MASA Planet

Volume 5, Issue 2 **May 2002**

Safety First!

Good Design is No Accident

Is Your Design Envelope Big Enough?

Ted Cochran

Safety is often learned through the misfortunes of others. Here's another example, presented in hopes that we can learn from it.

Didn't we just put that tower up?

A major oil company was commissioning an expansion to a refinery, including a distillation column—basically a standing pipe, one hundred feet tall and twelve feet in diameter, used to separate chemicals. This one was to separate a pressurized mix of butane and propane.

When a tower is erected and hooked up, a leak test is conducted. A hydrostatic pressure test is typically done first. The tower is filled with water and checked for leaks (it is always better to find leaks of water than leaks of flammable gases!). Since a column full of water exerts similar pressure on the base of a tower as a pressurized

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First March Launch!

Snow holds off (until April 1); 92 rockets fly

For the first time in MASA history, the officially scheduled March launch was not scrubbed due to weather. About two dozen MASA members flew rockets at our winter field at Sunrise Elementary School in White Bear Lake.

The winds were lighter than expected, keeping most rocket flights close to the range head. Several folks

MASA's March 2002 "It on da rod" Alan Estenson

flew their found parts rockets from the January meeting, and of course quite a few winter projects flew for the first time.

Memorable flights included Leland Cheng's Honest John and Mercury Redstone, (and a Mosquito flown on an A10-3T and recovered!), Dave Fergus' Sprint ABM on a new C11-3, John Carlson's 25-year-old V2, Glen Overby's 60-2 ("Very much not stable"--LCO), Ted Cochran's Big Bertha core sample (perfectly replicated a bit later, before he got wise to lousy ejection charges and changed motor lots), and Neal Higgin's 3xB6 clustered Ranger flight.

No rockets were treed, and only one was roofed. All in all, it was a terrific way to end the March jinx!

Alan Estenson

Ted's AQM-37A

Safety, continued from page 1

mixture of hydrocarbons, this is normally a safe and effective test. Unfortunately, water is also heavier than propane and butane—a fact that the project architect had neglected to take into account in his load calculations for the tower's foundation.

The foundation failed and the tower fell over. History did not record whether the water from the ruined tower did more damage than the tears from the project engineer.

The relevance to model rocketry?

A rocket design needs to consider the entire lifecycle. You can't just design for the first flight—you have to consider everything you will likely do to it. Most of us remember that a bigger than usual engine requires a re-check of the CG/CP relationship, but lots of other things can happen in the life of a rocket:

- If you are going to swing test it, you better design it to survive the swing test (ever swing test a Mean Machine? Ever swing it really fast? <grin>)
- If you plan to fly it a lot, you might want to think about charring from ejection charges, and body tube fatigue, and baffle chambers full of junk. For example, skinny rockets with plastic fin cans like the Maniac and Mongoose are very prone to body tube crimping right above the fins. If you want to get more than a few flights out of one, consider adding a reinforcing coupler.
- For cluster designs, plan for safe recovery even if one or more motors don't light.
- Rockets that may crash a lot (Venus Probe comes to mind) should be built extra strong!
- If you think you might want to add a booster some day, put the aft centering ring half a coupler length forward from the aft end of the body tube.
- If you plan to fly high, don't forget to put a vent in the payload section. If you plan to fly fast, don't forget to worry about drag separation.
- If you normally fly low and slow with a short delay, don't forget that more powerful motors may also require a longer delay.

Most importantly, don't attempt a flight for which the rocket was not designed. Otherwise, you, too, may end up all wet!

MASA Outreach

Rocket League Update

MASA Reviews Moose-Launching Designs

About 20 teams are competing in this year's inaugural Minnesota Rocket League competition, building payload duration rockets to fly a model of an ozone sensor. Teams may compete in one of three increasingly challenging divisions, earning points for time aloft and accurate measurements of the altitude and position of their payload.

MASA is sponsoring some of the awards, and MASA members are coaching some of the teams. In addition, April's MASA meeting was devoted to evaluating the teams' designs and providing encouragement and suggestions for improvement. Submissions ranged from stock Big Berthas to ingenious custom designs.

The teams will build their rockets and fly qualifying flights in April, followed by competition flights in May. The winners will be announced in early June.

More information can be found on the MRL web site: http://www.hightechkids.org/mrl/

Ted Cochran

These distillation columns had good foundations!

MEETING SCHEDULE

TUESDAY, MAY 7
Location: Science Museum of Minnesota, St. Paul
Time: 7pm to 8:30pm
Notes: NARTREK Bronze info and building session.

TUESDAY, JUNE 4
Location: Science Museum of Minnesota, St. Paul
Time: 7pm to 8:30pm
Notes: Altitude tracking.

SATURDAY JULY 20
MASA Annual Summer Picnic!

TUESDAY, AUGUST 6
Location: Science Museum of Minnesota, St. Paul
Time: 7pm to 8:30pm
Notes: Build MicroMaxx rockets!

LAUNCH SCHEDULE

MAY 25 - 27
NATIONAL SPORT LAUNCH
Rainbow Valley, AZ

SATURDAY, MAY 18: RED, WHITE, AND BLUE!
Note Date Change!
(Rain date: May 25)
Location: Blaine
Time: 9 am - 3 pm
Fun Event: Big Daddy Drag Race
NARTREK: B Streamer duration
Contest: B Streamer duration

SATURDAY, JUNE 22
Location: Blaine
Time: 9 am - 3 pm
Fun Events: Fat Boy Flyoff.
NARTREK: D-motor flights

SATURDAY, JULY 27: FOURTH ANNUAL SCALE EVENT
Location: Blaine
Time: 9 am - 3 pm
NARTREK: B Parachute Duration
Contest: B Parachute Duration

AUGUST 4-9
NARAM 44
McGregor, TX

SATURDAY, AUGUST 24: MULTI-STAGING
Location: Blaine
Time: 9 am - 3 pm
Fun Events: Fourth Annual UFO Drag Race, Comanche-3 Drag Race
NARTREK: Two stage flight

President's Corner

NARTREK

Alan Estenson

In the last issue of the Planet, I mentioned the NARTREK program. NARTREK is a progressive, self-paced rocketry achievement program administered by the NAR. It is designed for modelers of all ages and skill levels. There are four levels that you can progress through: Bronze, Silver, Gold, and Advanced. When you complete the requirements for each level, you mail in your packet along with a small fee. You will then receive a special patch and a certificate of achievement. When you complete the entire NARTREK program, you will be capable of designing, building, and safely flying nearly every type of rocket.

You don't need to spend a lot, either. Often, you can perform the NARTREK flights using rockets that you've already built. To complete the Bronze level, you must: fly a D-powered rocket, fly a 2-stage rocket, keep a B-powered streamer rocket in the air for at least 30 seconds, and keep a B-powered parachute rocket in the air for at least 60 seconds. You may perform these flights at a club launch or on your own. At the January MASA launch, I flew my Estes Maniac on a D12-5 for one of the four required flights. In March, I tried the 2-stage flight with my Estes Long Shot on a C11-0 to a B6-4, but it didn't light the upper stage motor (first time that my Long Shot has let me down!), so I'll have to try it again.

I'd like to encourage all MASA members to pursue the NARTREK Bronze level this year. In fact, at the end of 2002, MASA members who achieve the Bronze level will have their names entered in a special prize drawing! This summer, we'll also try to work the Bronze flights into contests and themes at the club launches.

If you go to http://www.nar.org/nartrek, you can read all about NARTREK and download the Bronze level packet. Print out the packet and read it through; you will have taken the first step towards becoming a more proficient rocketeer! Also, there was a great article titled "What I learned on the way to the NARTREK Bronze" on pages 24-26 of the Jan/Feb 2002 issue of Sport Rocketry. It's an interesting tale of how one rocketeer performed the Bronze level flights.

Hot jets!

Alan Estenson, MASA President

Slingwing BG

Launch a Slingwing on an A motor, and watch it circle with the hawks until it is out of sight!

Ted Cochran, NAR 69921

Ted Cochran

Slingwing prepped (left) and deployed (right)

Specifications

Length:	18 inches
Diameter:	0.6 inches
Weight:	about 2 ounces
Recommended engines:	A10-3T: about 500 ft.
	1/2A3-2T: about 250 ft.

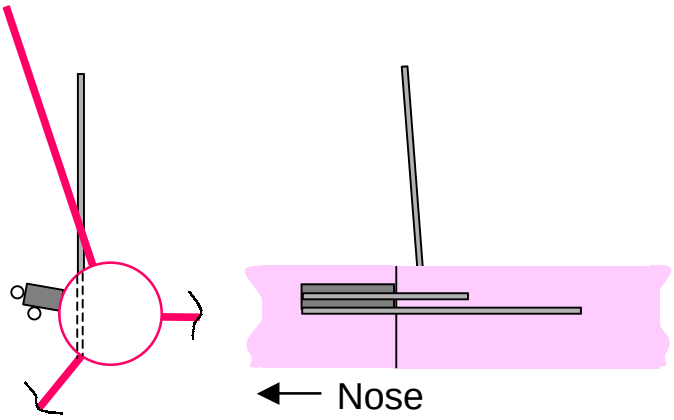
Parts list

A. BT20 nose cone
B. BT-20 body tube
C. BT-5 tube coupler
D. BT-5 engine block
E. 1/8" dowel
F. 1/8" diameter launch lug
G. Set of fins from a crashed Comanche (middle stage preferred).
H. Sling wing glider

The Slingwing is a folding flying wing made of foam that is launched with a rubber band. When I first saw it in a hobby store, I thought that it might be well suited for NARAM 2000's A-BG competition, if I could figure out how to loft it. I hacked a carrier out of spare parts, got a test launch in on a 1/4A motor, and then had it fly out of sight in its first competition flight. I trimmed a second Slingwing for a tight spiral, and still almost lost it! The two flights were enough to win on that breezy day. A subsequent flight at Blaine easily crossed three fields, only to be run over by a mower. Still, this design is in no way optimized: I'm sure with a little experimentation and more attention to aerodynamics, you can do better. So buy a bunch of Slingwings and get busy!

Details:

The carrier is a simple BT-5 based rocket that divides 7.5" from the nose. The Slingwing is hooked on near the BT break point, and held there with a fork-like clamp. When the rocket breaks at apogee, the Slingwing's rubber bands pull the wings open and it flies away. During boost, the Slingwing acts like a pair of fins, so the carrier rocket needs to be long with relatively large fins to maintain stability.



Bottom and side views of glider attachment points

The attachment points are a bit unconventional. A 1/8" wooden dowel is skewered through the bottom body tube so that the Slingwing's hook can engage it. To keep the Slingwing from opening, a pair of wooden dowels is glued to a standoff balsa block on the upper body tube, forming a clamp that is released when the rocket splits at apogee. The shorter dowel is positioned over the Slingwing's plastic hinge; the longer dowel rests against the wing itself. The clamp can be rotated toward the Slingwing to adjust the tightness of its grip. I have built two of these using approximately the same design, and have found that it is easiest to hold the Slingwing next to the otherwise-completed rocket in order to determine the precise positions of the dowels.

Slingwings are available at National Hobby in Blaine. Slingwing's web site is: http://www.slingwing.com

Streaming Broadband

At launch, it has no recovery system. At recovery, it has no body tube.

Ted Cochran, NAR 69921

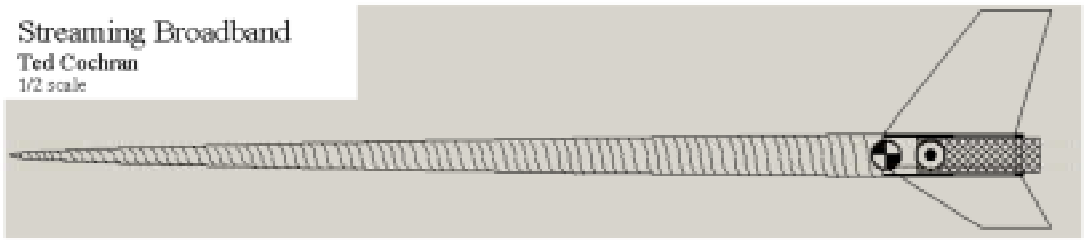
Specifications

Length:	15 inches
Diameter:	0.6 inches
Weight:	about 0.5 to 1.5 ounces, depending on the paper used.
Recommended engines:	1/4A3-2T: 200 ft. 1/2A3-4T: 400 ft. A3-4T: 600 ft.

Parts list

I. One roll of adding machine paper
J. Two index cards
K. Three bits of stiff cardboard, say from an Estes boxed kit.
L. One 18-inch length of kevlar shock cord.

This rocket grew out of the "Found Parts" construction session in January. It does not have a body tube; instead, a tightly wound paper tape is inserted into a socket in the fin can, and is blown out by the ejection charge. About 35 years ago my brother tried to build something like this, but the tube kinked during launch and it crashed. I always thought the idea was cool and decided to try to improve on the concept. Perhaps this summer I'll see if a Mylar-based model makes a good streamer duration design.



Instructions:

1. Make a BT-5 sized motor mount tube by rolling and gluing a piece of index card. Squash the top ends of the tube down just enough to make a motor block but don't close off the top of the tube. Glue the squashed end liberally.
2. Poke a small hole through the squashed top of the motor tube and tie a piece of kevlar shock cord there. Put a liberal blob of glue over the hole and the knot.
3. Use two layers of a thin strip of index card to make a centering ring at the rear of the motor tube.
4. Roll and glue another piece of index card to make a two inch long fin can tube to fit the rear centering ring. There should be a small gap between the motor mount tube and the fin can.
5. Cut out some cardboard fins, and glue them on to the fin can. Leave room for taping the motor at the rear of the fin can.
6. Now for the fun part! Rewind adding machine paper from the roll as tightly as you can, until you have a drum of paper that is as wide as the fin can tube. Carefully push the center of this drum out, and work it into a cone. Keep winding it as you pull so that it remains tight. Once you have about 12" pulled out, test fit the base into the fin can. You'll probably have to cut some off the end to make it fit. The wide end of the cone should just fit into the socket created by the fin can and the motor tube.
7. There may be a small gap in the nose; if so, close it with a wad of recovery wadding. Push all the kevlar up into the cone, and insert a 13mm motor. Tape the motor to the fin can so that it can not blow out without taking the fin can with it. At apogee, the cone is blown out of the fin can, and lowers the rocket gently to the ground. At least, that's the theory!

Memorable Flights

True Blue Rousts Bambi

Steve Hum

For several years a group of college friends got together at our friend Paul's hobby farm in Hillman. The excuse was that we needed to help Paul get the farm ready for winter, but it was really just a weekend with "the boys." We really did try to help get the farm ready for winter, cutting, splitting, and hauling firewood (arr arr arr power tools), when we weren't firing every type of firearm you can legally own (e.g., a replica flintlock musket—the *real* reason we had the FFFFG black powder). And when we weren't going four wheeling (we were checking the fences. Really).

But the last year we went up, Mike Casmey and I decided to bring up a few rockets. This wasn't anything unusual, but since I had just certified Level 1 and Mike had certified Level 2 that past summer, the rockets were decidedly high power. Paul works for the FAA, so getting a wavier wasn't an issue, and a quick talk to the neighbors netted us the use of several hundred acres of cleared farm fields. Only problem was that it was opening weekend for deer hunting, meaning that whenever you went outside, you had to wear blaze orange.

So Sunday morning, after a late night of card playing, we decided to launch some rockets. Our GSE looked like an old Estes set-up—an Aerotech launch controller with about 200 feet of extra wire hooked to the battery in Mike's pickup, and a Magnum launch pad sitting on the side of a dirt road, with empty farm fields in all directions.

None of the other guys there had ever seen a HPR fly, so when my Aspire on a G64 went there were a lot of "wows" and "definitely not an Estes" from the group. Next to fly was Mike's Honest John on a small H—more oohs and ahs. After that my Excel went on an I161—still more oohs and ahs, and also "is this legal?"

Finally Mike pulls out True Blue, loaded with a J350 with dual deployment. (For those of you that know Mike, True Blue was the remains of his initial Level 2 rocket, the Nike portion of his scratch-built Nike-Ajax that survived when the transition collapsed under level 2 power.)

Now imagine the scene: Ten tired guys in blaze orange jackets and vests are standing behind a pickup truck with its hood up. There's a launch pad in the road that looks a like an Estes Port-a-pad on steroids, with an 8' tall 4" diameter rocket painted red white and blue sitting on top of it. Lots of deer hunters are in the woods surrounding the farm fields. Mike goes to the front of the pickup, puts in the key, gives a quick countdown, and True Blue jumps off the pad on a pillar of smoke and flames on its way to 3800'.

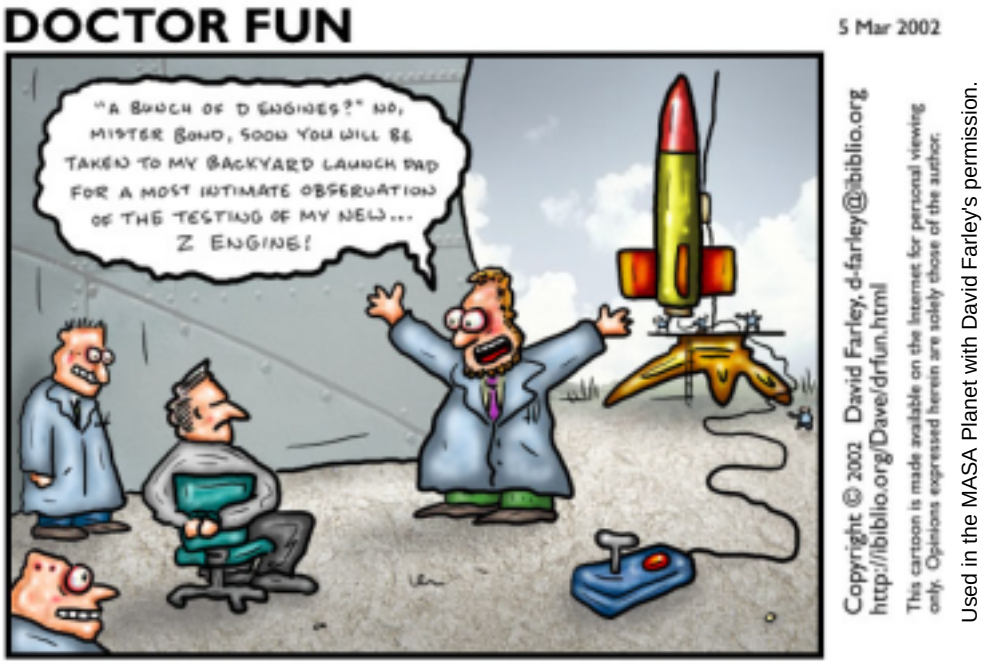
Suddenly the area around us is alive with gunfire—the J350 has spooked some deer in the area. We're all diving for cover, not knowing where the shots are coming from. After what seemed like an hour, the shooting dies off, and we hear a loud "bang" directly overhead. True Blue has just fired its second charge and the main chute is now out.

By the time we recover it, several hunters have come over to see what the h*** was going on. One of them tells us that from his deer stand he could see what we were doing, but when True Blue left the pad he almost fell out of the stand. He didn't get a deer.

We launched a couple more for the crowd, finally deciding that the November wind had picked up too much when my Excel manages to land in the top of a tree 1/2 mile away. It was recovered with the aid of a chainsaw.

Snapshot

Black Brant XII: Wheeee!



Vern Estes returns to the big screen as James Bond's latest nemesis in the eponymous "Balsafinger".

Road Trips

Nike Missile Site SF88

Glen Overby

One of the Nike sites just north of San Francisco has been turned into a museum run by the National Park Service. With the help of a lot of volunteers, the site has been restored to the point where the lifts and launch pads work! The tour begins in the ranger's office in the maintenance building.

The maintenance building has a Nike-Hercules upper stage on a maintenance cradle. The cradle allows the technicians to rotate the missile so they can observe that the guidance system is operating and is connected properly. The nose was opened up and we could see the discrete components of the guidance system (no surface mount chips here!) and the (empty) bay for the explosive: either a conventional high explosive or a nuclear warhead.

From there we went over to a pair of large army-green boxes a bit smaller than a semi trailer box, with a pair of radar dishes next to them (see photo below). Our park ranger fired up the rotator on one of the dishes, but did not activate the radar itself (I'm unclear on whether or not it worked). We went inside the first one, and I think it was the targeting radar control unit.

Both of these radars were moved to the museum from a nearby mountain peak. There was a second Nike site a half mile to the north, across a shallow valley.

Our next stop was the fueling and arming area. It is surrounded by an earthen berm just in case something bad happened. Outside was the fueling area for the Ajax upper-stage that consisted of an overhead crane and a shallow pit (see photo above). The Ajax uses pressure-fed hypergolic propellants: Nitric Acid and Aniline. The missile has to be fueled in a somewhat upright position.

Glen Overby

Glen Overby

Inside the arming building was crammed full of parts:

- A Nike-Ajax booster partially cut open and with the skin of one fin partly peeled off to reveal the honeycomb construction.
- Ajax upper stage cut open to reveal the fuel tanks and ordinance. Again, the large fins were honeycomb inside.
- An intact (inert) Ajax hanging from the ceiling
- An ordinance shipping container (labeled "Nuclear Delivery System")

We watched an 8-minute video of a Nike-Hercules live test conducted from the pacific test range during the Cuban Missile Crisis.

"For your safety, please hold on to the nuclear missile"

Finally, we walked up to the launch site. The site consists of a long row of double rails connecting 3 permanent launch pads/erectors and one elevator / erector that provides access to the magazine. Missiles are manually slid along the rail. All 4 pads can't launch at the same time, but I don't think much time between launches was required.

Our tour guide started up another generator and went inside while the rest of us gathered around the elevator opening. The doors opened downward, revealing a Nike-Hercules on an elevator. It rose up to the surface, then was elevated to a ~85 degree

Nike Site, continued on page 8

Nike Site, continued from page 7

launch angle. This BEATS Dan Gates' truck-mounted launch pad!

We all climbed aboard the elevator for a trip down into the magazine. The tour guide commented, "You'll probably never hear this any other time: for your safety, please grab on to the nuclear missile."

We went down about 20' into the magazine. On either side of the elevator were three missiles on rails ready to be sent up top. On the wall was a painted black line about 6' off the floor where the water level was when they started restoring the site.

The elevator was sent back up so we could watch from below, brought back down and the doors closed. Upon opening of the doors, a high-pressure seal blew, sending out a stream of a brown fluid. The ranger went to get pads to soak up the oil while we milled around down below. This pretty much ended the tour since he wanted to get working on repairs.

While site SF-88 was the last decommissioned site, one of the Minneapolis sites remained open for use by the Department of Mines up until about 1997 or '98. A former co-worker has a hobby farm south of Farmington, next door to the south-side Nike site. When the army shut it down, they turned the site over to Castle Rock township. He was called up the night before and asked to meet at the site the following morning at which time he was told about the new plans. All of his neighbors got a tour of the site!

The magazine was clean and dry inside, and the elevators worked. He was told that they operated on Glycerol, not hydraulic fluid. The site has asbestos, which is a deterrent for anyone considering buying it.

Glen Overby

NIKE HERCULES TRIVIA

- The Nike-Hercules goes supersonic in its own length (you calculate the Gs)
- The noise at launch is about 160db (the launch crew runs for cover somewhere)
- The first stage cluster (4 motors) burns out at about 3,000'. You don't want to be this site's neighbor since the booster doesn't have parachutes!
- The attack approach was for the missile to go above the incoming bomber formation, turn downward under thrust just before burn-out then navigate into a point in space where its detonation would be the most effective. This was not a direct-strike missile, but instead spreads fragments to knock out aircraft.

References

www.nikemissile.org/

More of Glen's pictures are at reality.sgiweb.org/overby/SF88

Those of you who want dimensions can see:

www.yellowjacketsystems.com/jimball/nike-hercules/

Fourteen US Army Missiles of the Cold War by Peter Alway and Chris Timm, available from NARTS

Certified Motor Table

Just in time for the flying season!

The rules with regard to motor use, in very brief form:

- A FAA Waiver is required for all flights with more than 125 g propellant weight. These may not fly at Blaine.
- Except for certification attempts, a Level 1 Certification is required for HPR motors, defined as having
  - more than 62.5g propellant OR
  - more than 80 N average thrust OR
  - more than 160 Nsec total impulse
- A LEUP is required to store single use motors with more than 62.5g propellant (marked for your information).

Information is based on web sources and believed but not guaranteed to be accurate

Key:
Organization data in black
Mfr data in red

Motor may not be used under Notification Rules
Motor may be used conditionally

Designation	Mfg.	Size (mm)	Propellant Mass (grams)	Total Impulse N-sec.)	Certifying Organization	Additional Notes, Restrictions, Dates
1/4A Motors						
MicroMaxx-1	Quest	6 x 26	0.4	0.2	NAR	1/12A0.2-1
MicroMaxx-2	Quest	6 x 26	0.504	0.35	NAR	1/8A0.35-0.5 replaces above
1/4A2-2,4	Apogee	10.5 x 38	0.8	0.62	NAR	
1/4A3-2T	Estes	13 x 45	0.8	0.62	NAR	
1/2A Motors						
1/2A2-2,4,6	Apogee	10.5 x 38	1.5	1.25	NAR	
1/2A3-2T,4T	Estes	13 x 45	2	1.25	NAR	
1/2A6-2	Estes	18 x 70	2.6	1.25	NAR	
A Motors						
A2-0,3,5,7	Apogee	10.5 x 57	3	2.5	NAR	
A10-PT	Estes	13 x 45	3.8	2.5	NAR	
A10-0T	Estes	13 x 45	3.8	2.5	NAR	
A10-3T	Estes	13 x 45	3.8	2.5	NAR	
A3-4T	Estes	13 x 45	3.3	2.5	NAR	
A8-3,5	Estes	18 x 70	3.3	2.5	NAR	A8-5 is new for 2002
A6-4	Quest	18 x 70	3.5	2.5	NAR	
B Motors						
B2-0,3,5,7,9	Apogee	10.5 x 89	6	5	NAR	
B7-4,6,8,10	Apogee	13 x 45	2.8	5	NAR	
B4-2,4	Estes	18 x 70	6	5	NAR	
B6-0	Estes	18 x 70	5.6	5	NAR	
B6-2,4,6	Estes	18 x 70	5.6	5	NAR	
B6-0,2,4,6	Quest	18 x 70	6.5	5	NAR	
C Motors						
C4-3,5,7	Apogee	18 x 50	4.5	9.5	NAR	
C6-4,7,10	Apogee	13 x 83	7	10	NAR	
C10-4,7,10	Apogee	18 x 50	4.9	10	NAR	
C5-3	Estes	18 x 70	11.3	9.5	NAR	Discontinued
C6-0,3,5,7	Estes	18 x 70	10.8	9	NAR	
C11-0,3,5,7	Estes	24x70	12	9	NAR	New Spring 2002
C6-0	Quest	18 x 70	12	9.5	NAR	
C6-3,5	Quest	18 x 70	12	8.5	NAR	
C6-7	Quest	18 x 70	11	8.1	NAR	

Motors, continued on page 10

Motors, continued from page 9

D Motors			Mass	Impulse		
D21-4,7	Aerotech	18 x 70	9.6	20	NAR	
D24T-4,7	Aerotech RMS	18 x 70	8.8	18.5	NAR	
D7-RC	Aerotech RMS	24 x 70	10.5	20	NAR	
D9-4,7	Aerotech RMS	24 x 70	10.1	20	NAR	
D13-4,7,10	Aerotech RMS	18 x 70	9.8	20	NAR	
D15-4,6	Aerotech RMS	24 x 70	8.9	20	NAR	
D15-8	Aerotech RMS	24 x 70	8.9	20	NAR	Decertified 7/1/2002
D3-3,5,7	Apogee	18 x 77	9.8	19.5	NAR	
D10-3,5,7	Apogee	18 x 70	9.8	19.5	NAR	
D11-P	Estes	24 x 70	24.5	18	NAR	
D12-0,3,5,7	Estes	24 x 70	21.1	17	NAR	
E Motors						
E6-4,6,8,P	Aerotech/ Apogee	24 x 70	21.5	40	NAR	
E15-4,7,PW	Aerotech	24 x 70	20.1	40	NAR	
E6-RC	Aerotech RMS	24 x 70	21.5	40	NAR	
E7-RC	Aerotech RMS	24 x 70	17.1	30	NAR	
E11-4	Aerotech RMS	24 x 70	25	35	NAR	Decertified 7/1/2002
E12J-RC	Aerotech RMS	24 x 70	30.3	36	NAR	
E16-4,7	Aerotech RMS	29 x 124	19	40	NAR	
E16-10	Aerotech RMS	29 x 124	19	40	NAR	Decertified 7/1/2002
E18-4,8	Aerotech RMS	24 x 70	20.7	39	NAR	
E18-10	Aerotech RMS	24 x 70	20.7	39	NAR	Decertified 7/1/2002
E23-5,8	Aerotech RMS	29 x 124	17.4	37	NAR	
E28-2,5	Aerotech RMS	24 x 70	18.4	40	NAR	
E28-8	Aerotech RMS	24 x 70	18.4	40	NAR	Decertified 7/1/2002
E30-4,7	Aerotech	24 x 70	19.3	40	NAR	
E9-0,4,6,8,P	Estes	24 x 95	35.8	29.5	NAR	avg thrust 10.6N Max LOW 15 oz
E15-4,7	Rocketvision	24 x 70	20.1	40	NAR	
F Motors						
F10-4,6,8	Aerotech/ Apogee	29 x 85	40.7	80	NAR	
F20-4,7	Aerotech	29 x 73	30	64	NAR	
F21	Aerotech	24 x 95			TRA	New Econojet in Estes-E form factor
F23FJ-4,7	Aerotech	29 x 73	32	56	NAR	
F25W-4,6,9	Aerotech	29 x 98	35.6	80	NAR	
F25-4,6,9	Aerotech	29 x 98	35.6	80	NAR	"Classic" Decertified as of 7/1/2002
F32-5,10,15	Aerotech	24 x 124	37.7	80	NAR	
F50-4,6,9	Aerotech	29 x 95	37.9	80	NAR	
F72-5,10,15	Aerotech	24 x 124	36.8	80	NAR	
F12-2,5	Aerotech RMS	24 x 70	30	45	NAR	
F13-RC	Aerotech RMS	32 x 107	32.3	63	NAR	
F16-RC	Aerotech RMS	32 x 107	62.5	80	NAR	
F22-4,7	Aerotech RMS	29 x 124	46.3	65	NAR	
F23-RC-SK	Aerotech RMS	32 x 107	37.8	70	NAR	
F24-4,7	Aerotech RMS	24 x 70	19	50	NAR	
F37-6,10,14	Aerotech RMS	29 x 99	28.2	50	NAR	
F39-3	Aerotech RMS	24 x 70	22.7	50	NAR	Decertified 7/1/2002
F39-6,9	Aerotech RMS	24 x 70	22.7	50	NAR	
F40-4,7,10	Aerotech RMS	29 x 124	40	80	NAR	
F52-6,8,11	Aerotech RMS	29 x 124	36.6	78	NAR	
F62T-S,M,L	Aerotech RMS	29 x 99	25	52.2	TRA	
F62-4,6,9	NCR	29 x 103	51.5	80	NAR	
F50-6	Public Missiles	29 x 95	37.9	80	NAR	
F32-5,10,15	Rocketvision	24 x 124	37.7	80	NAR	
F72-5,10,15	Rocketvision	24 x 124	36.8	80	NAR	

Motors, continued on page 11

Motors, continued from page 10

G Motors			Mass	Impulse		
G25-5,10,15	Aerotech	29 x 124	62.5	120	NAR	
G35-4,7	Aerotech	29 x 98	50	105	NAR	
G38FJ-4,7	Aerotech	29 x 98	55	94	NAR	
G40W-4,7,10	Aerotech	29 x 124	55.1	120	NAR	
G40-4,7,10	Aerotech	29 x 124	55.1	120	NAR	"Classic" Decertified as of 7/1/2002
G55-5,10,15	Aerotech	24 x 177	62.5	125	NAR	
G80-4,7,10	Aerotech	29 x 124	56.9	120	NAR	
G12RC	Aerotech RMS	32 x 107	51.1	93	NAR	
G33-5,7	Aerotech RMS	29 x 124	72.2	100	NAR	Requires L1 Cert
G54-6,10,14	Aerotech RMS	29 x 124	46	85	NAR	
G64-4,8,10	Aerotech RMS	29 x 124	62.5	120	NAR	
G75J-S,M	Aerotech RMS	29 x 194	105.6	145.6	TRA	Requires L1 Cert
G101T-S,M,L	Aerotech RMS	29 x 125	46	85	TRA	Requires L1 Cert
137G60-12A	Cesaroni Tech	38 x 125	78.4	139.4	TRA	Requires L1 Cert
G40-P	Kosdon	29 x 206	48.4	120	NAR	
G70-5,7,10	NCR	29 x 103	62	90	NAR	Never sold at retail
G40-4,7	Public Missiles	29 x 124	55.1	120	NAR	
G80-4,7	Public Missiles	29 x 124	56.9	120	NAR	
G55-5,10,15	Rocketvision	24 x 177	62.5	125	NAR	
H Motors						
ALL MOTORS H AND ABOVE REQUIRE LEVEL 1 CERTIFICATION						
H45W-10,15	Aerotech	38 x 194	186	289.3	TRA	Requires FAA WAIVER and LEUP
H55W-6,10,14	Aerotech	29 x 191	93	157.1	TRA	Requires LEUP
H70W-6,10,14	Aerotech	29 x 229	111	214.8	TRA	Requires LEUP
H125W-S,M,L	Aerotech	29 x 330	185.7	321.8	TRA	Requires FAA WAIVER and LEUP
H73J-S,M	Aerotech RMS	38 x 152	125	188.6	TRA	
H97J-S,M	Aerotech RMS	29 x 238	140.9	191.2	TRA	Requires FAA WAIVER
H112J-S,M	Aerotech RMS	38 x 191	187.5	265.7	TRA	Requires FAA WAIVER
H123W-S,M,L	Aerotech RMS	38 x 152	125	246.8	TRA	
H128W-S,M,L	Aerotech RMS	29 x 194	92.2	177.9	TRA	
H148R-S,M,L	Aerotech RMS	39 x 152	115.1	208	TRA	
H165R 10,15, P	Aerotech RMS	29 x 194	83.1	165	TRA	
H180W-S,M,L	Aerotech RMS	29 x 238	123	236.8	TRA	
H210R 10,P	Aerotech RMS	29 x 238	110.8	220	NAR	
H220-6,10,14	Aerotech RMS	29 x 238	106.4	220	NAR	
H238T-S,M,L	Aerotech RMS	29 x 194	83.8	178.4	TRA	
H268R 10,14,P	Aerotech RMS	29x	166	320	NAR	Requires FAA WAIVER
H242T-S,M,L	Aerotech RMS	38 x 152	110	246	TRA	
265H110-13A	Cesaroni Tech	38 x 184	145.6	270.7	TRA	Requires FAA WAIVER
H70-P	Kosdon	29 x 291	81.7	180	NAR	
H135-11	Kosdon	29 x 291	112	240	NAR	
H70	R.A.T.T. Works	29 x 457	108	177.4	TRA	Hybrid
NOT CERTIFIED, but still encountered once in a while						
B4-6	Estes	18 x 70	6	5	NAR	Expired
F101T-S,M,L	Aerotech	24 x 124	48.3	78.6	TRA	Expired
All Kosdon except listed above						TRA Certification voided

Snapshot

A Very Bad Day at the office for Trident test engineers. Says Commander Dave Fergus, U.S. Naval Reserve, to the submariners below:

"Duck!"

Tech Tip:

Use vinyl spackle to fill the grain on balsa-finned rockets. The spackle sands much easier than the balsa so you don't over sand the balsa, like you might with a tougher filler. I get great results.

--Rick Vatsaas

The *MASA Planet* is the official newsletter of the Minnesota Amateur Spacemodeler Association, Section 576 of the National Association of Rocketry. It is published bimonthly as a service to its members.

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Submissions may be made to the editor at: mailto:masa.planet@mn-rocketry.net. (Volunteer quickly, lest you be drafted to write the definitive legal history of US Rockets.)

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We also appreciate being notified about address and phone number changes!

Answer Box

MASA Planet Volume 5, Number 1: Rocket Ships in the Age of Steam

The Vatsaas brothers

(http://www.vatsaas.org/rtv/construction/construction.asp)

Ted Cochran

Parting shot

George Gassaway's scale X-1 radio-controlled rocket glider soars into the thin Colorado air at NARAM.

You can almost hear Chuck Yeager's drawl calling out the Mach number!

Unfortunately, this is the best this flight ever looked (Hint: The model weighed more than the thrust generated by the rocket motor).

See the dénouement in the next MASA Planet.

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