



Safety First!

Motor Retention

Recent incident highlights importance

Ted Cochran, NAR 69921

Most of us know why motor retention is important: If the ejection charge kicks out the motor instead of the nose cone, a lawn dart is often the result. And, if we're flying high power, the hazard posed by a falling motor casing is not insignificant, either!

However, a recent incident at a NAR launch taught some of us about the existence of a whole new kind of hazard: Unrestrained motors that escape from clusters. In this incident, a rocket with two high-initial-thrust motors (H275s) launched with only one of the motors burning, and the other motor fell out as the rocket cleared the launch rail *and then ignited*. The burning unrestrained motor attained a high velocity, flew over the heads of spectators, and struck and damaged two cars in the parking area behind them.

The more we looked at this incident, the scarier it appeared, and the more we learned. I'd like to share some of the analysis here, so that we can all take full advantage of the lessons learned.

First, since the rocket was relatively light (3-4 pounds) the initial acceleration, even on one motor, was around 60 g. This subjected the unlit motor to a force of around 30 lbs, which apparently overcame its retention.

Motor retention, continued on page 2

ALSO IN THIS ISSUE

- 2** Asymmetric Atlas 5 Launch
- 3** Event Schedule; President's Corner
- 4** Sky Hook Kit Review
- 6** TARC Tales
- 10** Milestones; Parting Shots

Outreach

Four Minnesota Teams Make TARC Finals

Dakota County 4-H returns to defend title

Eleven of fifteen TARC teams from Minnesota had made qualification flights by the end of the last hectic weekend before the deadline, and four of those teams scored well enough to make the national finals in Great Meadow, VA on May 20.

Two teams will return from last year: The Dakota County 4-H team will defend its national title, and Apple Valley High School will attempt to improve on last year's 75th-place performance. The other Minnesota team from last year, Hope Christian Academy, scored fourth place then. This year, they made good qualifying flights, but not quite good enough to reach this year's finals.

Two teams from Minnesota made the finals for the first time this year. Kimball High School, in its third year of TARC competition, and first year competitor Maranatha Christian Academy will also be traveling to Great Meadow.

Many of these teams, including all four of the teams that made the finals, were assisted by MASA members who served as mentors and observers: Ted Cochran, Ken Corey-Edstrom, Mike Erpelding, Art Gibbens, Ken Jarosch, Buzz McDermott, Mark Nelson, Glen Overby all helped TARC participants get the most out of their experience. Huge thanks to all of them on behalf of NAR and AIA, and congratulations to all of the teams that participated.

Keep an eye out for stories on these teams in the local news media. Kimball has already scored coverage in the St. Croix Times newspaper, and The Minneapolis Star Tribune and WCCO are also planning stories. ↓

Second, once that motor came up to pressure, it became a high-speed hazard in a hurry. The high initial thrust spike (180 pounds) over a very short period of time (fifty milliseconds) enabled it to reach a high straight-line velocity--there was no time for it to tumble and cancel that initial thrust vector. It is possible under some conditions for that particular motor to reach a speed of about 500 mph, traveling about fifty feet in only about one-tenth of a second! Under these circumstances, the motor will have significant kinetic energy--approximately equivalent to a ballistic return of an eight-pound rocket.

But as it turns out, this problem isn't confined to this particular motor. Since most motors have a relatively large thrust spike, there is always the chance that they'll start moving in some direction if they get loose and then ignite. If this happens, the only real safety barriers we have left are luck (maybe the motor won't head toward us) and distance--which is reason enough to carefully observe the required extra safe distance requirements for HPR clusters.

Distance helps in two ways: It gives us more time to react (and recall that we'll have to react very quickly indeed!), and it makes us a relatively smaller target for the rocket motor to hit. As a reminder, the minimum distance for a clustered HPR rocket is 200 feet. More is better.

Even low-thrust-spike motors can pose a hazard: There are documented cases of motors flying in relatively straight lines during their burn, enabling them to reach a high speed. We'd like to think that freed motors will harmlessly pinwheel, but it doesn't always happen.

The bottom line is that motor retention is more important than you might think in clusters, because these configurations have extra failure modes that can make for a Very Bad Day.

And remember, even for rockets with a single motor for which motor ejection at the pad is difficult to imagine, retention is still important. If you lose the motor at apogee, something is still going to get bonked hard!

Fly safely, and have fun!



Full Scale

Unique Atlas 5 Makes Perfect Launch

Asymmetric configuration works as planned

A Lockheed Martin Atlas 5 rocket with a unique single strap-on booster configuration, carrying the European ASTRA 1KR television broadcast satellite, made a perfect flight April 20 from Cape Canaveral. This was the 79th consecutive mission success for the Atlas program.

The nozzle of each booster is aligned with the Atlas' center of gravity, and the Russian RD-180 main engine is steerable, so the Atlas can be configured to deliver just the right amount of thrust regardless of the asymmetry of the booster(s). This is the first time an Atlas 5 has launched with a single strap-on.



Credit: Ben Cooper/Spaceflight Now

Atlas 5-411 lofts 9,548 pounds to a 22,237 x 3,860 mile geosynchronous transfer orbit.

MEETING SCHEDULE

MONDAY, MAY 8 (NOTE DATE CHANGE!)

Location: Science Museum of Minnesota

Time: 7 PM to 9 PM

Topic: Planes on Skis--Russ Durkee on his stay in Antarctica last winter

THURSDAY, JUNE 1

Location: Science Museum of Minnesota

Time: 7 PM to 9 PM

Topic: Rocket Locators (How to take on a cornfield--and win!).

Note: Classrooms 11 & 12.

THURSDAY, JULY 15

SUMMER PICNIC AND LAUNCH!

Watch for details!

LAUNCH SCHEDULE

**NOTE: TIMES AND LOCATIONS SUBJECT TO CHANGE!
CHECK THE WEB SITE FOR UPDATES**

TEAM AMERICA ROCKETRY FINALS

SATURDAY, MAY 20

Location: The Plains, Virginia

Time: 6 AM to 5 PM

Theme: TARC Finals

NATIONAL SPORT LAUNCH

SATURDAY, MAY 27 - SUNDAY, MAY 28

Location: McGregor, Texas

SATURDAY, MAY 27

Location: Nowthen

Time: 9 AM to 4 PM

Waiver: 5500 feet MSL.

SATURDAY, JUNE 24

Location: Nowthen

Time: 9 AM to 4 PM

Waiver: 5500 feet MSL.

NAR Contest (Buzz McDermott CD)

SATURDAY, JULY 15

SUMMER PICNIC AND LAUNCH!

Watch for details!



www.rocketcontest.org

Will Dakota County 4-H repeat as TARC Champions?
Stay tuned....

Editor's Note

I Need Your Help!

Ted Cochran

This is the fifth year that I've edited the *MASA Planet* newsletter. Note that I wrote, "edited." Since it is very difficult to edit a newsletter that has no articles, I'm appealing to you for help.

Since March of 2002, we have collectively published 290 pages of articles, many of which have gone on to see press in the National Association of Rocketry's flagship magazine, *Sport Rocketry*. I've been proud to help us be a part of that.

Lately, the *Planet*, as well as *Sport Rocketry*, has been falling a bit short of contributions. I'd like to encourage each of you to help to solve that problem by contributing content to the *Planet*. This doesn't have to be a Herculean effort on your part--you can contribute photographs, short articles, reviews, stories--almost anything that is related to sport rocketry as a hobby is welcome! In particular, please consider contributing:

- Kit reviews, like Alan Estenson's excellent *Sky Hook* review in this issue. Other rocketry-related product reviews (altimeters, motors, parachutes, whatever) are also welcome!
- Launch reports, especially of interesting rockets or of interesting flights.
- Outreach reports: Schools, youth groups, build and flies, demonstrations, you name it!
- Construction tips, hints, suggestions, or how-to articles.
- Road trips: Reports of national events, regional launches, spaceports, and the like.
- Articles about things related to sport rocketry that MASA members might also be interested in: Full-scale launches, astronautics, astronomy, space history, etc.
- Photographs, especially of MASA members and their rockets.

Don't worry about making the article perfect--I'll take drafts, too! Thank you in advance for your efforts!

Kit Review

Let's Do the *Sky Hook* Again!

Alan Estenson, NAR 69539

I'm looking at an original Estes Industries invoice that is framed and hanging on my hobby-room wall. It's dated 2/18/82, and it represents my entry into model rocketry at the grand age of 10-and-a-half. One of the items on that invoice was an Astron Sky Hook, kit #1208, priced at \$3.25.

As things turned out, that Sky Hook kit ended up being the third model rocket that I built. I particularly remember that I had to cut out the fin pattern, trace it on the piece of balsa stock, and then cut out the individual fins. I had constructed one previous rocket with die-cut balsa fins, but this was definitely more of a challenge. My cousin Greg, who was a few years older than I, had convinced me that I should sand a special shape into balsa fins. I recall sitting there with my sandpaper block, carefully rounding the leading edges and tapering the trailing edges. A couple coats of sanding sealer from the local hardware store served

to seal and smooth those fins. I thought that the white/red/black paint scheme shown in the catalog was boring, so I brought out my little square bottles of Testors enamel model paints. Brush in hand, the body tube ended up bright orange with metallic gold fins and nose cone. It was definitely bright and colorful!

My memory is fuzzy on how many times the ol' Sky Hook flew, but I do remember its demise. Living on a farm, going to the launch site was as simple as walking out into the front yard. On that day, I decided that I should put a C6-7 in the Sky Hook. After all, the instructions said that it could fly on a C6-7, right? It probably shot up a good 1,500 feet and drifted south a quarter-mile under that 12-inch parachute. Where did it land? Right in the middle of a slough! I could see it hanging out there above the smelly green water--parachute caught on a cattail. Lacking a way to retrieve it, that was the last flight of my Sky Hook.

Fast forward a bit over two decades, and Semroc is producing a Sky Hook kit in their "Retro Repro" line of kits. The price is a bargain \$5.50 -- not much more than I paid over two decades ago. There's no way that I could resist building a new Sky Hook!

The Semroc kits are professionally packaged and poly-



bagged. Opening it up, I found that the bag front-card also served as the front page of the instruction book. The instructions are first-rate, clearly-written, and step-by-step. At the front is some history of Semroc, Estes, and the Sky Hook kit. Looking at the parts, some things have clearly changed in 20+ years. The fins are now beautifully laser-cut; they almost fall right out of the balsa sheet. There is a body tube, nicely-turned balsa nose cone, engine spacing tube, water-slide "Specifications" decal, and two small bags. One bag contains the parts for the printed-plastic 12 inch Semroc parachute; the other bag contains the motor block, launch lug, screw eye, Kevlar string, and elastic shock cord. Besides the laser-cut fins, the Kevlar shock cord mount is the other major update to this kit. You tie one end of the Kevlar around the motor block during assembly and then tie the other end to the elastic shock cord.

Assembly was straightforward. This is, after all, a fairly simple 3FNC rocket. The only major change that I made was to glue the launch lug at one of the fin roots instead of centered between two of the fins. This time, I didn't bother to sand an airfoil shape into the fins. Instead, I just rounded all but the root edge. After assembly, I applied and then sanded some diluted Elmers Fill-n-Finish to fill the grain on the nose cone and fins.

You can stop holding your breath; I had no urge to paint this Sky Hook orange and gold! Instead, I settled on something fairly close to the kit art. After a coat of grey primer, I painted the nose cone gloss black and the remainder of the rocket gloss white. Masking off one fin, a stripe between fins, and the body tube forward of the fins, I painted the two other fins and exposed rear body tube gloss red. The black stripes were cut from self-adhesive Trim Monokote. It looks pretty sharp as-is, so I probably won't apply the "Specifications" decal.

There are only two things in this kit that I feel could be done differently. First, some people are skeptical of using Kevlar string as a shock cord mount. After many ejections, the heat can eventually weaken it, and allow it to snap. Second, the 12 inch chute seems enormous for a rocket this size. It would likely recover nicely under a 2 by 20 inch plastic streamer. I've elected to

try the chute, but I did cut a huge spill hole in the middle.

I haven't yet had a chance to fly my new Sky Hook, but it should be a great performer on A8-5 and B6-6 motors. I plan to resist any urge to try it on a C6-7!



Outreach

TARC Tales

Ted Cochran, Mike Erpelding, Art Gibbens, Ken Jarosch, Buzz McDermott, Mark Nelson, Glen Overby

Here are some stories from the hectic final weekends of TARC Qualification, by NAR mentors and observers on the front lines.

25 March at Apple Valley: First Qualifications!

MASA moved the previously scheduled March launch to Apple Valley High School, braving a foot of snow and chilly temperatures. Four TARC teams made over one dozen flights.



North High, mentored by Ken Jarosch, flew three times, at least, and made one official qualification attempt. They got within one foot of the target altitude, but alas their egg capsule separated and came in ballistic. So did their altimeter, falling all by itself into the snow, but it kept beeping and it was recovered in excellent condition (see photo above).



Mounds Park Academy (MPA), also mentored by Ken, got in a practice flight and acquired valuable practical knowledge (above).

Hope Christian Academy, mentored by Art Gibbens, had a successful qualification flight (below).



Apple Valley High School, mentored by Ted Cochran, had at least seven(!) practice flights (below), followed by two successful qualification flights, the final

one generating a single digit score. They were the last ones off the field a little after 2:00 PM, tired but very happy. Apple Valley was one of four Minnesota Teams to make the Finals. Congratulations!



1 April: No Fooling!

Afrocentric Educational Academy made two successful qualification flights, not without some, interesting adventures. The highlights included a practice flight on one of two motors in a cluster, a good practice flight, a good, but low, qualification flight, a rip snorting CATO of an E9 that split the casing end to end and destroyed one of their two rockets, and a decent qualification flight at the end of the day.

Mounds Park Academy came down and flew another practice flight. It separated, alas, and the nose & egg lawn darted. They rebuilt and returned the following week in Dakota County.

North High came down again and flew practice flights, including a really good one. Jamie was all alone representing her team and we thought she would not only qualify but achieve a great score.

In previous practice sessions, North only had 8 flights. As they improved their goal changed from, "we want to qualify" to, "we want to be competitive." They had several flights around the 800' mark and several very close to 45 seconds.

Of their 11 flights, only two failed. Alas, both were qualification attempts. During the previous flight, Jamie got 786 feet and 46 seconds. Unfortunately, on the next flight, their last qualification attempt, the parachute tangled badly. The rocket landed hard, but might have been OK except the landing was on the

pavement and broke (smashed) the egg. That was sad.

North High's team was mostly Seniors, and their teacher said he had other assignments next year, so this might have been a last flight.

Southwest Middle School drove up from Albert Lea and qualified--they went high on an F50, and lower than expected on an F20, but both were good flights. A TARC rocket on an F50 is something to behold!

Hope Christian Academy was able to get in three practice launches to try to home in on a better qualifying score. The students discovered some things: For example, even if only two of three engines ignite and the rocket drags along half of the clip whips, the rocket is stable enough to be recovered safely. So they got their "bad flight of the day" out of the way on their first flight. Upon inspection, it was discovered that the igniter had fired, but that there was clay residue coating the propellant of the Estes D motor. All subsequent motors were inspected and had this dust removed if present. They had no more misfires the rest of the day.

Their second flight was weighted to adjust the flight back up closer to the 800 foot mark. The week previous they only went 739 feet. This flight went over 930. For the third flight, they added more weight, and still went over 870 feet.

For the fourth flight, the team added even more weight to make it heavier than last week's rocket. It still managed 839 feet. They deduced from the last three flights that the previous week's flight had to be an anomaly, as this final qualifying flight was pretty close to the altitude that RocSim said their rocket should have achieved. Had they the time to put up a couple of more practice flights they might have gotten a qualifying score lower than their best score of 44.56. They were left on the bubble waiting to see if it was good enough to get to nationals.

2 April: Kimball Gets Wet! (But Qualifies)

Kimball High School's day could be summed up in one word: WET. Mentored by Mike Erpelding, they started prepping their tube fin rockets at the school. The rain was light but steady. Then they went out to

the farm to fly. There was only a faint drizzle for the first practice flight.

An F21-4 sent it 795 feet, but it had a timid chute from near apogee to about 6 feet from the ground- it did fall horizontally all that time (got to love those tube fins!)--so the time was just 29 seconds.

A second practice rocket was flown in a light rain to 864 feet. The chute came out this time, and it took 56 seconds to come down.

The rain continued to increase. A third practice flight had a chuffing motor and went only 556 feet.

The fourth flight was also the 1st qualification attempt, also in the rain. It also chuffed (it was from same pack). It went only 567 feet, returning in 32 seconds.

No eggs were broken that day. This team has been participating for three years now. The three core participants are all seniors, with two 7th grade siblings. They flew a *much* better flight later in the month (below) to score a 13 and qualify for the Nationals! Congratulations!



St. Cloud Times photo by Kimm Anderson

7 April: Reigning National Champion Dakota County 4-H Qualifies!

Glen Overby's TARC Observer report, in its entirety:
~15mph wind, airliners passing by every 2 minutes, 3 bad copperheads, 1 flakey launch controller, muddy field. Flight time: 52.11 seconds. Altitude: 799 feet. Qualified!

(Dakota County 4-H, mentored by Mark Nelson, got another good qualification flight in the next day, and was selected for the finals! Congratulations!)

8 April: Maranatha Christian Academy Qualifies!

Buzz McDermott met with the **Maranatha Christian Academy** in the morning at Noble Sports Park in Brooklyn Park. It was a beautiful morning, with temperatures in the 40s, absolutely dead calm winds and clear sunny skies. The part of the park they fly out of is the size of three or four soccer fields, all flat and green and nicely mowed. If it were possible for MASA to get a permit to use this facility it would make a great model rocket launch site (up to E power or F power on large clunky rockets).

The four boys on the team and their teacher/sponsor arrived at 9:00 AM, flew until 1:00 PM, and made a total of four flights. The first two were a last pair of 'tuning' test flights. The first flight flew to only 750 ft and stayed up only 33 seconds. They ended up cracking the egg, too. Fortunately, they had ballast they could remove from the nose. The second flight went to 825 ft and over 40 seconds. It took about an hour each to prep, fly, recover and evaluate these two flights.

By 11 am the breeze started to pick up a little. Buzz was concerned that it might continue to pick up and suggested they go ahead and try for their first qualified flight. About 11:30 they made a fantastically straight flight on two D11P and one D12-7 motors in a BT-80-based rocket. Ejection was a little after apogee. With a good chute deployment they had a flight time of just less than 41 seconds. The reported altitude was 813 feet and the egg was undamaged. Success!! Score: 17.06.

About 12:30 they were ready for attempt number two. They got an even straighter flight this time with deployment right at apogee and a very gentle chute opening. Duration of this flight was 43.85 seconds. When they brought the payload section back the altimeter was beeping 820 feet. Another success!

Altogether, MCA made about one dozen test flights and 2 successful qualification flights. They flew five different times at Noble Park. Their efforts paid off!

They burned through 8 packs of D11Ps, 1 pack of E9s and 3 packs of D12-0s. This effort paid off, as Maranatha Christian Academy qualified for the Finals! Congratulations!

8 April: Last Chances

Four teams went to Mark Nelson's farm to make their final attempts to qualify. That morning, Mark had finished the last session of our three part Introduction to Rockets Workshop for the Dakota County 4-H kids. We had 20 kids, most building and launching for the first time. All the kids left with a launch pad, launch controller and at least one flight under their belts. We also did some demo launches.

Then it was time for the TARC flying. There were seven qualification attempts with four successful flights--All teams got at least one good flight. Once again the teams that prepared and practiced did the best.

Mark's 30+ year-old launch controller was sacrificed when it quit working--another childhood keepsake donated to TARC. Mark cut the wires off and connected the battery clamp wires to the alligator clip wires. The battery clamps became the launch switch and safety key all in one.

After all the misfires, Aerotech gets five more votes of no confidence in their copperhead igniters!

Dakota County 4H had another excellent flight.

One student from **Mounds Park Academy's** team of five showed up. They had redesigned their booster; they wanted to increase their power to a full "F". They lengthened the booster and made it accommodate a 29 mm motor mount for an F25. They thought that if it went too high, they would add weight to bring the altitude down.

On the first test flight of the day, the egg capsule fell free due to a ripped elastic shock cord, but with no damage to the egg or altimeter! On the second test flight, the shroud lines ripped off the parachute and the rocket core sampled. This time the altimeter punctured the egg. Glen helped him with both recoveries, and helped find his second attempt -- most stuff sticking out of a farm field doesn't have fins :-). The egged altimeter may have been damaged and returning

strange readings, as the first qualification flight had an altitude that was a bit high. His second attempt had a reported altitude of 5280 feet, and Glen was sure that was wrong.

They only had three flights total all of which were ended in some kind of separation of parts. The payload sections were held together only by some tape which did not hold. This was supposed to be a one year event for them, but the teacher is fired up for next year.

Andover High School was the only team that Glen saw with a checklist. They measured everything! Their first qualification attempt caught a thermal and went a bit long. Their second attempt didn't catch a thermal and was short.

Unfortunately on the second flight the "fin can" portion of their rocket twisted up the parachute - after parachute deployment - and came in ballistic.

Minnehaha Academy's first flight was an under-powered qualification attempt with a D12-D12 combo. They made a good test flight on an E30 and a successful qualification attempt on that motor.

I think everyone had a lot of fun!

Many thanks to Mark Nelson for offering his field to the other teams, and for spending the entire day flying rockets; Mark and his family ran a 4H launch in the morning, and then flew TARC rockets until sunset. He also brought plenty of extra qualification forms :-)

Congratulations to all the TARC teams that qualified and good luck to those going on to the finals.



All photos by Russ Durkee

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. MASA authors and photographers retain rights to their submissions, which are used by permission. The *Planet* is available in **color** on MASA's web site:

<http://www.mn-rocketry.net/masa/>

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Web Gems



Brad Vatsaas' Darmok and Jilad at Tenagra heads towards the photographer, Tsolo T. Tsolo of Rocketshots. See <http://www.vatsaas.org/rtv/> for the gory details. Referred by Rick Vatsaas.



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