of rubber gloves, and one pair of non-slip work gloves for the rougher jobs. We have ear muffs, and a box of disposable foam rubber ear plugs. We also have on hand two or three different types of air particulate face masks, again a variety so that our team members can chose what they want to wear.

Gray Wolf 7 Critical Design:

1. Airframe. The inner airframe is made from an 8" concrete tube. The tube is covered with a dog mesh. The dog mesh is cut in a pumpkin tooth design as to prevent a single seam. This will keep the airframe from splitting upon hitting rocks or the side of mountains. The dog mesh is covered with a Kevlar® impregnated epoxy. FCRT has placed a trademark on the combination of dog mesh and Kevlar® calling it Dogskin™. The Dogskin™ acts like an armor coating. Since Gray Wolf 7 is designed to fly in the rugged territory of northern Montana it was only appropriate that we make Gray Wolf 7 durable and reusable. The Dogskin™ makes the rocket heavier and thus more power is needed to obtain the USLI competition altitude objective of 5,280 feet. The airframe has three removable doors located between the fins; they are fitted with an o-ring seal. The doors are tightened down using a 6-32 stove bolt backed by a non-removable nylon nut to prevent them from coming lose during flight. Both the front and rear areas of the airframe are keyed so that either the boat tail or the coupling are to fit only one way. This is to ensure proper balance and positioning at all times.

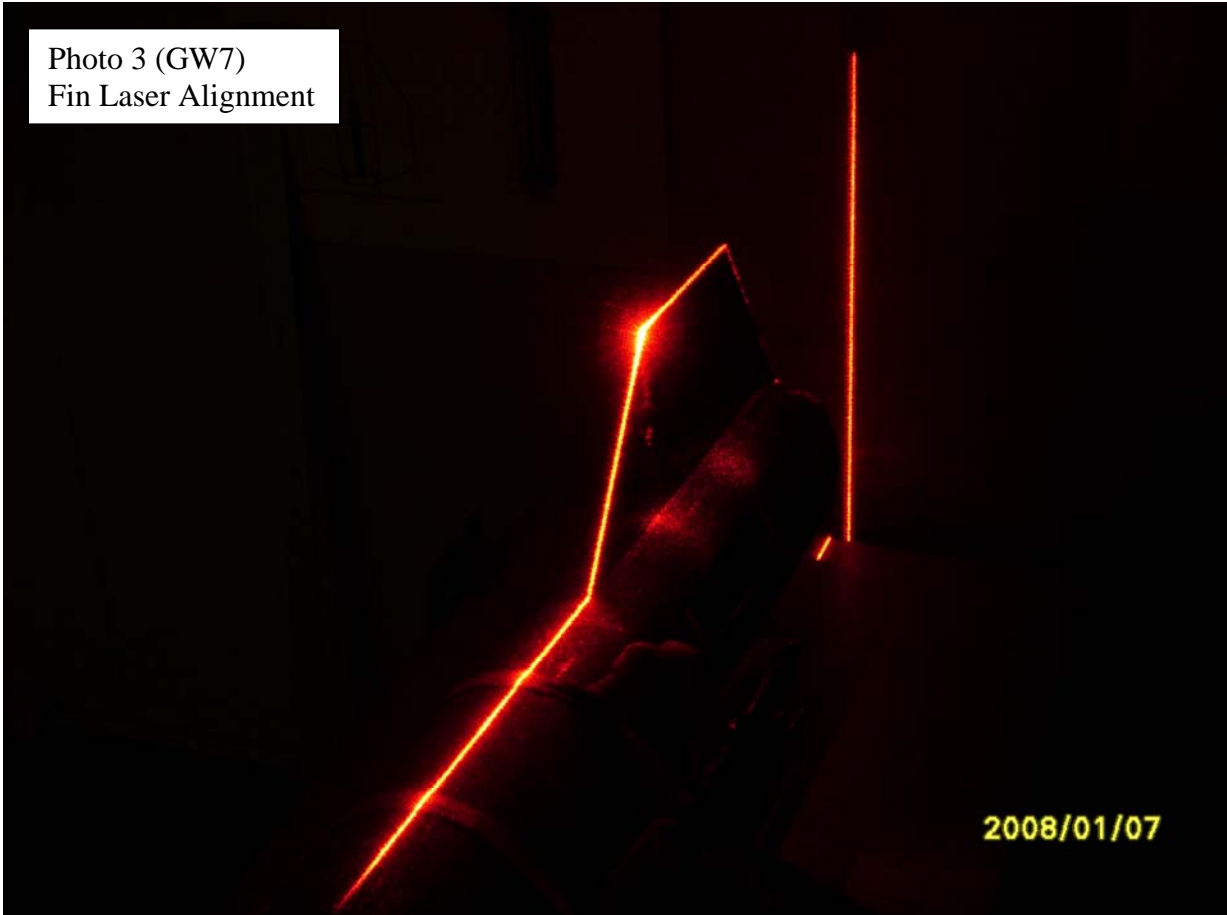




2. Fins. The three fins are made from a .13" pegboard wrapped in Dogskin™. The fins are trapezoidal and boat tail beveled by router. The fins were slotted with the used of an overhead mounted construction 90 degree laser. The laser was also used to ensure the fins were 90 degrees from the motor casing tube. The fins were tacked in place using 5 minute epoxy while ensuring the laser beam projected over the top of the fin. When the fin was secured, using extended time epoxy, the fins were glued to the airframe using six fillets; on each side, two on the top of the airframe, two on the bottom of the inside airframe, and two more on the motor casing tube. The two on the top outside were first laid by using marine epoxy. The latter a design consideration for using the rocket in wet weather conditions, such as snowfall.



Photo 3 (GW7)
Fin Laser Alignment



3. Boat Tail. The boat tail was first molded from cardboard and formed. The cardboard was removed, leaving the shell. The boat tail shell was keyed up with the aft airframe section. Using extended time epoxy the boat tail shell was glued to the aft airframe section. The boat tail was ground down to fit the boat tail template where needed. Dogskin™ was added to the boat tail section to ensure durability as in the same manner as the airframe and fins. A jig was made from the paper roll of the dog mesh and Plexiglas®. By inserting the paper roll in the motor casing tube and twisting the jig between fin sections we obtain a smooth even Dogskin™ boat tail section. Motor mount is attached to the Boat Tail using a single inverted eyebolt (attached to the fin section) and retained by a stainless steel washer and SS nylon nut.



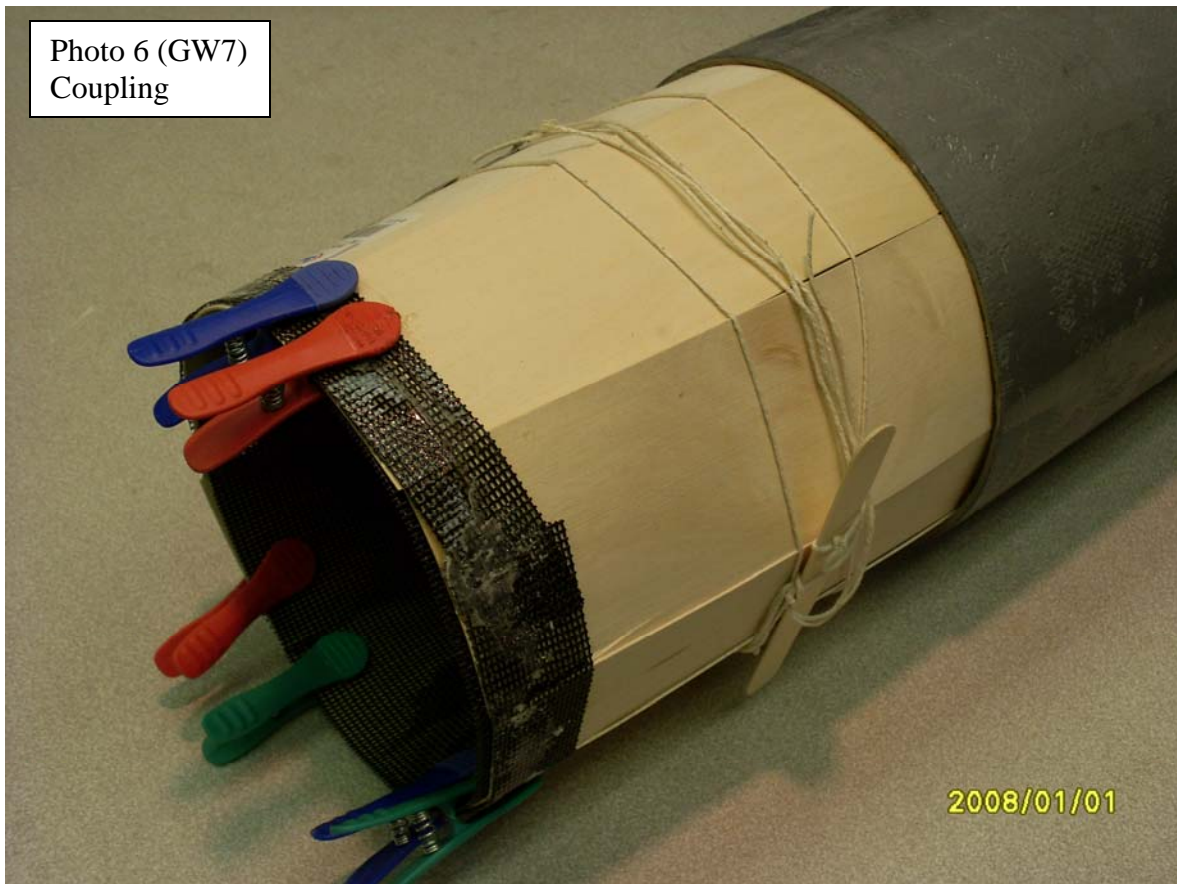
Photo 4 (GW7)
Boat Tail Form
& Jig Device



Photo 5 (GW7)
Boat Tail Polishing
& Jig Device



4. Coupling. The airframe section of the coupling is made the same way the airframe is made in no.1 above. The coupling portion is made by lining the airframe part with epoxy and basswood strips. A rubber ball is deflated and placed in the airframe part, then inflated until the basswood strips are pressed against the inner side of the airframe part. The result is a basswood coupling. On the inside of the basswood coupling a layer of dog mesh and epoxy is used to create a strong, impervious, positive friction fit. The length of the coupling portion is 8" which is slightly longer than the airframe diameter of 7.67". The coupling is also keyed to fit the airframe section so it can only go on one way, again to ensure balance and continuity of rocket sections. Epoxy provides a strong impervious positive friction fit.



5. Nose Cone. The nose cone is formed by cutting out bunches of cardboard circles, based on a RockSim8 template. The boat tail was formed in a similar fashion. The cardboard circles are skewered on a cut-off campfire hotdog fork. The template is placed under Plexiglas® and ½ the template is cut slightly smaller than the template (approximately 1/8th of an inch. The Plexiglas® is placed between two pieces of pegboard allowing the glass part to be slightly raised. The hotdog skewer with the cardboard circles is used to match the Plexiglas® template. The cardboard is spun while applying wood putty and or epoxy until the form matches the Plexiglas® template. When the form is done, a sheet of aluminum foil or other non-stick medium is placed over the solid form, dog mesh is added. The Plexiglas® template is raised the desired thickness (1/8th"), and the form and non-stick is spun while applying Kevlar® epoxy. Epoxy is applied until the form matches the template. The nose cone form is being made, and should be available for viewing for the February 4th presentations. The nose cone is our IR/ thermal imaging equipment payload bay. Photo 4 shows the nose cone form for Soaring Eagle 1.

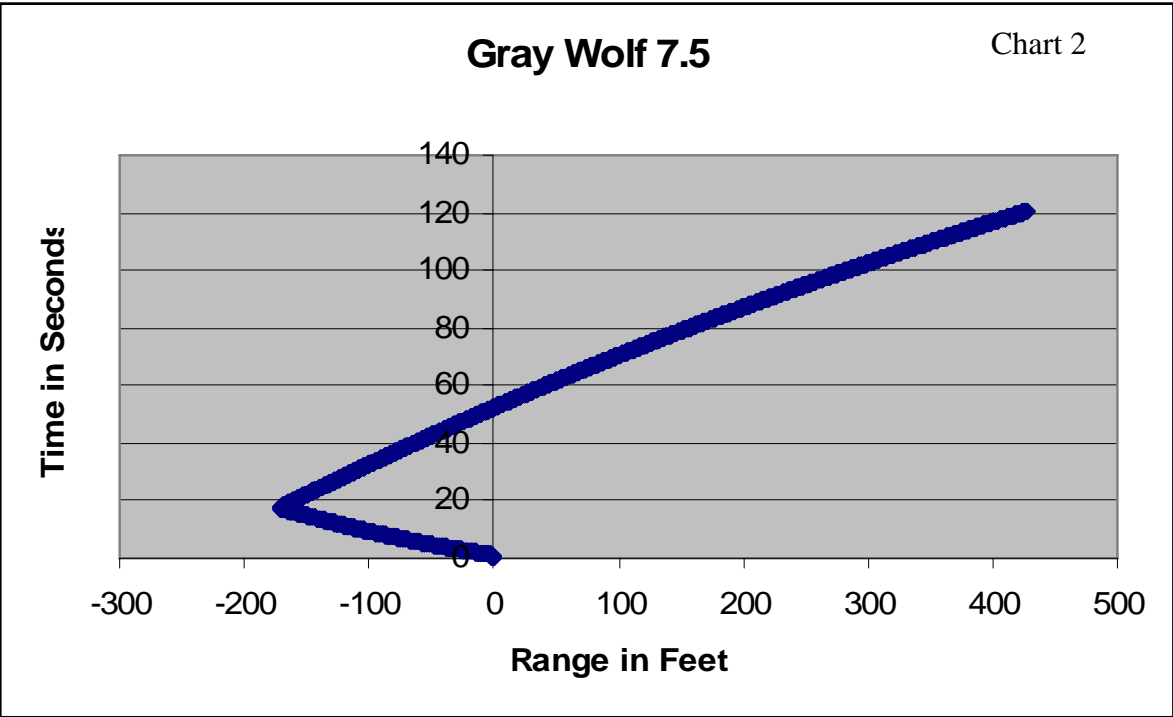
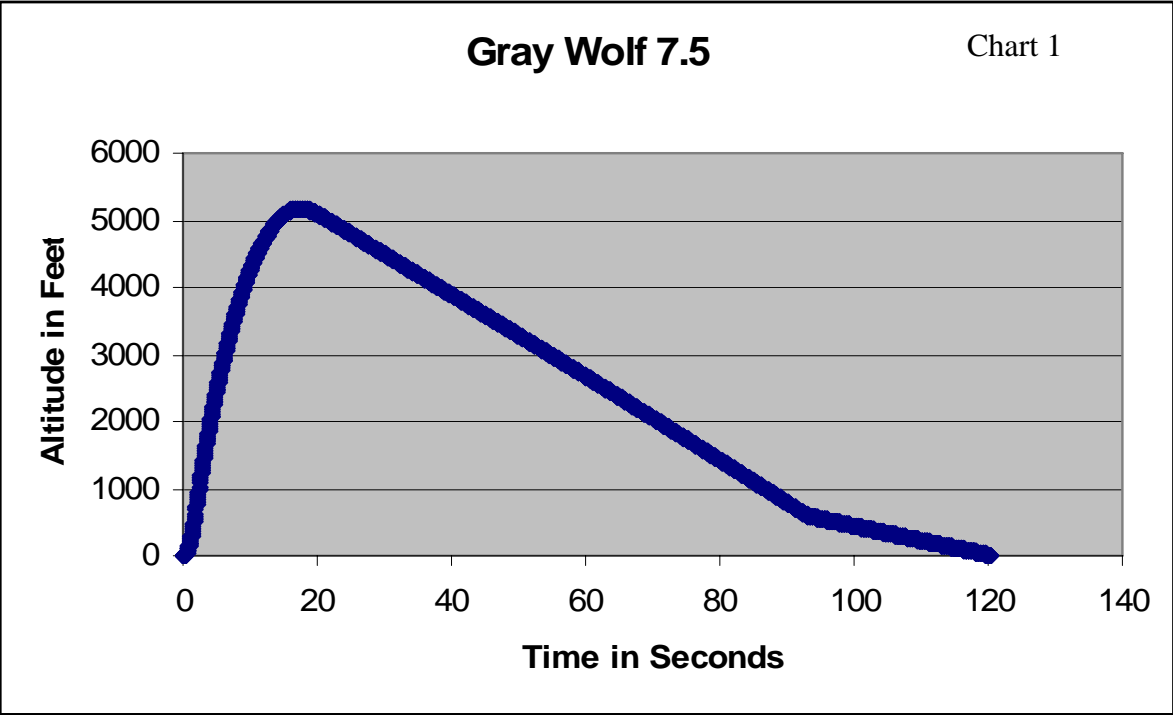


6. Parachutes. The main parachute is eight gores and 144". Each gore has a .75" hole; combined, the eight .75" holes are equal to the area of single 8" hole. The main and drogue parachutes are made of the same rip stop nylon. The shroud lines are doubled to ensure reliability in the rugged northern Montana territory. The 42" drogue parachute is not intended to be used in the Experimental Launch Vehicle. The drogue parachute will slow the rate of descent to approximately 58 ft/ second then at an altitude of 600 feet the 144" main parachute will deploy slowing the rate of descent to approximately 16.25 ft/ second (Chart 1). With light winds of 3 to 7 mph the range of drift is approximately 427 feet (Chart 2). We will ground test black powder ejection charges starting with a standard of 1 gram BP for a 7.5" body tube at 7.5" long for pressure of 7.5 psi. We will determine the average minimum charge and add .25 grams BP for fail safe ejection.



Photo 9
Sheila making 58" GW7
Test Parachute





7. Experimental Payload. Depending on the territory which wolves live they are considered to be either threatened or endangered (Endangered Species Act). Gray Wolf 7 payload is designed to detect wolf movement at night in order to estimate their current population and to predict their future population based on available habitat and food supply. FCRT hopes that through experimentation that Gray Wolf 7 might serve as a valuable wolf pack monitoring tool. Photo 1 shows at least five wolves. Gray Wolf 7 has approximately a 4 pound payload capability. We are researching IR and thermal imaging equipment that might best fit the nose cone parameters. Some example equipment options.

a. World Communication Center, SBD Pro (1 lb) Iridium Short Burst Data Service offers distress messaging with 3D GPS coordinates sensor event notification, waypoint marking, remote sensor monitoring, and geofencing.

b. Wahl handheld heat spy long distance thermal imager.

c. Fluke thermal imaging camera (capable of withstanding a 2 meter drop).

d. EVS-14 Gen 3
night vision (11oz)
adapted to video
camera.

www.imaging1.com



e. Forward Looking
Infrared (FLIR)

IR-235 handheld (can be set to infinity) see in dark IR technology, wireless video output for real-time capability, (2.9 lbs).

f. Nikon D80 with IR lens.



Conclusion:

The FCRT is ahead of schedule for building, testing, and pre-launch for the 2007-2008 USLI. FCRT is satisfied with the current and future outreach activities. FCRT is actively pursuing sponsorship in regards to the high-costs of experimental equipment for Gray Wolf 7. We are confident that lesser quality experiment equipment will work, but perhaps will not get us the resolution or the accuracy we are looking for. We will try to balance our equipment capabilities; versatility and user friendly attributes to deploy a needed, yet very useful high-quality reusable rocket.

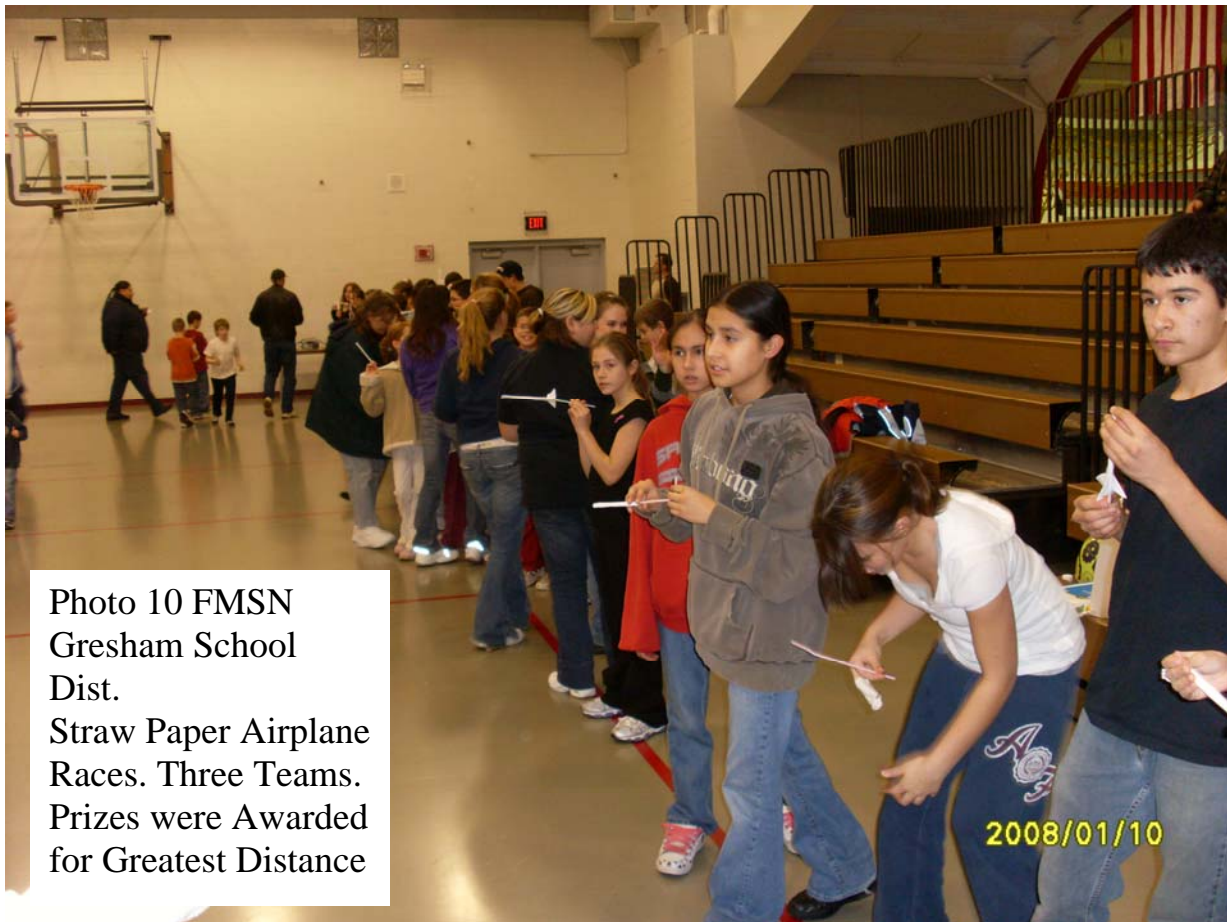


Photo 10 FMSN
Gresham School
Dist.
Straw Paper Airplane
Races. Three Teams.
Prizes were Awarded
for Greatest Distance



NAR OFFICIAL CERTIFICATION LABORATORY

HIGH POWER ROCKET ENGINE TESTING REPORT

Manufacturer and Type: AMW L1300

Effective Dates: NAR Certification: 4/1/04

Certified Total Impulse (N-Sec): 2675

Delay Times: Plugged

Propellant Type: Blue Baboon

Propellant Mass (GM): 1314

Casing Diameter (MM): 54

Casing Length (MM): 728

----- STATIC TEST DATA -----

Number Tested: 3

Casing Date Codes: None

Date Tested: 3/27/04

Test Temp (°c): 17

Elevation (FT): 200

Total Impulse (N-Sec): 2672.02

std. deviation: 3.96

Peak Thrust (Newtons): 1586.74

std. deviation: 11.78

Burn Time (Seconds): 2.06

std. deviation: 0.05

Casing Burnt Mass (GM): 1201.2

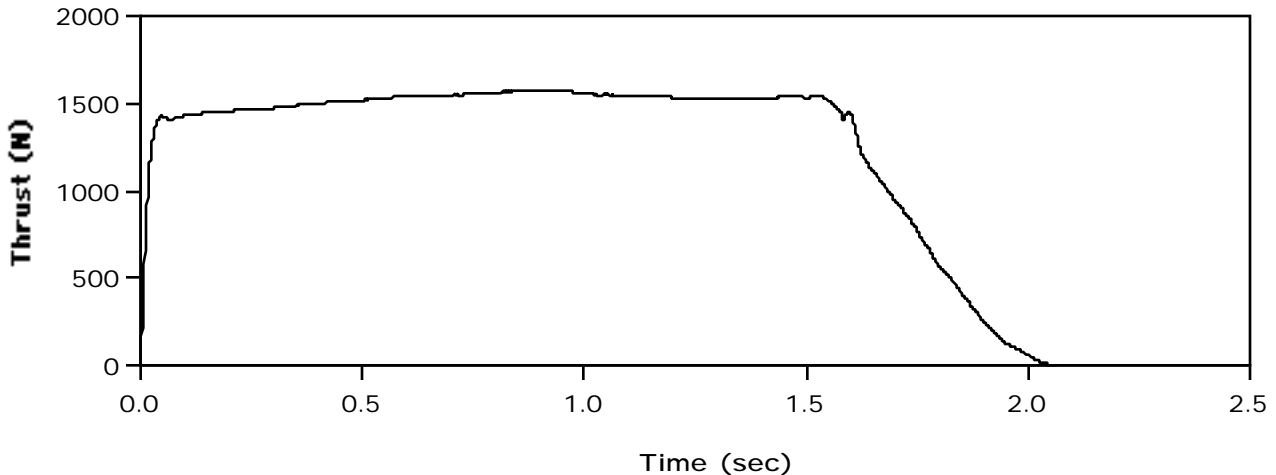
Max Casing External Temp (°c): under 200

Delay Time (sec)	Plugged
Initial Mass (gm)	2545.4
Avg. Measured Delay	None

Remarks:

Uses the 54-2550 case and produces about 10 to 15 sec of smoke

Typical Thrust - Time Curve:



John Kane
NAR S&T Committee Chairman

; AMW L1300 RASP.ENG file made from NAR published data
 ; File produced April 19, 2004
 ; The total impulse, peak thrust, average thrust and burn time are
 ; the same as the averaged static test data on the NAR web site in
 ; the certification file. The curve drawn with these data points is as
 ; close to the certification curve as can be with such a limited
 ; number of points (32) allowed with wRASP up to v1.6.

L1300	54	728	P	1.314	2.5454	AMW
0.014	710.467					
0.025	1247.640					
0.039	1384.132					
0.053	1447.829					
0.074	1420.530					
0.120	1447.829					
0.276	1474.116					
0.475	1519.614					
0.712	1555.001					
0.942	1586.740					
1.147	1562.078					
1.360	1534.779					
1.484	1551.967					
1.537	1551.967					
1.569	1497.370					
1.590	1406.376					
1.604	1451.873					
1.615	1333.580					
1.640	1168.778					
1.689	986.687					
1.753	767.749					
1.824	512.503					
1.891	275.512					
1.933	147.816					
1.987	74.737					
2.060	0.000					

