

# THE LEADING EDGE

Award Winning Newsletter of the Northern Illinois Rocketry Association,  
NAR Section #117

Volume 25, Number 1  
January/February 2002

## Club News and Notes

**NIRA Elections** – One of the most important parts of the January meeting (next to ‘Model of the Month’) is the election of club officers for the new year.

The newly elected officers for 2002 are:

President – Rick Gaff  
Vice President – Cole Arntzen  
Secretary/Treasurer – Ken Hutchinson  
RSO – David Wallis

Rick, Ken and David were reelected by unanimous acclamation in their unopposed races. Adam Elliot challenged Cole Arntzen for the position of Vice President. Cole squeaked by Adam to replace outgoing Vice President Pierre Miller (who didn’t run for reelection because he’s attending college in Michigan). Rick, Pierre, Ken and David all deserve a lot of kudos for doing an outstanding job as club officers last year.

**Illinois mailing to LEUP Holders** – At the January club meeting, several federal Low Explosive User Permit (LEUP) brought in packets from the Illinois Bureau of Mines (regulators of explosives in Illinois).

These packets describe the requirements for needing an Illinois explosives permit. The main point (from the letter) is “With very few exceptions ... 1.1, 1.2, 1.3, and 1.5 are regulated by the Department.”

Mark ‘Bunny’ Bundick, President of the NAR, pointed out at the meeting that almost all of the motors we use are classified as 1.4 and thus doesn’t need an Illinois permit. There are motor/material classified as 1.3 in some 54 mm and larger motors (check with the manufacturer or on their documentation for the proper classification).

Mark went on to suggest that if you do get such a packet and do only use motors classified as 1.4 that you reply to the letter and state that you don’t need to obtain a state permit because you don’t have or plan on using material classified as 1.1, 1.2, 1.3, or 1.5.

*(Club News and Notes continued on page 11)*

## New NIRA Web Site

Our web site has moved! The new home of NIRA on the web is [www.NIRA-rocketry.org](http://www.NIRA-rocketry.org). The new site will have all the great content of the old one plus a URL that is more easily explained to new people.

The website also has a new maintainer - our RSO David Wallis. As of the time I’m writing this, David has moved over the vast majority of the information from the old site to the new one. If you have any suggestions for the new site, please let him know. The email address for web-site matters is [webmaster@NIRA-rocketry.org](mailto:webmaster@NIRA-rocketry.org).

As some point in the near future, the old site should automatically redirect visitors to the new one, but be sure to update your bookmarks now.

For those who don’t know, our old site was hosted on a machine at the CLOUT project (see [www.clout.chi.il.us](http://www.clout.chi.il.us)). Many thanks to them for providing several years of free hosting.

Also thanks are always in order for our prior webmasters. Mark ‘Bunny’ Bundick built the first site on his personal CompuServe account. John Guzik moved it to the CLOUT machine (he was working with the project) and maintained it until he moved to San Diego when Steve Piette took the helm for several years. Thanks to all of you for your dedication over the years—and good luck to David!

## NIRA on TV

Bob Kaplow was contacted by the producers of “UP N Running” to let him know that the segment they shot at our October launch is going to be aired.

It will be broadcast by the local UPN station, WPWR Channel 50, on Sunday January 27th at 7:30 am.

If it turns out to be a normal show segment, it should last 5 to 10 minutes. Be sure to tape it - you might be a TV star!

## Field Search - Help Needed!

We’re at it again – looking for a new flying field! The DuPage Forest Preserve has told NIRA that they’re planning on using our current flying field at Greene Valley for dog runs.

They did indicate that they are willing to look at the other forest preserve sites with us for a field.

A committee was selected at the January meeting to find a new site, either in a forest preserve or an entirely new site. They can use all of our help in this search, however.

If you know of a possible site somewhere in the general Chicago area that’s suitable, please let either Rick Gaff, David Wallis or Mark Bundick know about it. Although there are advantages of flying at a forest preserve, any great site is welcome.

## Winter Activities

### February - Adler Planetarium

1300 South Lake Shore Drive,  
Chicago, IL 60605  
(312) 922-STAR [(312) 922-7827]  
<http://www.adlerplanetarium.org>

February 18th, 2002 - 10:00 to ?

Rather than filling up the winter with building sessions, NIRA’s decided to go on another informal outing in February. We’ll meet up by the main ticket counter at 10:00 am and then wander inside to decide what to do.

Don’t miss out - this will be our last winter activity of the season since we’re trying to get an early start on the season with a launch in March!

Prices:	Admission + 1 show	Admission + 2 shows
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### Adults

General Public	\$13.00	\$16.00
Chicago Residents	\$11.00	\$14.00

### Kids (ages 4-17)

General Public	\$11.00	\$14.00
Chicago Residents	\$10.00	\$13.00

### Seniors (65 & over)

General Public	\$12.00	\$15.00
Chicago Residents	\$10.00	\$13.00



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### NIRA Officers

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Secretary/Treasurer – Ken Hutchinson  
RSO – David Wallis

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THE LEADING EDGE is published bimonthly by and for members of the Northern Illinois Rocketry Association (NIRA), NAR Section #117, and is dedicated to the idea that Sport Rocketry is FUN!

Articles, plans, photos, other newsletters, and news items of interest should be sent to:

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Photos will be returned, other material returned upon requested.

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Send membership applications (dues: \$6 per youth, \$8 per adult, \$12 per family, including a six issue subscription to the Leading Edge), non-member subscriptions (\$10 per six issues), and change of address notifications to:

Ken Hutchinson  
82 Talcott Avenue  
Crystal Lake, IL 60014-4541

NIRA web site: <http://www.NIRA-rocketry.org>

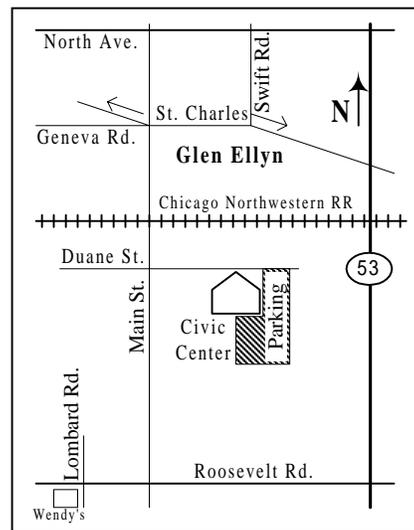
NIRA InfoLine: (630) 830-1587



## CLUB MEETING DATES

All meetings start at 7:30 pm. Bring a model for 'Model of the Month.' We always need volunteers for pre-meeting lectures, contact Rick Gaff if you want to schedule a date. The location is usually the Glen Ellyn Civic Center, 535 Duane Street (check the board in the lobby for the room number).

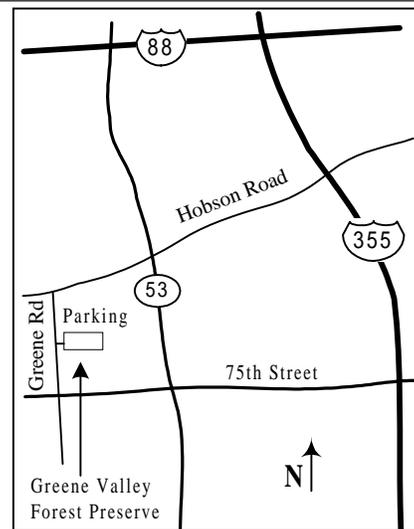
February 1  
March 1  
April 5  
May 3  
June 7  
July 5  
August 2  
September (time and/or place to be determined)



## CLUB LAUNCH DATES

Launches are BYOL (bring your own launcher). The location for our launches is the Greene Valley Forest Preserve (see map at right). Call the NIRA infoline for pre-launch information: 630-830-1587.

February 17 - Adler Planetarium trip (see page 1 for details)  
March 24 - Greene Valley Forest Preserve (note: this launch is on the **Fourth Sunday**)  
April 21 - Greene Valley Forest Preserve  
May 19 - Greene Valley Forest Preserve  
June 15-16 - Midwest Regional Fun Fly (location: To Be Determined)  
July 21, 2002 - Greene Valley Forest Preserve  
August 18, 2002 - Greene Valley Forest Preserve



**Model of the Month Winners!** (photos by Jeff Pleimling)

**December** – David Wallis poses with his L2 certification rocket - a 2.5X upscale of his son Alex's LOC 'Lil Nuke' called "Big Nuke." There were no youth entries.

**January** – Mark Soppet holds his scratch built copy of the Estes Night Hawk glider while Alex Wallis displays his Estes Fat Boy.

**Last Official Club Launch of 2001 - November 18th**  
by Rick Kramer

226 Total Flights, which is not bad for a cloudy overcast day in mid-November. Light drizzle began about 3:00 P.M. but ended around 3:25. A few fliers packed up their equipment and left early. Those of us who are true blue die-hard rocketeers, threw tarps over our rockets and stayed and flew until almost sundown. The most unusual thing about this launch was the lack of composite E, F, and G motors being flown compared to previous monthly launches. The Aero-tech factory fire obviously had a lot more to do with this situation than a few raindrops on launch day. A few of the memorable mid-power flights were: Bob Kaplow flying the new LOC Precision V-2 kit on an F-52 reload. My Ultimately Tubular on an Econojet G-35, which I came close to losing as it drifted east and landed just short of the tree line at the river. The tall dead weeds were tough to walk through without

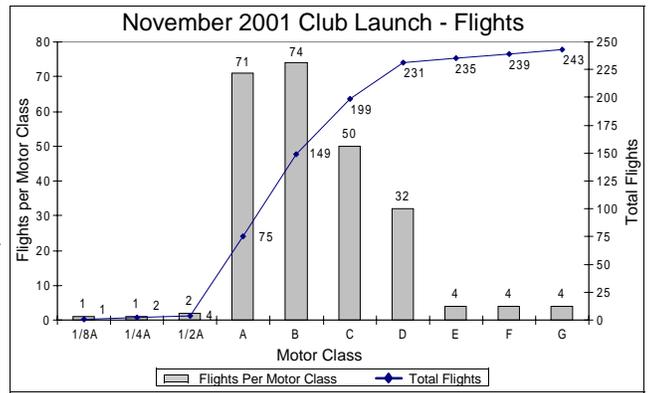
tripping and falling. I also launched a new spool rocket (E-Spoolie) on an Estes E-9 which surprised me with its quickness off the pad and straight as an arrow flight. It was made from a plastic spool that was used to hold loudspeaker wire and just happened to have a 24-millimeter core.

**Prolific fliers were:**

Rick Kramer	17
Hojec Family	15
Dan Cordes	9
Jonathan Charboneau	9

**Rocket Type flown:**

2 Stage	9
Cluster	1
R/C Glider	1
Helicopters	2
Spools	4
UFO's	15



A few Cato's, 3 Lawn Darts, 2 Land Sharks, And a Rocket in a Tall Tree. (Sung to the tune of "The Twelve Days of Christmas.")

Happy New Year to everyone and a great 2002 Flying Season! 🚀



(from L to R) A couple of Hojeks prepare for launch, two kids and their rockets, Tom Pastrick and Adam Elliott prepare a Bomarc (Rick Gaff photos)

**The December Outing: Museum of Science and Industry**  
by Jeff Pleimling

This year instead of a holiday party NIRA decided to have an outing as the December club activity. Bob Kaplow suggested a visit to the Museum of Science and Industry since they were showing the Robert Lesser Collection of Robots and Space Toys. This collection of over 200 toys took 20 year to amass.

The group from NIRA met up at 10:00 by the ticket counter. Attendance was a bit light, with a total of 12 members & family making an appearance by the time I had to leave.

First stop was the highly anticipated toy exhibit. There was a large variety of toys presented; most of them seems to be Japanese tin toys (remember when 'Made in Japan' meant 'cheap?') displayed in sets of ground vehicles, robots and

space ships. There was also the prop spaceship used in 'The Day the Earth Stood Still' as well as a reproduction of the model time machine used in George Pal's 'The Time Machine.' Among the more eclectic toys were a British Mechanno set (like an Erector set) and a Coke can toy that I though might have been inspired by R2-D2 – except that the sign indicated it was from the 1960's!

After the toys, we visited the airplane, general science and other areas. Unfortunately, the model train layout wasn't operating – the kids (and several adults) were disappointed. Then we moved to the Henry Crown Space Center.

The center (like most of the Museum) hasn't changed much in the past few years. There's still Scott Carpenter's Mercury capsule, the Apollo 8 Command Module and the Lunar Module used for astronaut training.

After the Space Center some of us had to leave but the rest of the crew continued to roam around the Museum until closing - including a trip down into the coal mine.

Although it was a sparsely attended outing, those who showed up had a great time. See you at the Adler Planetarium in February! 🚀



Robbie the Robot toys along with plenty of imitators. (more photos on back cover) (Jeff Pleimling photo)

**NIRA Gets Badges!**  
by David Wallis

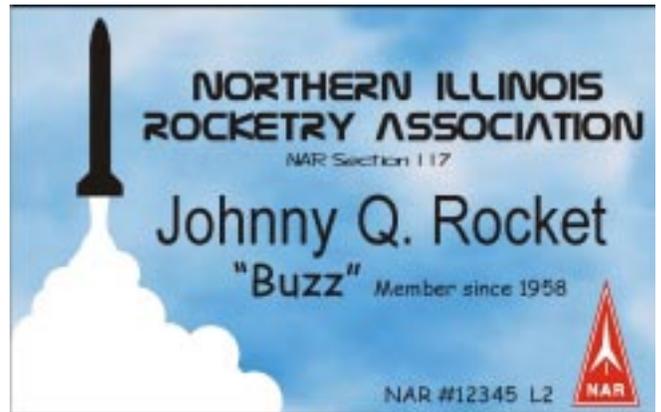
After several months of looking at sample layouts and debating fonts, colors and backgrounds, NIRA has finally decided on a new membership badge! The design selected at the January club meeting is shown here.

The badges, which are optional, will be printed on solid, heavy plastic badge stock with permanent ink, not paper in a flimsy sleeve or a laminated pouch. They are extremely sturdy, and should last for many years with a little care. Best of all, if you buy them now, we can get a quantity discount price of \$1.50 per badge, as long as we get order at least 80 badges. The price for subsequent orders (new members, replacements, etc) will be about \$3.00 each. Got a family membership? Be sure to get a badge for everyone in your family! Please add \$1.50 for each order (not each badge) for postage/envelopes/administration costs.

The badge will prominently display your name, the year you joined NIRA, and, optionally, your nickname, NAR member number and certification level. Also included will be either a neck lanyard or pocket clip (we haven't determined which yet).

Our group order will be placed on February 15. If you want to get a membership badge and take advantage of the discounted price, you need to act now! Fill out the order form below, and mail it with your payment (check or money order) to the address on the form. Orders received after February 14 will be returned, and will have to be re-submitted at the full price. Once the badges are delivered, they'll be mailed to you.

If you have any questions, please contact David Wallis either by email at wallis@walc.com or by telephone at 630-778-0448.



**NIRA Badge Order Form**

Mail completed form, with payment (check or money order payable to NIRA) to:

NIRA Badges  
c/o David Wallis  
500 West Gartner Road  
Naperville, IL 60540

Your name: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Phone number: \_\_\_\_\_ Email: \_\_\_\_\_

Name (as it is to appear on the badge)	Nickname	Member Since	NAR Number	Cert Level

Total # of badges:  x \$1.50 = \$  + \$1.50 = \$

**Press Release: New AeroTech Propellant Facility Site Selected**  
from www.aerotech-rocketry.com

AeroTech, Inc. is truly pleased to announce site selection for their new propellant manufacturing facility. This will allow for resumption of motor availability in time for the spring flying season and in support of the many Level 1, 2 and 3 projects that are currently in progress.

Located in Cedar City, Utah the 5,000 sq. ft. building will house propellant manufacturing, packaging and shipping for the full line of AeroTech advanced solid fuel composite rocket motors and reload kits.

AeroTech was initially drawn to this location by its proximity to the main ammonium perchlorate supplier and was very pleased with the support shown by local governmental entities. This support was instrumental in making the final decision.

The project has been given official approval by Cedar City officials. Engineering and construction

plans for this larger, more advanced facility are being completed. Move-in is expected to occur in late February with production to begin shortly afterwards.

Motor production is planned to begin in March with 28 of the most popular Hobby and Easy Access™ motors in 29mm and 38mm sizes. The new F21 (fits 24mm "E" kits) is also planned in the initial production run. Delivery of Restricted Access™ motors is scheduled to begin in early April. The sequence of specific motor releases will be provided before the end of January.

Corporate headquarters and rocket kit manufacturing will remain in Las Vegas.

AeroTech, Inc. would like to thank all of its customers for their support over the last three months and is looking forward to meeting their rocketry needs in 2002 and beyond.

Any questions regarding this press release may be directed to Mike Martens at mmartens@aerotech-rocketry.com or he can be contacted at 702-641-5988.

## Rocket Math 6: Altitude Tracking Part II – Two Station Tracking

© 2001, Norman Dziedzic Jr. (NAR 72426)

In Rocket Math 6 Part I (Sep/Oct 2000 Leading Edge), we covered the single station tracking method for determining how high a rocket has flown. In this Rocket Math, we'll explore the two station tracking method.

This is the tracking method used by the National Association of Rocketry (N.A.R.) for determining altitudes in competition and in general is immune to the non-vertical flight errors which plague single station tracking.

### Tea for Two

As the name suggests, two trackers are required for this tracking method. The two trackers are positioned a set distance apart on a baseline as seen in Figure 1. When the rocket is launched, the trackers follow the flight and zero in on the apogee using a device called a Theodolite (See Figure 2). This device allow the trackers to measure the angle in the plane of the ground and the angle of elevation at which they observed the model's apogee.

The layout of the baseline deserves a little discussion as it can make or break a tracking effort especially over the length of a day long launch. First, the baseline is spaced away from the launch area so that angles measured in the ground plane (azimuth angles) are not near zero. Referring back to the single station article, tracker errors were greatly magnified when elevation angles were near 0 or 90 degrees. The same is true for angles measured in two station tracking. If the baseline were in line with the launch area, flights which are close to straight up would generate almost no azimuth angle.

The baseline usually runs east/west and is offset north or south of the launch pad area to minimize the effect of the sun blinding the trackers. If the line was run north/south, flights veering east in the morning and west in the afternoon would be flying directly into the sun and be virtually impossible to track. Variations should be made to account for local conditions include prevailing winds to avoid trackers looking into the sun.

### Back on Track

So, the theodolites are located on either end of the baseline and set up so that the azimuth and

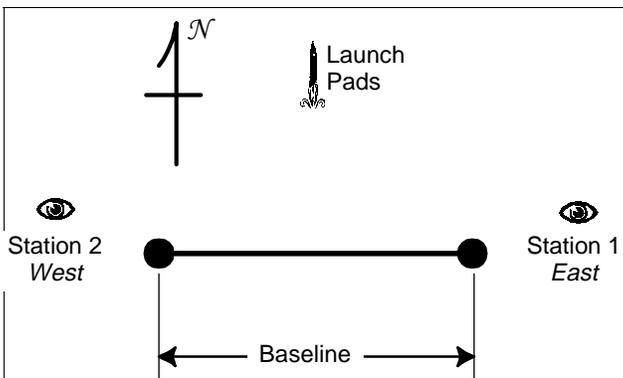


Figure 1: Tracker Layout

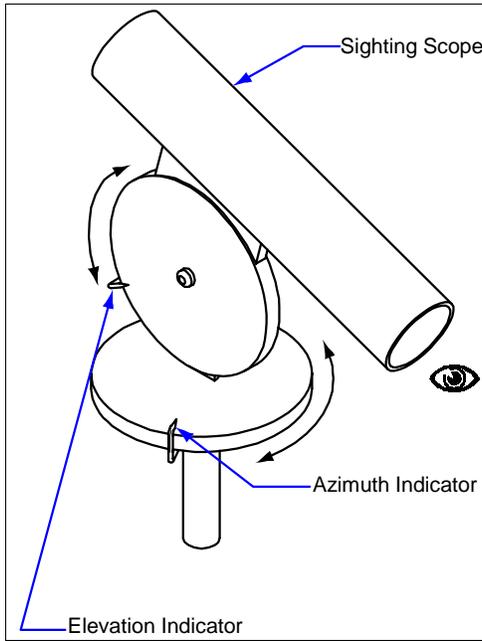


Figure 2: The Theodolite

elevation readouts point to zero when the theodolites are pointed directly at each other. Then the trackers follow the flight and lock in their theodolites at apogee or ejection (which is easier to see and synchronize between the trackers). The next step, called *data reduction*, is where the math comes into play to turn these 4 angle readings (and the known length of the baseline) into an altitude.

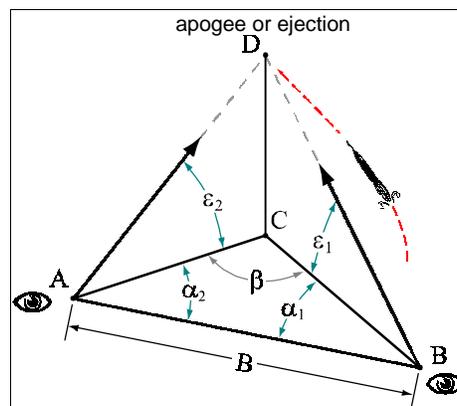


Figure 3: Triangulation Layout

### It's Greek to Me

Figure 3. shows the measured angles on a diagram of the tracking field. As touted, in previous Rocket Math articles, don't let the greek symbols bog you down, they are just there to hold a place for the angles until we actually take a reading. They also allow us to generate equations which can later be applied to any set of measurements we take.

The azimuth (or ground plane) angles are given by  $\alpha_1$  and  $\alpha_2$  (*alpha one and alpha two*) and the elevations by  $\epsilon_1$  and  $\epsilon_2$  (*epsilon one and epsilon two*). The angle at

the back of triangle ABC (*the triangle defined by traversing from point A to B to C and back to A*) is given by  $\beta$ . Note that the labels *east* and *west* have been replaced by 1 and 2 to save space and make the equations easier to read.

Let's focus in on triangle ABC which lies in the ground plane. First we'll calculate angle  $\beta$  from the fact that the sum of all of the angles for any triangle must add up to  $180^\circ$ . So angle  $\beta$  is given by:

$$\frac{A}{\sin \alpha} = \frac{B}{\sin \beta} = \frac{C}{\sin \gamma}$$

$$\beta = 180 - (\alpha_1 - \alpha_2) \quad [1]$$

To move on, we need to find the lengths of the sides of triangle ABC and to do this we need to use another trick brought up in the single station tracking article: The Law of Sines as seen in Figure 4.

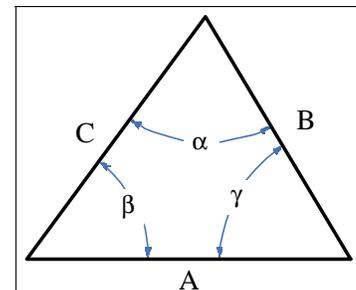


Figure 4: The Law of Sines

Remember, that we know the length of one side already; the baseline (B) which we set when we laid out the field. Also, from our tracking azimuth angles and equation [1] we know all of the angles.

Let's plug the length of side AC into the law of sines and re-arrange to get equation [2]:

$$\frac{AC}{\sin \alpha_1} = \frac{B}{\sin \beta}$$

$$AC = \frac{B \sin \alpha_1}{\sin \beta} \quad [2]$$

Similarly, we can find the length of side BC as follows:

$$BC = \frac{B \sin \alpha_2}{\sin \beta} \quad [3]$$

Now lets look at the angle formed by the points BCD as seen shaded in Figure 5.

The corner of this triangle at point C is a 90 degree corner making this a *right triangle*. Inspecting this triangle we see that the length from C to D is the altitude we seek and the length from B to C is the one we just calculated. The ratio of CD to BC is a definition for the tangent trig function for angle  $\epsilon_1$ . So:

$$\tan(\epsilon_1) = \frac{CD}{BC}$$

Or... re-arranging gives:

(Rocket Math 6: Part II continued on page 9)

# LITTLE JOHN

Semi-scale model of the U.S. Army's smallest nuclear missile

by Mark Kotolski (NAR 35707, TRA 3609), Plan #062299

Redrawn by Jeff Pleimling

## Parts List:

- A. LOC PNC-2.14 Nose Cone
- B. LOC BT-2.14 x18" Body Tube
- C. LOC MMT-1.14 x 5" Motor Tube
- D. LOC CR-2.14 Centering Ring (2 needed)
- E. LOC LL-25, 4" long Launch Lug
- F. LOC SCM-2 Shock Cord Mount
- G. LOC LP-18 Parachute
- H. SC-375 Shock Cord
- I. 3/32" Plywood Fins (4 needed)

## Specifications:

Length: 27.5 inches

Diameter: 2.26"

Weight: 14.88 Ounces (prototype model)

CP: 20 inches from tip of nose

## Recommended Motors:

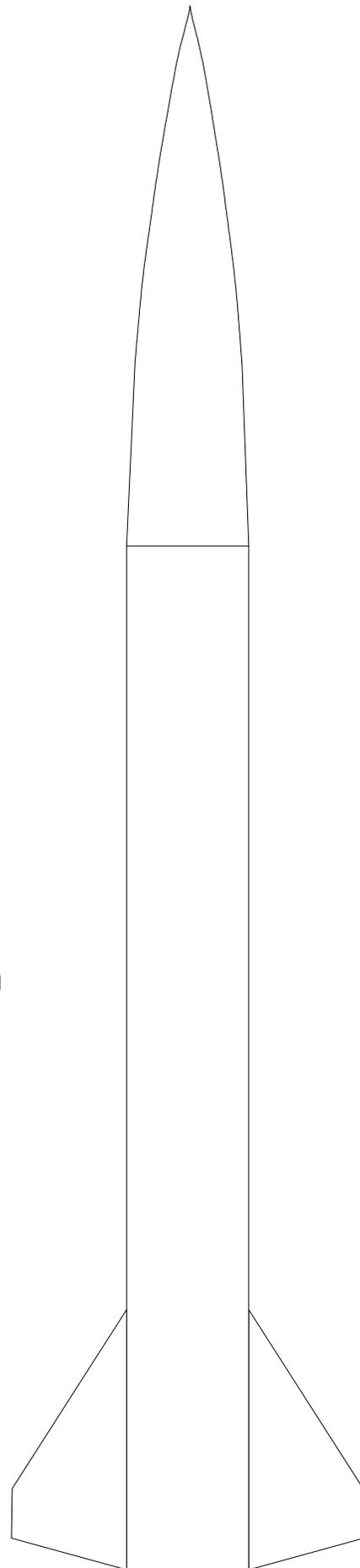
E23-5t	F20-7w	F25-9w	F40-10w	F50-9t
F52-8t	F62-9ds	G25-10w	G40-10w	G54-Mw
G64-10w	G70-10ds	G80-10t	G104-Mt	G125-10t

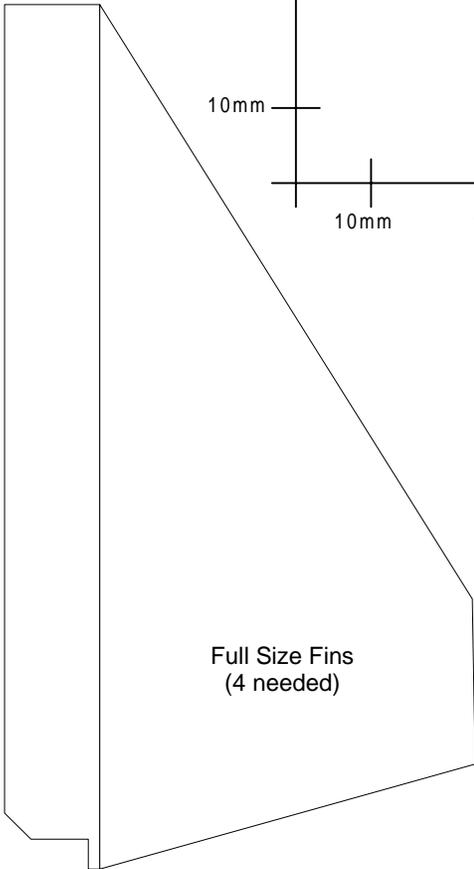
## Construction:

- Mark the body tube for four fin lines and a launch lug line. Extend the fin lines about 6" and the launch lug line the length of the tube.
- Prepare the fine lines for dado style fine slots and then cut the fin slots. The slots are 3/32" wide and 4 7/16" long. (Dado slots, for those who don't know, go to the end of the tube.)
- Assemble the motor mount as shown in the full size diagram. The forward ring is epoxied in place 1/4" from the end of the motor tube. The aft ring is epoxied flush with the other end of the motor tube.
- Epoxy the motor mount into the body tube. Position the mount so the aft ring is flush with the end of the body tube. Use rubber bands or tape to keep the slotted ends of the tube in contact with the aft ring until the epoxy cures.
- Cut 4 fins from 3/32" plywood. Shape the edges as desired. Test fit the fins in the slots and trim the slots if necessary.
- Apply epoxy to the fin tabs and insert the fins through the slots. Be sure the fins are positioned straight before the epoxy sets.
- Glue the launch lug in place on the launch lug line. Position the lug so the rear of the lug is about 6" from the rear of the tube.
- Apply epoxy fillets to all fin/tube and launch lug/tube joints.
- Install the LOC shock cord mount as directed in the directions included in the package.
- Attach the shock cord to the nose cone and the shock cord mount.
- Attach the parachute to the shock cord about 3" below the nose cone.

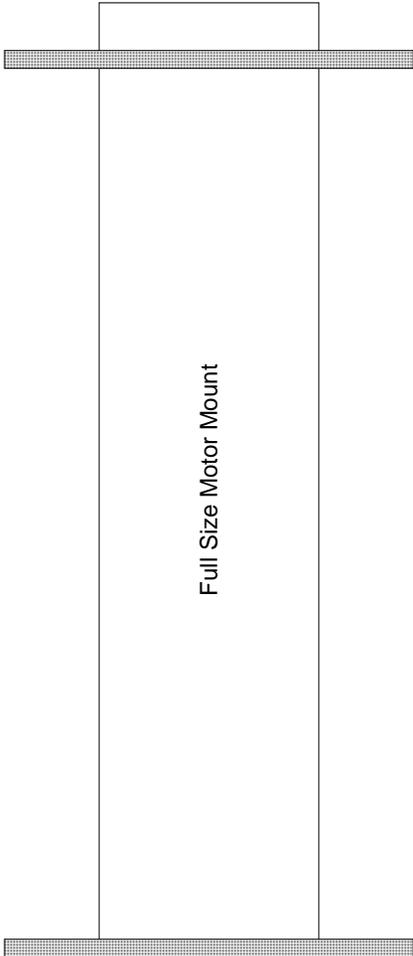
## Finishing:

- Fill and seal the grain of the wood using your favorite method.
- The paint scheme for the Little John is very simple. The model is olive drab overall. The lettering is white in standard block letters 1" high. The lettering, U.S.ARMY is centered between the front of the fins and the front of the body tube. Arial Black, a Windows font, is a close approximation of the real font (use 100 pt, 90% spacing).
- The two body section lines were done with an extra-fine black paint marker. The forward band is placed 2 1/2" from the front of the tube. The aft band is between the fins, placed 1 7/8" from the rear of the tube.
- Be sure to balance the model before flight. The CP was calculated at a position 20" from the tip of the nose cone. The CG should then be placed 17 3/4" from the tip of the nose cone. With a motor installed, the model should balance at, or forward of, the 17 3/4" point. Add a mixture of lead shot and epoxy inside the nose cone to balance.
- Fly Safe!



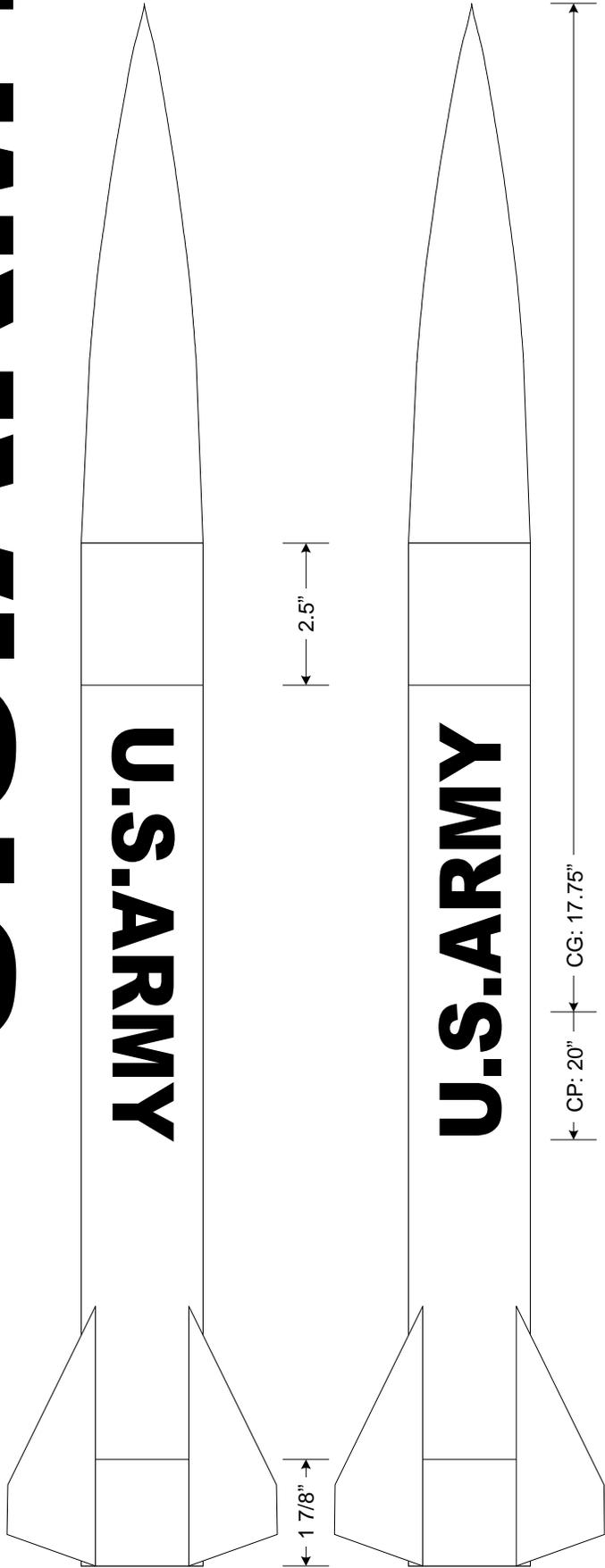


Full Size Fins  
(4 needed)



Full Size Lettering (using Arial Black, 100 pt)

# U.S.-ARMY



## Space Launch Report for November-December 2001

by Tim Johnson

### Year in Review

November-December's eight flights brought 2001's world space launch totals to 56 successes in 59 attempts, fewest since 1963 and 30% less than recent annual results. A tight commercial launch market was largely responsible for the decline.



The International Space Station as seen by STS-108 (NASA photo)

International Space Station (ISS) support accounted for 13 launches - six by NASA's space shuttle fleet and seven by Russia's venerable Soyuz booster. Four three-person crews continuously inhabited the station during the year. Thirty-five others visited the station, carried by the shuttles and by two Soyuz "taxi missions," including, most famously, Dennis Tito, the first self-paid "space tourist." ISS grew with the addition of Canadarm-2, of NASA's Destiny and Quest modules, and of Russia's Pirs docking module. By year's end, however, NASA had slashed future ISS plans, had cut the shuttle flight rate, and was thinking about mothballing orbiter Columbia. Russia's TsSKB Progress Soyuz/Molniya booster was the busiest launch vehicle, with 11 launches. The 2.5 stage Soyuz booster flew nine times from Baikonur, with the Soyuz-U version handling seven flights and the newly upgraded Soyuz-FG variant two flights. The 3.5 stage Molniya-M flew twice from Plestesk.

One of the Soyuz-U rockets launched Progress M1-5, which docked with and then, on March 23rd, deorbited Russia's history making 15 year-old Mir station. Boeing's Delta had a typical year with seven launches. The versatile rocket boosted two military, one commercial, and four NASA missions, including the successful Mars Odyssey orbiter. Delta flew five times from Canaveral and twice from Vandenberg.

Space Shuttle, Ariane 4, and Proton flew six times apiece. Both Shuttle and Ariane 4 flew for the 107th time during the year. Krunichev's Proton missions included the first by upgraded Proton-M/Briz-M.

Lockheed Martin's Atlas IIA flew four times, including one launch from Vandenberg. The company also launched three Titan 4B rockets. Only a handful of these early ICBM descendants remain. Russian-powered boosters will soon

replace them.

Six Ukrainian rockets manufactured by NPO Yuzhnoe flew during 2001. Sea Launch used two Zenit 3SL/DMSL models to orbit commercial satellites from its floating Odyssey platform. A Zenit 2 launched a Russian military satellite from Plestesk. One Tsyklon-2 and two Tsyklon-3 rockets also boosted milsats from Baikonur and Plestesk, respectively. Ariane 5G flew twice for Arianespace, but Ariane 510's second stage engine failed during July's V142 mission, stranding two satellites short of geosynchronous transfer orbit (GTO). It was the third Ariane 5G failure in ten flights.

An Orbital Sciences Taurus 2110 failed to reach orbit after a September launch from Vandenberg when a second stage thrust vector actuator momentarily stuck at staging. It was the first Taurus failure in six attempts.

India's maiden GSLV mission was almost successful in April, but the vehicle's Russian-built cryogenic third stage shut down 12 seconds early, leaving G-Sat 1 400 km short of GTO apogee. India recovered with a successful PSLV launch in October.

Five other launchers; H-2A, Kosmos 3M, Start 1, CZ-2F, and Athena 1; each flew once during the year. After years of delay, Japan's H-2A managed a completely successful maiden flight in August. China's CZ-2F orbited the second Shenzhou spacecraft on an uncrewed test in January on what proved to be that country's only space flight of 2001.

Boeing and Lockheed Martin shipped their initial EELV boosters to Cape Canaveral during 2001 for planned inaugural flights in early 2002.

Boeing's Delta IV was scheduled to fly first from SLC 37B, but Lockheed's Atlas V, already stacked on nearby SLC 41, seemed to be leading the first heat of the EELV space race. RLV efforts ended with NASA's cancellation of the X-33 and X-34 programs during 2001. Work continued on X-38, precursor to the still-planned ISS crew rescue vehicle.

### November-December

After more than a month without space launch activity, the second Soyuz-FG launched Progress M1-7 (NASA ISS-6P) on November 26 from Baikonur LC 1. The cargo craft docked with but was unable to firmly attach to ISS



Tsyklon 2 launches from Baikonur.

until a December 3rd cosmonaut spacewalk removed a stray O-ring from the docking port. The last Ariane 44LP variant launched Direct TV-4S into GTO from Kourou ELA-2 on November 27. It was the 145th flight of an Ariane launch vehicle.

A Proton-K/DM2 put three Uragan ("Hurricane") satellites into circular 19,000 km orbits from Baikonur on December 1. Uragan's are Russia's GPS navsat equivalent. Orbiter Endeavour lifted off from Kennedy Space Center

LC39B on December 5 with the three-member ISS Expedition 4 crew, four other crewmembers, and tons of supplies in the Raffaello logistics module. The shuttle, flying mission STS-108/ISS-UF-1, landed at KSC on December 17 with the Expedition 3 crew.

Delta 289, a 7920-10 model and the 100th Delta II, lifted off from Vandenberg SLC 2W on December 7. Delta put the NASA/CNES JASON 1 and NASA TIMED spacecraft into polar LEO. A Zenit-2 lifted off from Baikonur LC45 on December 10, carrying the earth science Meteor 3M-N1 spacecraft and four small piggyback experiments into a 1,000 km sun synchronous orbit.

A Tsyklon 2 launched Kosmos 2383 into LEO from Baikonur LC90 on December 21. The two-stage rocket boosted its sigint payload to just-orbital velocity. The spacecraft then fired its own engine to circularize the orbit. It was the 90th consecutive Tsyklon 2 success, best among active space launchers.

A three-stage Tsyklon 3 orbited six sats from Plestesk LC32 on December 28. The rocket's

S5M third stage fired twice to put Kosmos 2384-86 and Gonets D10-D12 into circular 1,400 km orbits.

### Space News

On December 13, NASA's X-38 prototype ISS crew rescue vehicle completed its highest, fastest, longest landing test flight at Edwards AFB. The tubby V131R glider was dropped from NASA's B-52 at 45,000 feet, flew for one minute, then descended to a lakebed landing beneath the world's largest parafoil.



The X-38 gliding after being released from NASA's B-52 (NASA photo)



The 100th Delta II lift off from Vandenberg (Boeing photo)



1963 photo of a Little John sitting on it's towed launcher (see plan on page 6&7).(U.S. Army Redstone Arsenal photo)

(Rocket Math 6: Part II continued from page 5)

$$CD = \tan(\epsilon_1) \cdot BC$$

and calling CD by  $Alt_1$  yields:

$$Alt_1 = \tan(\epsilon_1) \cdot BC \quad [4]$$

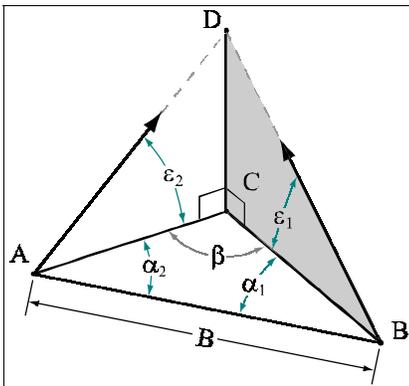


Figure 5: Triangle BCD

### Perfectly Average

In a perfect world this would be the end of our calculations since we have come up with an equation for the altitude. However, there is almost certainly some discrepancy between the readings taken by the two trackers.

To address this difference, triangle ACD is inspected in a manner similar to triangle BCD. This leads to a second equation for altitude:

$$Alt_2 = \tan(\epsilon_2) \cdot AC \quad [5]$$

In order to come up with a final altitude, the altitudes computed in equations [4] and [5] are averaged:

$$Altitude = \frac{Alt_1 - Alt_2}{2} \quad [6]$$

### Case Closed?

So we have an altitude but what if the two component altitudes differ greatly? How do you know if you can trust the average value?

An accepted procedure is to calculate the difference between the two readings as a percentage.

$$Err = \frac{Alt_1 - Alt_2}{Alt_1 + Alt_2} \cdot 100 \quad [7]$$

Then if this difference is less than or equal to 10% the averaged altitude is accepted as the actual altitude. If the error exceeds 10% the situation is referred to as a *Track Not Closed*.

The procedure just outlined is called the *Vertical Mid-Point Data Reduction* method. In it we first assumed the two tracker line of sights intersected. Then we used trigonometry along with the triangles formed by the tracking lines and baseline to determine the altitude.

Another form of data reduction is called the *Geodesic* method. This method starts by assuming that the tracker line of sights do not intersect. Then the shortest line connecting these skew lines is found with the calculated altitude being at the mid point of this line. This involves vector math and will probably end up the subject of its own Rocket Math column.

### The Big Square Dance

At large competitions such as NARAM where the number of flights is great and the number of trackers is plentiful (due to mandatory range

duty for competitors) you can use more trackers to improve the chances of getting a closed track.

Figure 6 shows a layout of 4 trackers in a square around the launch pads. In this setup, there are 6 possible baselines to use for calculating the altitude: the four sides of the square and the two diagonals.

All 6 altitudes are calculated and those that have an error of less than or equal to 10% are averaged to determine the actual altitude.

### Check - Double Check

If you want to perform some of your own calculations, here are a couple of examples for you to use to double check your work (based on a 300 m baseline).

$\alpha_1$	$\epsilon_1$	$\alpha_2$	$\epsilon_2$	Alt	Err
50	35	70	40	225	1.2%
66	41	30	32	152	13.5%

So, now you know how actual altitudes are calculated in competitions. If you want to try to track your own models, your best bet is to contact a club in your area to see if they have a set of theodolites which you can borrow. With a little

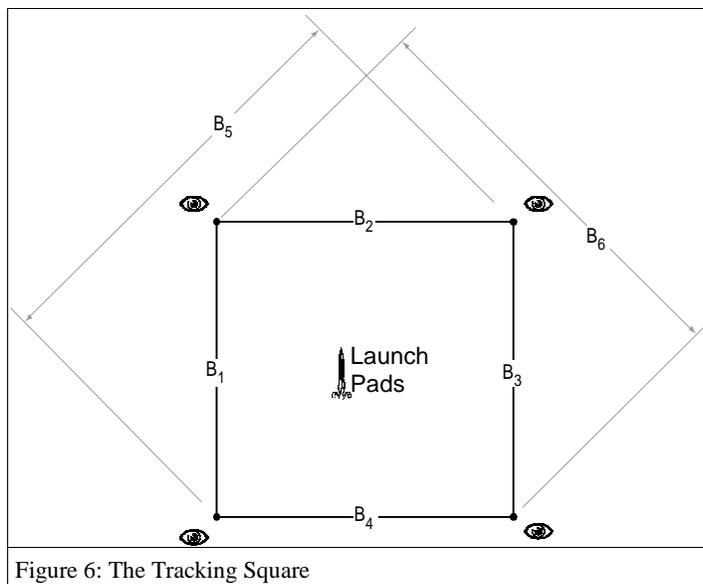


Figure 6: The Tracking Square

practice you can hone in on your models actual altitudes gain new insights into your own Rocket Science.

## Product Review – Plasti-Kote Automotive Lacquers

by David Wallis

I've been painting rockets for a number of years with a variety of rattle-can spray paints, and have been less than satisfied with all of them. Rustoleum and Krylon, both enamel paints, are readily available and come in lots of colors. However, in my experience, they both suffer from the same problems: they dry fairly slowly, and produce a soft finish that is susceptible to fingerprints for a considerable time after painting, and is easily dinged later on. Both also suffer from incompatibility problems with primers and clear coats, even within the same brand line, often resulting in fisheye and orange peel defects in the finished paint job. Enamel paints also don't stick well to the plastic used in nose cones.

As I was nearing completion of my Level 2 certification rocket, a scratch-built 2.5x upscale of the LOC/Precision 'Lil Nuke, my attention eventually turned toward the question of how I was going to paint it (I've intentionally ignored the issue of whether or not rockets should be painted at all!).

At about the same time, I was in my local Pep Boys auto parts store getting some parts



to fix one of my cars. On a lark, I stopped by the paint section to see what was there. I noticed a display of Plasti-Kote Candy Apple and Metal Flake paint. I love metal flake finishes, and the blue looked great, so I picked up a can of sandable primer, a couple cans of metallic blue, and a can of clear coat.

This line of paint is automotive lacquer, rather than enamel. I've always liked working with lacquer, because it's easy to apply, and yields a very smooth, shiny and hard finish. Lacquer dries quickly (typically, you can re-coat in about 10 minutes), and since the lacquer softens the previous layer of paint, you get a good bond between layers and don't usually have trouble with wrinkling like you do with enamel, especially when applying several coats in a short period of time. The only drawback to lacquer is the smell – it's not suitable for indoor use, but is ok in a garage with good ventilation or with a respirator.

My experience with the Plasti-Kote paint lived up to my expectations of a lacquer paint. It was easy to apply, and gave me a smooth glossy finish. The sandable primer covered well and sanded easily. It did not fill up the sandpaper too badly, nor did it ball up when sanded. The blue paint contained a lot of metal flakes, and flowed out

into a great looking metal flake finish. The clear coat covered well. I had no problems with compatibility between the primer, color and clear coats. Although I didn't do a lot of testing, I didn't notice any problems with the paint not adhering to the plastic nose cone. I wasn't surprised, since I usually wipe down plastic parts with lacquer thinner just before painting anyway, since I've found that it softens up the plastic and helps even enamel paint stick better.

As the saying goes, "The proof of the pudding is in the eating," and the quality of a rocket paint job is best judged by the way others react to it. At every launch I've taken my L2 rocket to, at least a couple people have said, "Wow – great paint job! What kind of paint did you use?" I know I'll be using the Plasti-Kote Candy Apple/Metal Flake paint again!

Although the product line is called, "Candy Apple/Metal Flake," the primer was labeled simply, "Sandable Primer," while the colored paints were labeled, "Competition Colors." According to the Plasti-Kote web site, however, they are considered part of the same product line.

The paints cost about \$3 - \$5 per can, which is comparable to Krylon and Rustoleum, but more expensive than, say, Wal Mart's store brand enamel. While it doesn't have the same selection of colors as the enamel brands, the candy apple paint is available in red, blue, burgundy and silver, while the metal flake is available in red, blue, green, burgundy and black. You should be able to find these paints at most auto parts stores that stock spray paint. 🛠️



David and son Alex with the upscaled 'Lil Nuke.

## Confused Stages – Stage 23

by Jonathan Charbonneau

"What kind of glue should I use?"

The above question has been cried by many a rocketeer, both beginner and experienced alike. It's even asked more than once by the same rocketeer while still working on the same rocket. Some people say to use white glue. Some say model airplane glue. Others swear by CA. Still others use epoxy. Feel bamboozled? This stage is for you.

To start with, no one kind of glue is best for all applications as each kind has its attributes, which follows.

**White Glue** (Elmer's Glue All/School Glue): This is commonly used by beginners. It's good for joints involving paper and/or wood but it doesn't work on plastic or fiberglass. It has a tendency to be runny and takes at least 10 minutes to set and an hour to cure (dry). It has no fumes nor is it flammable. Spills are easily cleaned up with water.

**Wood Glue** (Carpenter's glue, craft glue): This glue is usually yellow, sometimes brown. It is used for the same applications as white glue but

it's stronger and sets faster. It is more or less an improved version of white, practically speaking.

**Plastic Cement** (Testors): This glue is often called 'model airplane glue.' It is good for joining plastic to wood, paper or another plastic part. It takes 30 minutes to 2 hours to cure. It works by welding the plastic. Spills must be cleaned up immediately to avoid damage. Do **not** use as a substitute for wood glue because it works only on plastic. Also, **don't** breathe the fumes, **they're toxic**.

**Cyanoacrylate glue** (CA): This is commonly called superglue and comes in many brands and viscosities. It can be used wherever wood glue or plastic cement is called for. Always use hobby grade CA because it's better. Thin CA is great for tacking parts together. Medium CA is generally used and thick CA provides the strongest bond of the three. Cure times of the latter two can be accelerated by using accelerator (kicker) but is not recommended for thin CA. This glue is popular because it saves time due to its fast cure. If this is your glue of choice, **get some debonder**. You're going to need it. Sooner or later you'll get a finger stuck. Debonder will help you free it. Use ventilation, the fumes of CA are an irritant.

**Epoxy**: This is available in different cure times and always consists of two parts, resin and hardener. These have to be mixed in the proper amounts before using. Don't mix anymore than is needed at the moment because once mixed its working time is limited. Quick cure (5 minute) epoxy works very well on rockets up to "G" power. For "H" and above, use mid cure (15 minute) epoxy because it's stronger. Slow cure (30 minute) epoxy is the strongest and strongly recommended for rockets powered by "J" or larger engines. Epoxy will bond almost anything to almost anything.

**Hot Glue**: This type of glue comes in sticks. It is put into a glue gun that operates at high temperature (400+° F). Be very careful or severe burns may result. I personally don't recommend hot glue for this reason – never tried it.

### Superman's advice

1. Choose your glue wisely.
2. Know the capabilities and limitations of each glue.
3. Read and follow instructions and warnings carefully.
4. **Don't** use a substitute for epoxy. 🛠️

## Welcome to the Club!

Seth Avecilla, Dale Chrystof and Taylor Morreale have all joined NIRA in the past few months. Welcome to the club!

If you've joined recently and I somehow missed your name, please let me know! ✉

## Trustee Nominations Solicited from www.nar.org (11/14/01)

In accordance with the by-laws, the NAR has annual elections to fill three of the nine board positions. The three positions to be voted on in July 2002 will be for three-year terms.

If you wish to run for the board, or know someone you feel is qualified and will accept, the NAR is soliciting nominations. If you nominate someone other than yourself, you must include a letter from the nominee indicating his or her acceptance.

Nominees themselves should provide a resume and statement no longer than 300 words to be published with the ballot material. Be sure to include your name, address, and NAR number on your resume. By NAR policy, Sport Rocketry magazine will not publish any campaign-related material, either paid or unpaid. All nomination material (letters and resumes) must be received no later than March 1, 2002 by the NAR secretary. Send to:

George Rachor, NAR Secretary  
33380 NW Bagley Road  
Hillsboro, OR 97124 ✉

## Editor's Ranting and Ravings

Not a great name for a section, but this stuff isn't really news, just stuff you might find interesting

**Deadline for Next Issue** - the deadline is the NIRA meeting in March (the 1<sup>st</sup>). This is the normal deadline - the meeting day for the 'cover month.' If you're not done by then, let me know and I can work around it until you're finished.

If you have something ready before the deadline, please get it to me as soon as you can! The reason this issue is out only two weeks after the January meeting is because I received several articles well before the deadline.

**The Leading Edge needs Articles** - This should go without saying, but all of the articles for the Leading Edge are written by NIRA members. The newsletter needs technical articles, plans, kit reviews, **launch reports**, and whatever else you want to write about. There've been only a couple of launch reports in the past few issues even though we've had plenty of launches (club and youth group) and I'm sure some of you've attended non-NIRA launches that members would be interested in hearing about to know if they want to attend. If you have questions, or need

*(Club News and Notes continued from page 1)*

Mark is writing a letter to the state regulators to get some clarification on this matter and to start a productive working dialog with them.

**Reminder: March Launch** - At the repeated urgings of Tom Pastrick, NIRA has decided to try holding a launch in March 2002 instead of having a building session (or yet another outing).

Instead of being on our traditional third Sunday, the March launch will be on March 24th - the **fourth** Sunday. This will hopefully bring better (warmer & drier) weather.

### December Model of the Month contest -

David Wallis - Big Nuke (Adult Winner)  
Todd Bavery - BSD Horizon  
Greg Cisko - 'Star Spangled Banner' (Scratch)  
Jonathan Charbonneau - Estes Eliminator  
Pierre Miller - Ariane V (scratch)  
Martin Schrader - Holverson Silver Hawk  
Adam Elliott - D-80 (scratch)

### January Model of the Month contest -

Alex Wallis - Estes Fat Boy (Youth Winner)  
Mark Soppet - Cloned Estes Night Hawk (Adult Winner)  
Martin Schrader - Very heavily modified Quest Flat Cat ✉

## Public Missiles Has Moved!

Public Missiles recently moved to a new address and has new contact information:

Public Missiles Ltd.  
25140 Terra Industrial Dr.  
Chesterfield Twp., MI 48051

Phone: 1-586-421-1421  
Toll free: 1-888-PUBLIC-M (sales only)  
Fax: 1-586-421-1419 ✉

help, please contact me! I'm always willing to help someone who doesn't know where to start or when to stop.

**New membership option** - At the urging of several members, members can now elect to **not** get the Leading Edge mailed to them. The cost of the membership is the same as with newsletter.

This membership option is now on the renewal forms mailed out with the newsletter, but if you want to switch before then, please let NIRA's treasurer Ken Hutchinson know.

The Leading Edge is, as always, available through the NIRA web site as soon as it is mailed to members. At this point, the version on the web site isn't at the same resolution as the printed version but this will hopefully be changing in the near future (my schedule permitting).

**NIRA's Email List** - NIRA does have an email list where club information is sent out and where we talk about rockets. It's hosted on Yahoo's Yahoogroups and to join you can either send a blank email to nira-subscribe@yahoogroups.com or go to the list's web site at <http://groups.yahoo.com/group/nira> ✉

## NSL 2002 Waiver Approved

From: "Peter Riddell" <riddell@prodigy.net>  
Subject: [PR] NSL 2002 Waivers Approved  
Date: Tuesday, January 08, 2002 12:17 PM

GILBERT, AZ-The FAA waivers for NSL 2002 has been approved! The FAA has granted a waiver of 7500' MSL (the site is at about 1200' ASL), with call-in windows up to 12,000' MSL. This is same waiver that the Superstition Spacemodeling Society has operated with for the last several years at the Rainbow Valley site.

Of special interest is the possibility of night launches during the NSL weekend. The FAA waivers are effective until 9:00 PM local time, contingent upon approval by the local Traffic Control Center (TRACON). While approval is not guaranteed, the Superstition Spacemodeling Society has never had a night launch request turned down, so be ready for a night launch! Rules for night launches will be posted on the NSL 2002 Website.

In other news, the main motel has been selected for NSL 2002. The Crossroads Inn (formally the Comfort Inn of Goodyear) will be the main motel for event participants and exhibitors (vendors). Room Rates for participants will be \$45 per night. The rooms are Non Smoking with two queen sized beds or Smoking with two queen sized beds. Special rooms located pool-side will be available for exhibitors at a rate of \$50 per night.

For reservations, call (623) 932-9191. When making reservations, be sure to mention that you are participating the National Association of Rocketry NSL 2002 event to get the special rate. All reservations must be in by May 11th, 2002. Other accommodations are available, and can be found elsewhere on the NSL 2002 website. Please direct inquiries to the launch director, Peter Riddell, at riddell@prodigy.net. You can also call at (480) 497-1960. ✉

## Press Release: 2002 Extreme Projects Calendar for Sale

Extreme Rocketry is pleased to announce that it is now selling the new 2002 Extreme Projects calendar on its website. The calendars are in stock and now shipping! In December Rocket-Silo 2.0 had Rocketeer Media design a beautiful, full-color calendar for the year 2002.

The calendar features the biggest and most impressive rockets flown last year. Impressive photos from 13 rocket projects were supplied by Photos by Nadine with graphic design by RocketeerMedia (publishers of Extreme Rocketry magazine). The calendar may be ordered on the Extreme Rocketry website for \$14.95 plus shipping.

See [www.extremerocketry.com](http://www.extremerocketry.com) for details. ✉



Photos from the December Outing to the Museum of Science and Industry



Jeff Pleimling, Editor  
 245 Superior Circle  
 Bartlett, IL 60103-2029

**This may be your last newsletter! Check your label for the expiration date. If it says Membership Expired or Membership Expiring this will be your last newsletter!**