THE LEADING EDGE

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

Volume 26, Number 1 January/February 2003

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. Elected by unanimous acclamation, the 2000 officers are:

President – Terry House
Vice President – Cole Arntzen
Secretary/Treasurer – Ken Hutchinson
RSO – David Wallis

Terry House is our newly elected president, filling the office vacated by Rick Gaff. Rick had been president for several years and decided that it was time to turn the position over to someone new. Terry has a big job ahead of him but has the assistance of returning officers Cole, Ken and David.

Rick deserves everyone's thanks for all of his past efforts with the club. In addition to being President several different times, he's also been the Editor of the Leading Edge and helps run the range at almost every launch.

Winter Outings – Winter is when we do things other then launch rockets - like build them! There are two more indoor activities scheduled for this year:

February - Laser Tag - Marty Schrader is coordinating this, see his article to the right.

March - A building session at Bob Kaplow's house is tentatively set for March. There should be more information on our website or in the next issue.

Hybrid Ground Support – At the January meeting, Cole brought up the idea of NIRA having a set of ground support equipment to support launching hybrid motors (NO_2 tank, fill valves, etc).

While there was support for the idea, it was pointed out that just a limited number of club members would use the equipment and we only have 1 or 2 high power launches each year.

Rather then the club purchasing the equipment with money currently in the treasury, it was proposed that the people who wanted to use hybrids

*(**Club News and Notes** continued on page 7)*

Laser Tag—NIRA's February Outing

In February NIRA is having a Laser Tag party! We're still figuring out where to go and exactly what day/time. We need to get a consensus soon so that the facility can be reserved. We will also need to get a deposit put together.

Please contact Marty Schrader at (630) 588-0240 or email nobodyspecial@technologist.com if you are interested.

All laser tag facilities have the following:
- provisions for group dining
- smoke for the laser arena
- spare equipment in case of in-game failures
- pre-game instruction/ready room

These three laser tag joints are the closest to our meeting place in Glen Ellyn:

Chaser's, Aurora
- $14 per person, with 3/10 of a pizza and a can of pop
- Least expensive package overall
- 2 tag games & 2 Mech Warrior games (8 station network)
- 3 teams of 5 each per game
- Laser Blaster gear; most capable
- Most eager to please; most game types & options
- 2500 sg ft arena (smallest); simplest layout & obstructions
- Most advanced gear

Laser-X, Addison
- $15 per player up to 30; food included (pizza)
- Two hour party; two 20-minute games plus twelve game tokens for video/pinball games in lobby
- Intersphere gear; least capable
- Maximum of 3 teams in the arena
- Active obstructions that shoot back
- 6 second timeout per hit; every 10 tags, 10 second timeout
- Most hip ambience (looks like set of Half-Life)
- 6700 sq ft arena
- Best layout for accurate shooters & fire team play; sniping possible from upper level
- Oldest, least capable equipment; 10 pound rigs

Laser Quest, Downers Grove
- $435 package up to 30 players; no food, but pizza discounts [price is high for 20 people and okay for 30]
- Three 20 min sessions; 3 hour party
- Loud, loud, loud -- kids love it
- 8000 sq ft arena
- Largest and most complex layout; two levels; no sniping possible because of short line of sight
- Middle of range equipment capability

AeroTech Cedar City, Utah Facility Receives Certificate of Occupancy

AeroTech is pleased to announce that it has received a temporary Certificate of Occupancy (CO) for its new propellant and motor manufacturing facility in Cedar City, Utah from the Cedar City authorities. This CO allows AeroTech to store chemicals and begin manufacturing its rocket motor products immediately. The remaining unfinished construction tasks should be complete within the 30 day term of the temporary certificate.

AeroTech employees Joe Burger and Gary Rosenfield have been in Cedar City nearly full-time overseeing the final phases of facility construction and equipment installation. Recent accomplishments include applying NFPA placards to all hazardous materials rooms and bunkers, sealing the concrete floors in preparation for painting and the pouring of a concrete pathway leading from the Ammonium Perchlorate storage bunker to the main building. The attached photo shows a portion of the pathway prior to the concrete pour.

AeroTech expects to commence production in the new facility in one to two weeks, and first deliveries of motors and reload kits manufactured in Utah are now projected for mid-February.

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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!

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or emailed to leadingedge@pleimling.org
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:
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Crystal Lake, IL 60014-4541

Web site: http://www.NIRA-rocketry,org

Email list: http://groups.yahoo.com/group/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 7

March 7

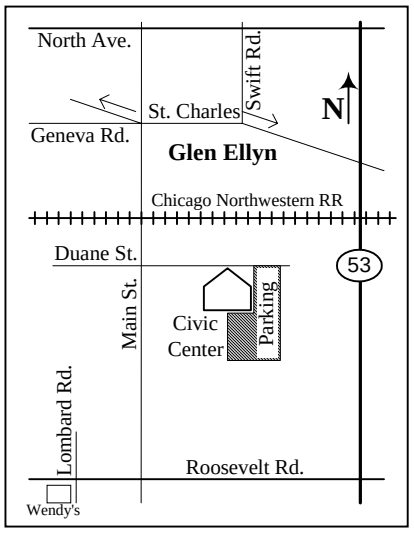
April 4

May 2

June 6

July 11

August 1



CLUB LAUNCH DATES

Launches are BYOL (bring your own launcher). Call the NIRA infoline for pre-launch information: 630-830-1587.

As the map shows, our new launch field is the East Branch Forest Preserve but the arrangement may not be permanent! **Please** call/check the infoline/website before coming!

April 20, 2003 - East Branch Forest Preserve

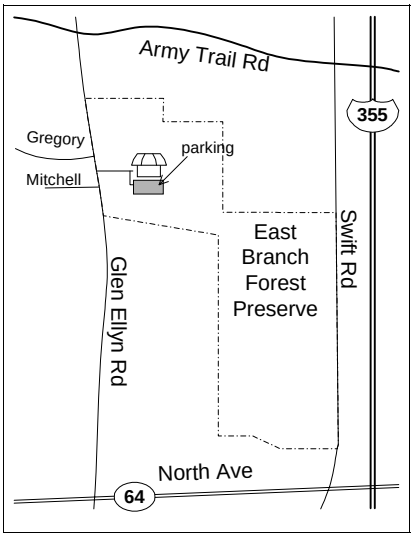
May 18, 2003 - East Branch Forest Preserve

June 14-15, 2003 - Midwest Regional Fun Fly (site TBD)

July 20, 2003 East Branch Forest Preserve

August 17, 2003 East Branch Forest Preserve

August 21, 2003 East Branch Forest Preserve



Model of the Month Winners! (Jeff Pleimling photos)

December – Marty Schrader's scratch built helicopter recovery rocket won the Adult category. There were no youth entries this month.

November – Kevin Keene won the Adult category with his Estes Echostar. He used this kit for the 8th grade rocket club he mentors. There were no youth entries again this month.

Review: Apogee SR-72 Darkbird
by Marty Schrader

Introduction
Apogee has a fun little 13 mm powered sport flyer here. I have always liked rear engine boost gliders, and this one is very much on the classic plan. Apogee added a few little twists to give this kit their own special flavor. Builders of other rear engine boost gliders will recognize everything here as pretty standard.

The designation is obviously a takeoff of the Lockheed SR-71 Blackbird. The layout of the model is like the SR-71 with decorative outboard engine pods and inward canted stabilizers. By changing the model's name Apogee doesn't have to pay Lockheed Martin their pound of flesh.

Apogee 'SR-72 Darkbird' Specifications:
Length: 35.6 cm (14.0")
Diameter: 18 mm (0.736")
Weight: 30.0 grams (1.05 oz)
Recovery Type: Glide with a streamer for power pod.
Recommended Rocket Motors: 1/2A3-2T (first flight), A3-4T, A10-3T, B7-6 (Apogee), C6-7 (Apogee)
Skill Level: 4 - Slightly Challenging
Price: $12.95

Components
The die cut balsa parts are okay, but not great. Everything needs a little trimming. As always, measure everything to be cut carefully before you touch anything with a knife. The resin hold down ring for the rear of the engine pod was too loose. Both the engine mount tube and airframe fit required considerable tuning. I was worried about some of the smaller components, so I used CA to harden all exposed body tube ends and the smaller fins. I also had to build my own cockpit canopy, since the one provided in the kit was not so great. This came as a bit of a surprise since I have used other Apogee card stock canopies to good effect.

Building
The kit's fascia card says this is a Skill Level 4 rocket. The instructions say Skill 3. Let me tell you – it's really a Skill 5.

The wings are assemblies composed of an inner section (three pieces), an outer section (two pieces), and an engine pod. Both inner and outer sections must be accurately assembled before the final wing assembly can be completed. The instructions say sand the wing parts together, but this only makes them the same – not necessarily right. You must measure and sand accordingly. It is important to make the root edges of the inner wing assemblies completely straight and the outer edge of these assemblies parallel to the root edge. After the wing sections are built they can be sanded together to make them the same.

Attaching the inner wing sections to the airframe is difficult to get right. The alignment along the very long wing root is quite difficult to sustain if one is using CA. White glue is a much better choice for the less experienced modeler. Attaching the engine pods is child's play after hassling with the inner wings. The outer wings and stabilizers go on easily and are easy to check by eye. The kit includes templates to use for alignment while assembling all this stuff.

The instructions call for CA to attach the elevon hinges and the elevon stops (which double as the rubber band hooks). CA makes for a real pain. The threat of gluing the elevons to the wings is very real. After the elevons are attached the stops/hooks must be mounted in the right place. You had better be able to get this right the first time or resort to white glue. My next one will be built using white glue for this purpose.

I made a few changes to the kit's plan. I chose a different streamer than what was included in the kit, mounting it at the balance point of the pod with an empty in it. (The instructions failed to mention this little trick, by the way.) The instructions call for the nice, lightweight Apogee nose cone to be stuffed with clay. I chose to use a plastic Estes cone which is longer, sleeker, heavier, and, I think, better looking. The Estes cone hangs less overall weight farther out the front for more effect. I mounted the rubber band hooks in the elevon centers instead of close to their edges. I worried about wind loading during boost, so I used one long launch lug instead of two short ones. I only used one centering ring in the front of the engine pod. The rest of the nose weight was a small piece of lead mounted as far forward as possible. This has less overall weight for the same effect. Additionally, I moved the entire engine pod a bit farther forward. My rocket has less engine sticking out the back. This shifts the entire CG forward a bit.

Finishing
My Darkbird got a treatment of Dupli-Color gray scratch filling primer. I found it hard to sand the smallest fins. Use light pressure on 400 or 600 grit. After priming and sanding I chose to use Model Master (Testor's) Titanium buffing metalizer lacquer instead of the recommended flat black. I like the way highlights show but the overall image is still rather dark.

The instructions say the completed rocket weighs 1.05 ounces. My measurements confirm this, within the limits of my scale.

Trimming
My glider flew fairly well on hand launches just as it was built. I knew that the real test would be from altitude, but my backyard hand launches proved that the glider wouldn't auger on its first flight. Trimming this glider requires sanding a tiny amount of balsa from the elevon stops, so trimming needs to be done very carefully.

Flying
Apogee recommends the 1/2A3-2T for the first flight, and that's what I used. My Darkbird went up somewhere between 100 and 200 feet or so, then kicked the engine pod. The pod unfurled its streamer and recovered nicely. The glider came down rather fast, but made a successful landing.

For the second flight I trimmed the flap stops up a little bit both to generate more up elevon and to correct a pronounced "lean" I had noticed during the glider's first flight. This launch was on another 1/2A3-2T. The glide path was noticeably flatter and I had corrected the imbalance from the first flight. However, the glider was still coming down pretty quick.

Marty's Darkbird (Marty Schrader photo)

I was afraid to put too much elevon angle into the stops for fear of adding too much drag, so I added just a tiny bit more elevon for the third flight. I used an A3-4T, since I was out of other engines. The rocket went up higher but the glide time was so short that it was hard to tell the difference. However, unlike the Estes F-14 Tomcat and other gimmick boost gliders, the Darkbird glides flat enough not to damage itself on landing.

Summary
The Apogee SR-72 Darkbird is not a very high performer in terms of straight glide capability, but this is not what you build it for. It is a neato-keeno sport model for spiffing up your collection. This rocket looks nice sitting on a display stand and provides a bit of a show in the air. I look forward to flying my Darkbird at club launches and wherever I want to give the crowd a gee-whiz thrill.

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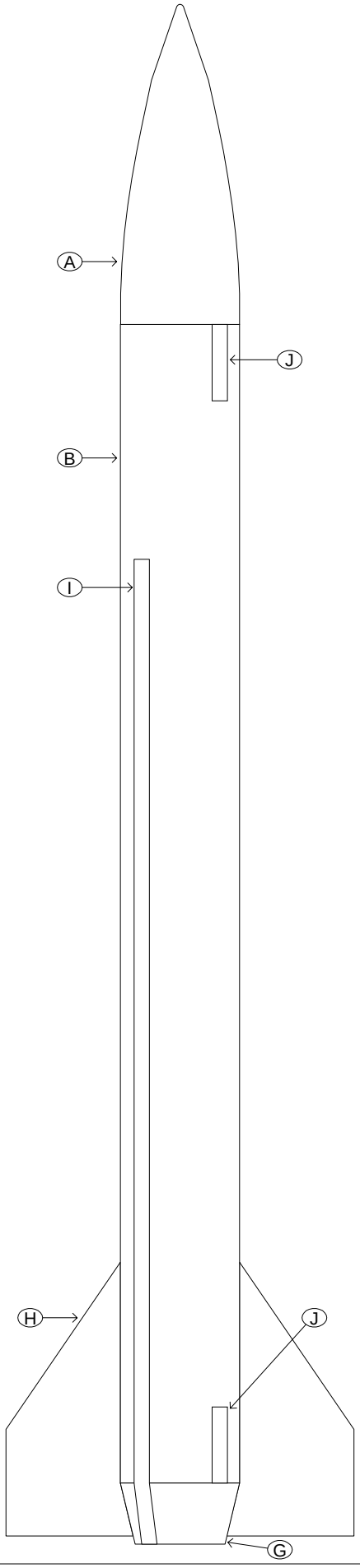
Press Release: Conformal Rail Guides and Lugs Price Drop

Giant Leap Rocketry, Inc. is pleased to announce new pricing on all conformal rail guides and launch lugs from Acme. All rail guides (both plain and color) are a flat $2.75 per pair, while all launch lugs are only $2.50 per pair. This represents a price reduction of up to 70% over previous prices. According to Ed at Giant Leap Rocketry, the price reductions are made possible by the huge success of conformal rail guides and lugs, which allows volume purchasing. (Note: *Colored* guides and lugs are being phased out and will be available while quantities last).

To order Acme rail guides and lugs, visit the Giant Leap Rocketry website at: www.giantleaprocketry.com

PATRIOT

Approximate 1/16th Semi-Scale model
Plan 102994, Designed by Mark Kotolski (NAR 35707, TRA 3609)
Redrawn by Jeff Pleimling (NAR 63951)



Parts List:

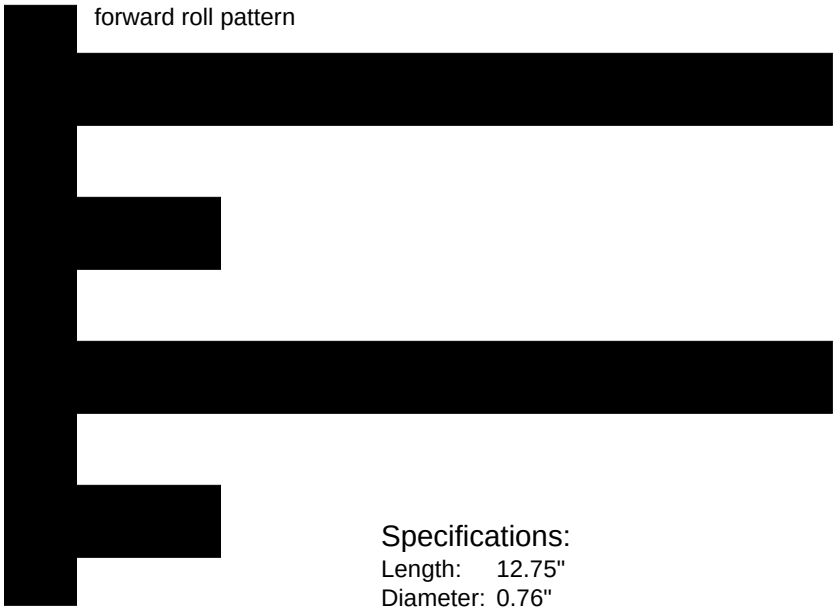
A. Nose Cone, BNC/PNC-50K
B. Screw eye - if needed
C. Body Tube, BT-50, 9.5"
D. Centering Rings, 20/50 (2 needed)
E. Motor Tube, BT-20, 2.75"
F. Motor Mount, 520
G. Card Stock, for tail cone shroud
H. Finstock, 1/32" basswood
I. Conduit, Basswood, 1/16" x 1/8" x 7 7/8"
J. Launch Lug, 1/8" x 1.25"
K. Parachute, 12"
L. Nose Weight, if needed

Construction:

- Use the tube marking guide to mark the BT-50 for fin, launch lug and conduit locations. Extend conduit lines the full length of the tube.
- Transfer shroud pattern to cardstock. Form shroud and glue at tab.
- Slide a 20/50 centering ring over one end of the BT-20 motor tube. Apply ring of glue around one end of tube and slide shroud in place so it is flush with the end of the tube (see drawing on next page). Slide 20/50 ring down and slightly inside of shroud. Apply glue fillet to ring/tube joint. Glue second 20/50 ring flush with the opposite end of tube.
- Assemble the Estes EM520 mount per instructions with the following changes: Step 1: mark at 3/8" instead of 1/4". Step 5: glue ring to tube 5/8" from "end of tube" which the hook protrudes from instead of the first ring. Do not perform steps 6, 7 or 8.
- Apply glue to inside of motor mount tube with shroud. Insert assembled 520 mount into tube until motor tube and the end of the shroud are even. Line up motor hook with the shroud seam. Allow to dry.
- Apply a ring of glue 2" inside the BT-50 on the side you marked for fins. Also apply a small band of glue to the centering ring closest to the shroud. Insert complete motor assembly into the BT-50 until the shroud is flush with the end of the tube (insure the shroud seam lines up with the LL line on the tube). Wipe off excess glue.
- Trace 4 fins onto 1/32" basswood. Cut with a sharp blade and a metal straight edge.
- Sand fins smooth. Round the leading edge on all fins; leave the other edges square.
- Attach the fins to the body tube. Note that the fins do not meet flush with the bottom of the shroud (this is correct).
- Cut the conduits from basswood strip stock, 1/16" x 1/8" x 7 7/8".
- Round one edge of each conduit. At the opposite end, measure and mark it at 1/2". At this mark, cut partially through the conduit and bend it to allow it to conform to the shroud angle.
- Glue the conduit, centered on the 'C' line on the body tube. The square, bent end of the conduit should be flush with the shroud end.
- Cut the 1.25" launch lug in half. Glue one piece to the LL line, even with the tube/shroud joint. The second lug is glued flush with the top of the body tube.
- Cut out the shock cord mount (next page) and assemble it in the typical manner.
- Glue the shock cord mount into the top of the tube making sure it is far enough inside so as not to interfere with the nose cone seating.
- Tie shock cord to the nose cone, Assemble parachute and attach to the nose cone.
- Apply sanding sealer to all wood surfaces. Sand smooth, the repeat until all wood grain is filled and surfaces are smooth.
- Paint the entire model flat white. Allow 24 hours to completely dry.
- Use the drawing on the next page to paint the other sections as follows. Paint the upper 5/8" of the body tube red. Paint the rear 1 1/4" of the body tube and all of the fins red.
- Below the forward red band, paint the tube yellow for 1 1/4". Trim monocoate may also be used. On this yellow section are placed 4 black stripes, in line with the fins and centered in the yellow section. These can be painted or use trim monocoate. These stripes measure 1" x 3/16". They also have a yellow section down the middle.
- The roll pattern can be painted on or use trim monocoate (full sized patterns are provided. Note the long sections on the forward roll pattern.
- The U.S. Army is easily done with 3/8" dry transfer lettering. This appears on both sides of the model, centered between the roll patterns.
- Note that the rear portions of the conduit are painted black.

NOTE: before flying the first time, insert an A10-3T motor and swing test for stability. To fly stable, nose weight will probably be needed. **Do Not** fly this model without checking stability first. If you are not familiar with what a swing test is, refer to the Estes Tech Manual or Estes Tech Report TR-1.

forward roll pattern



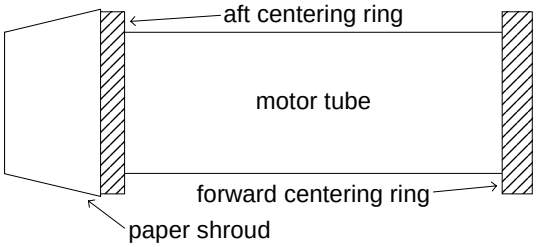
rear roll pattern

Specifications:

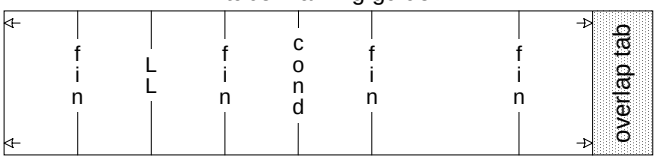
Length: 12.75"
Diameter: 0.76"
Recovery: Parachute

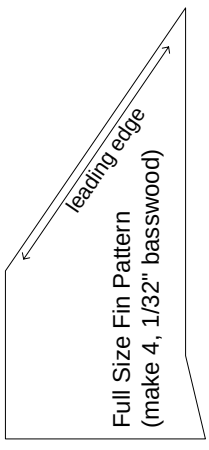
Recommended Motors:

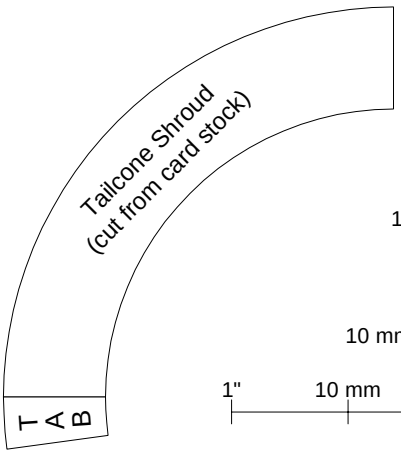
A3-2T A3-4T A10-3T

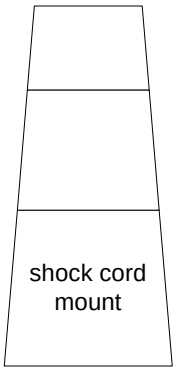


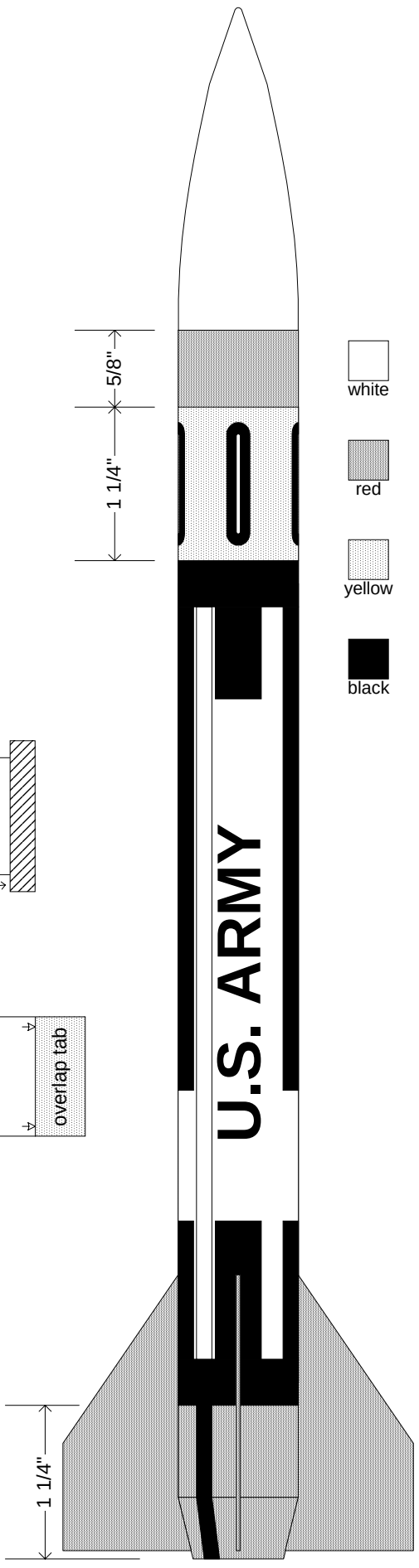
tube marking guide











Space Launch Report for November - December 2002
by Tim Johnson

Year in Review
During 2002, two new U.S. "Evolved Expendable Launch Vehicles" (EELVs) successfully debuted, construction of the International Space Station (ISS) continued, and China neared a human space launch capability. The year saw launch failures by Russian, European, and Chinese rockets. It also saw NASA shift planning toward development of a new orbital space plane.


First liftoff of the new Delta 4 (Boeing photo)

Thirteen November-December flights brought 2002's world space launch totals to 61 successes in 65 attempts, a slight improvement from 2001 but still 20 launches less than a few years ago. The dwindling commercial satellite launch market was largely responsible. In all, 23 launch vehicle types flew from 11 sites in eight countries and from one international sea launch platform. ISS accounted for nine of the year's space flights. These included four space shuttle, two crewed Soyuz, and three Progress cargo flights.

U.S. vehicles performed only 17 launches during the year, fewest since the early 1990s and about half the 1998 total. NASA's space shuttle was the busiest U.S. launch vehicle with five flights. Atlas 2A(S) and Delta 2 flew only three times apiece. Titan 2, Titan 4, Pegasus, Atlas 3, Atlas 5, and Delta 4 flew once each. The latter two were successful inaugural missions of the new EELVs built by Lockheed Martin and Boeing, respectively. They were the first new U.S. liquid propellant expendables to fly since Saturn 5.

Russo-Ukrainian vehicles recorded 24 successes in 26 attempts. Europe had 11 successes in 12 attempts. China performed four successful launches in five attempts.

Among launch vehicles, Ariane 4 finished its last full year in style with eight successful flights. Soyuz/Molniya flew nine times, but suffered one failure. Proton had eight successes in nine attempts. Three Ariane 5G rockets succeeded, but the first "10-ton" Ariane 5-ECA failed. Japan's H-2A scored three successes.

Baikonur, Kazakstan was the world's busiest launch site with 15 launches. Kourou was second with 12. One launch from each site failed. Plestesk, Russia had 10 flights including one failure. Cape Canaveral hosted nine launches.

Arianespace won the commercial space race, with 11 successes in 12 attempts. International Launch Services (ILS) was second with 9 successes in 10 attempts. Boeing Launch Services (including Sea Launch) was a distant third with 5 successful missions.

November-December
There were 11 successful space launches in 13 attempts during November-December 2002. Successes included the first Delta 4, the first commercial Proton-M/Briz M, a space shuttle flight to ISS, and the fourth Chinese Shenzhou 4 on an unmanned test flight. Failures included the first "10-ton" Ariane 5-ECA and a Proton-K/DM3.

Delta IV Inaugural
The first Boeing Delta 4, a 175-ton 4M+(4,2) model with two GEM-60 solid rocket boosters (SRBs) and a 4-meter fairing, scored a notable inaugural success on November 20. It carried 3,170 kg Eutelsat W5 into geosynchronous transfer orbit (GTO) from Cape Canaveral SLC 37B.

It was the first flight of the 5 meter Delta 4 Common Booster Core (CBC) powered by a 297,500 kgf thrust Rocketdyne RS-68. The RS-68 is the world's most powerful liquid hydrogen (LH2) engine.

A single 11,224 kgf thrust Pratt & Whitney RL10-B-2 LH2 engine powered the rocket's second stage. The stage is a stretched version of the previously-flown Delta 3 stage.

The twin GEM-60s provided 176,870 kgf thrust for 94 seconds. CBC burned for just over four minutes. The second stage then burned for nine minutes to reach a parking orbit. After a ten-minute coast to the equator, the stage completed a five-minute transfer orbit burn.

Ariane 5-ECA Failure
Europe's newest rocket failed during its December 11 inaugural launch from Kourou. The L517 Ariane 5-ECA rocket, carrying 3,342 kg HotBird 7, 2,205 kg Stentor, and 1,956 kg of ballast on Arianespace mission V157, faltered when its Vulcain 2 first stage engine failed three minutes after liftoff. The engine should have burned for about nine minutes. It was the fourth Ariane 5 failure in 14 flights.

The 780-ton Ariane 5-ECA uses a new ESC-A cryogenic second stage to boost 10 metric tons into GTO, 3.3 tons more than Ariane 5G. A single 6,630 kgf Snecma HM-7B engine from the Ariane 4 third stage powers the LH2 2nd stage.

Ariane 5-ECA also has improved SRBs that together produce 1,188,776 kgf thrust and an upgraded Vulcain 2 LH2 first stage engine that produces 137,750 kgf thrust, 20% more than its predecessor.

Shenzhou 4
On December 29, China launched Shenzhou 4 on the fourth CZ-2F from Jiuquan. The 7,800 kg, tri-module spacecraft entered low earth orbit. It was expected to be the final Shenzhou test. Shenzhou 5 may make China the third human space-faring nation during 2003.

Proton Flights
Three Krunichev Protons flew from Baikonur during November-December. A Proton-K/DM3 failed during a November 25 ILS mission when its Energia Blok DM3 fourth stage failed to restart, stranding 5,250 kg Astra 1K in an unstable low orbit. An improper fuel ratio during restart caused the engine nozzle to burn through.

Proton quickly recovered. On December 25, a Proton-K/DM-2 orbited three Glonass navigation satellites. Four days later, the first commercial Proton-M/Briz-M boosted Canada's 3,600 kg Nimiq-2 into a high perigee GTO during another ILS mission. The 691-ton vehicle used a new Briz-M hypergolic upper stage. The 2,000 kgf thrust stage performed four long burns, dropping a fuel tank after the second burn. It was the 24th successful ILS Proton flight in 26 attempts since 1995.

Other Launches
Shuttle orbiter Endeavour carried the Expedition 6 crew and the 12,193 kg P1 truss to ISS from Kennedy Space Center LC 39A on November 24 during the STS-113/ISS-11A mission. On December 7, Endeavour landed at KSC, returning the Expedition 5 crew who logged six months in space.

*(**Space Launch Report** continued on page 8)*

The new Ariane 5-ECA prior to liftoff and failure of its second stage... (Arianespace photo)

Welcome to the Club!

Jeff Liebich and Bill Reich have joined NIRA in the past few months. Welcome to the club!

(If I somehow missed your name, please let me know!)

For Sale

For Sale: 12v (2x6V) 7?AH Panasonic Gel Cell. Used in a computer UPS since 1998, in excellent condition. $10 donation to the NAR legal fund.

I will not ship them, but contact me and I'll deliver at any NIRA event. See Bob Kaplow.

Confused Stages – Stage 29
by Jonathan Charbonneau

In the previous stage, I described the different propellant grain configurations and how the engine works. Time for a little trivia to test your knowledge. Which engine is more powerful?

A) A10-3T
B) B2-5
C) C6-5
D) D21-7T

If your answer is 'D' you are correct. Can you identify the most powerful of the other three? 'C' you say? I'm afraid that you're wrong. The A10-3T is more powerful then the C6-5. "No Way!" you say. Yes, it is. While the A10-3T has only one eight (1/8) the impulse of the C6-5, it is more powerful by 2/3. *Power* and *impulse* are **not** the same thing. This stage is about the difference between power, impulse and energy.

To understand the difference, a lesson on physics is in order:

Work: is defined in physics as the product of force times distance. In rocketry, the work done by an engine is equal to the engine average thrust times the altitude change between ignition and burnout. In the metric system it is measured in *Joules*. The English unit is the *foot pound*. Any work done on a rocket causes a change in its kinetic energy.

Energy: measured in Joules (ft-lbs in English units), comes in three forms: potential, kinetic and heat. The engine propellant contains potential energy. As it burns, the potential energy is changed to kinetic energy. Kinetic energy is the energy possessed by a moving object. Heat energy is the energy lost to friction (drag). Kinetic energy is defined by the following formula: $1/2mv^2$, where m is the mass and v is the velocity (speed).

Power: is the rate at which energy is used with respect to time. It is measured in Joules/second. A Joule/second is a Watt. The English unit for power is the horsepower.

Momentum: is the product of mass times velocity. This is a different quantity from kinetic energy.

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

get together and purchase a set of equipment for the club to maintain (with a discount on the usage fee the club would charge for using the equipment and NO_2).

If this is something you'd like to assist with, please see Cole.

December Model of the Month contest –
Marty Schrader – scratch built helicopter recovery rocket (Adult Winner)

January Model of the Month contest –
Kevin Keehn – Estes Echostar (Adult Winner)
Jonathan Charbonneau - Estes Eliminator
Marty Schrader – 'Ridiculously Short Rocket' (scratch built)
Chuck Swindler – PML Endeavor

Leading Edge Update– The deadline for the next issue of the Leading Edge is March 7th, 2003 - the same day as the club meeting.

As always, NIRA can use a wide-range of articles including launch reports, kit reviews, technical articles, plans and whatever you think might interest NIRA members.

As you probably noticed, this issue is shorter then normal. I can only print what people write, get so please think about writing something for the next issue.

Also, I only have 2 more issues as Editor after this one. Marty Schrader has tentatively agreed to take the job and, if nothing changes, will be the editor for the July/August issue.

NAR Standards &Testing News

R87 New Motor Certifications 6 Dec 2002
The following motors have been certified by NAR Standards & Testing for general use as high power rocket motors effective December 2, 2002. They will not be certified for NAR contest use as they are not model rocket motors.

The following are reloadable motors, certified only with the indicated size casings and manufacturer supplied nozzles, end closures, delays (or smoke devices), and propellant slugs.

Animal Motor Works:
54mm x 326mm (54-1050 casing):
J357WW-P (1000 Newton-seconds total impulse, 548.1 grams propellant mass)
54mm x 492mm (54-1750 casing):
K570WW-P (1700 Newton-seconds total impulse, 914.6 grams propellant mass)
54mm x 728mm (54-2550 casing):
K975WW-P-SM (2450 Newton-seconds total impulse, 1357.3 grams propellant mass)

Propellant Key:
GG = Green Gorilla
WW = White Wolf
SM = Produces 10 to 15 seconds of smoke after burnout

Jim Cook, Secretary for
NAR Standards & Testing

Jack Kane, Chairman

Impulse: is the product of force times time. This is the quantity represented by the letter at the beginning of the engine's code. Any impulse imparted upon a rocket causes a change in its momentum.

When an engine operates, it produces a fixed amount of impulse. This is independent of the mass of the rocket. If drag were neglected, the change in a rocket's velocity would be equal to the total impulse of the engine divided by the mass of the rocket.

Work, on the other hand, is dependent on the rocket's mass. A given engine accelerates a small mass faster then a large mass and therefore applies the same thrust over a greater distance when the rocket is light than does the same engine in a heavier rocket. Consequently, an engine does more work on a lighter rocket than on a heavy rocket. This is why the letter at the beginning of the engine code is not an indicator of energy.

Since power is the rate at which energy is used with respect to time, it must be multiplied by the time of application to determine the energy. The A10-3T is more powerful then the C6-5 because it has more thrust (force) and therefore does more work within its burn time of 1/4 second than does the C6-5 in an equal amount of time. It is the thrust of the engine and not the total impulse that determines how powerful the engine is for any given rocket. The rocket's mass is also a factor.

Conclusion: The letter at the beginning of the engine code indicates the engine's total *impulse*, because that quantity is the only quantity that can be determined from the engines thrust curve. The rocket's mass has to be known before the engine's power can be determined or how much work it will do on the rocket.

U = impulse	a = acceleration
p = momentum	E_w = energy (work)
m = mass	E_k = energy (kinetic)
v = velocity	w = power
F = force (thrust)	t = time
L = distance	

Newton's 2nd Law: $F = ma$
Work: $E_w = F \bullet L$
Impulse: $U = F \bullet t$
Kinetic Energy: $E_k = \frac{1}{2}mv^2$
Power: $W = E_w/t = (F \bullet L)/t$
Momentum: $p = mv$

Units of Measure - Metric
Mass - Kg
Time - second (s)
Distance - meter (m)

Force (thrust) - newtons	$Kg\ m/s^2$
Impulse - newton seconds	$Kg\ m^2/s$
Work - joule	$Kg\ m^2/s^2$
Power - watt	$Kg\ m^2/s^3$

Some of the formulas used in this stage.

Japan's H-2A launches the ADEOS-2 satellite. (NASDA photo)

*(**Space Launch Report** continued from page 6)*

Three non-Proton Russian rockets flew. A Kosmos-3M orbited several satellites from Plestesk on November 28. A Molniya-M launched a Russian early warning craft from Plestesk on December 24. A three-stage Dnepr 1 orbited six microsats from an underground Baikonur silo on December 20.

Japan's fourth H-2A, a 202 model with two solid boosters, boosted ADEOS-2, an earth observation satellite, into sun synchronous low earth orbit (LEO) from Tanegashima on December 14. It was H-2A's first LEO mission.

The 115th Ariane 44L launched NSS-6 into GTO from Kourou ELA-2 on December 17. Only one Ariane 4 remained after this Arianespace V156 mission.

AC-144, the 23rd and final Atlas 2A, lifted 3,190 kg TDRS-J into GTO from Cape Canaveral SLC 36A on December 5. It was the last classic Atlas with Rocketdyne engines and no solid boosters. Several Atlas 2AS models remain.

Space News

NASA's new space transportation plan, announced during November, shelved the costly SLI space shuttle replacement effort. The new plan calls for development of a small EELV-launched Orbital Space Plane (OSP) that could serve as both a crew carrier and as an ISS rescue vehicle.

At year's end, at least seven U.S. launch vehicles were on launch pads preparing to fly.

The final Atlas 2A sits on the pad for launch. (NASA photo)

THE LEADING EDGE

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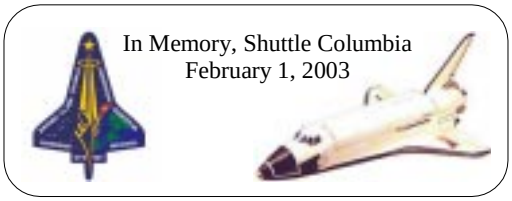

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