MASA Planet

Volume 6, Issue 4 **July 2003**

Safety First!

Off-Axis Thrust

Keeping your rockets from getting loopy

Ted Cochran, NAR 69921

You may be sitting under the sunscreen, prepping a rocket, not paying much attention to the LCO on the PA, but you're unlikely to miss the unmistakable sound of an unstable rocket doing loops: WooOOOOoooOOOOOoooOOOOosh!

The usual cause for this problem is that the rocket's center of gravity is too far back. But there are other

http://tjm.home.texas.net/skyedance33.html

possibilities, and I started thinking of them while hearing that noise during TARC launches--where, given that there were two eggs in the nose of every rocket, the CG location was never a problem.

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Team America Finals

A volunteer's report from The Plains, VA.

Mike Erpelding, NAR 79922

Well the TARC Final Fly Off could be summed up in two words: "fun", and "rainy".

Friday morning was overcast with light rain when we flew out of MSP. The weather was about the same when we landed at Dulles. Ted was very kind to allow me to ride with him so I didn't have to rent a car. We checked into the Holiday Inn, the staff hotel, in Manassas, VA. We headed out to Stonewall Jackson High School a little early to help set up for the Range Crew and Contestant's briefings. Ted and I helped haul in all of the packages various teams shipped to VA, and we got our t-shirts and caps.

I finally got to meet Tim Van Milligan from Apogee Components. I've been buying stuff from Tim for a couple years now. Tim was also one of the volunteers. Astronaut Jay Apt sat right behind Ted and me during the Range Crew briefing.

NARTS also had a table set up selling NAR stuff. I bought a copy of "Modern High -Power Rocketry An Illustrated How-To Guide" by Mark Canepa. I've been meaning to get a copy of this book

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Looping can be caused by control surfaces that are not aligned properly, but usually that result is either a rainbow arc and impact under power (the Estes RTF foam Space Shuttle is famous for this) or, more often, spiral, coning, or otherwise squirrelly flights. Unless the misalignment is symmetrical, the rocket both yaws and rolls, resulting in a spiral instead of a loop.

To generate loopy flights on an otherwise stable rocket, you need off-axis thrust. Off-axis thrust simply means that the force that is pushing the rocket forward is not aligned with the geometric axis of the rocket.

There are three common causes for this:

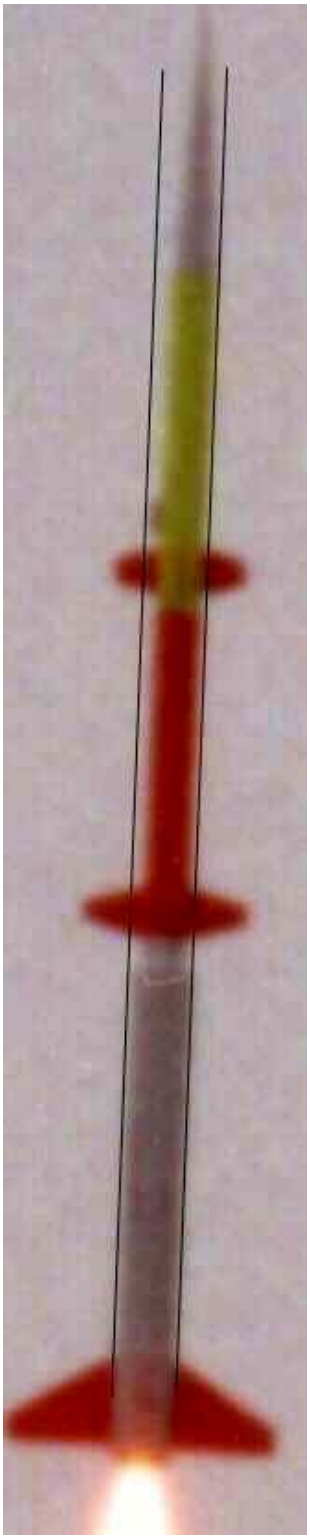
1. The rocket motor nozzle isn't straight
2. The motor mount isn't straight
3. The rocket isn't straight.

Mis-aligned single-use motor nozzles are rare, but they can happen. My Lil' Nuke "found" one of these in an F25 at NARAM. Post-flight inspection detected a subtle but noticeable cant in the nozzle that was easily confirmed by an Aerotech technician with a mini square. To prevent such fun from happening to you, check the motor nozzle before you install the motor. Black powder motor nozzles can sometimes erode asymmetrically, with the same result.

It is also possible to assemble a reloadable motor with a crooked nozzle, especially if you leave parts out. Rocket Team Vatsaas demonstrates this capability in spectacular fashion on their web page (start at: www.vatsaas.org/rtv/lessons/lessonslearned.aspx).

Misfires in clustered motors can have the same effect in that the center of the thrust vector is not aligned with the rocket's geometric axis (see page 8, for example).

Canted motor mounts are rare, especially in commercial kits. The ones I've observed resulted from damage. Perhaps the rocket landed on the protruding motor, breaking the top of the motor tube away from its centering ring, or perhaps the top of the motor tube has been charred by the ejection charges from one too many flights, allowing it to become crooked. You can minimize the chances of this happening by using an extra centering ring in the middle of the motor mount tube, and by checking for this damage after every flight.



Crooked rockets are more common, as anyone who has observed a Super-roc contest can attest. Any bend in a long rocket will shift the geometric axis off of the thrust line, resulting in "interesting flight" profiles. Off-axis thrust can also occur in a multi-stage rocket if the coupler isn't strong enough, especially if there are misalignments between upper stage and lower stage fins. The accompanying photo shows the *Big Honkin' Rocket*, a Tripoli Minnesota project, beginning to bend at a coupler just prior to entering the first of two loops it made on its maiden flight.

Finally, remember that, unless you're launching from a tower, the thrust axis at launch is always at least a little bit misaligned, because it is offset from the launch rod or rail. This may lead to rod whip and at worst can lead to rod lock, as Ken Corey-Edstrom's Jupiter 2 demonstrated for us at the June launch!

So check the thrust axis, and keep the pointy end up!

References

Richard Nakka's Experimental Rocketry Web Site

MEETING SCHEDULE

SATURDAY, JULY 19
FIFTH ANNUAL SUMMER PICNIC!
Location: Elk River / Otsego VFW
Time: 5 PM - 7:30 PM
Annual Swap and Sell
Topic: Eat, Drink, and Launch Rockets!
More info on the web site:
http://www.mn-rocketry.net/masa/news/2003/2003-01.htm

TUESDAY, AUGUST 5
Location: Science Museum of Minnesota, St. Paul
Time: 7 PM to 8:45 PM
Topic: Junkyard rockets building session!

THURSDAY, SEPTEMBER 4 (NOTE CHANGE)
Location: Science Museum of Minnesota, St. Paul
Time: 7 PM to 8:45 PM
Topic: Payloads!

LAUNCH SCHEDULE

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

SATURDAY, JULY 19
FIFTH ANNUAL SUMMER PICNIC LAUNCH!
Location: Elk River / Otsego VFW
Time: 3 PM - 5PM & 7:30 PM - dusk
More info on the web site:
http://www.mn-rocketry.net/masa/news/2003/2003-01.htm

SATURDAY, JULY 26
WILLIAM MCCOOL MEMORIAL LAUNCH
Location: tbd
Time: 9 AM - 4 PM
Fifth Annual MASA Scale Event

AUGUST 1-8
NARAM-45
NAR's annual competition and sport launch
Location: Evansville, IN
For more info see: http://www.naram45.org/

SATURDAY, AUGUST 23
ILAN RAMON MEMORIAL LAUNCH
Location: tbd
Time: 9 AM - 4 PM
Fifth Annual Great UFO Drag Race,
Second Annual Comanche-3
Drag Race, & Junkyard Rockets !

Coming Soon: Plans for Tim Bush's incredible Ringhawk!

Editor's Note

Keep Flying!

Ted Cochran

Glen Overby has been having a difficult time in his real job of late (it involves writing computer software without electricity. Really--ask him if you don't believe me!), so I'm going to use his soapbox for just this month.

First, see the box on the left of this page? See the first entry under *Meeting Schedule?* See the first entry under *Launch Schedule?* They're the same! That's right, it's MASA Picnic time again! Last year 50+ people came and launched and lunched and launched some more, and it was a truly wonderful day! You don't want to miss it--so right now, log on to the web page and RSVP and sign up to bring root beer. Or anything else your heart desires.

Second, it looks like we have a new field to replace Fricke's sod farm, which as you know was eaten by the developer trolls. Thanks to Glen for organizing the search and Rick for strong-arming, er, sweet-talking his friends. You can get a preview of the new field on the Team Vatsaas web site's launch sites page.

Third, I've noticed that APCP motors are beginning to become more readily available. Even though the bigger ones (those that have more than 62.5g of propellant) are now accompanied by some irksome paperwork, they can be had, which is more than we could say last year.

Which brings me to the point: Keep Flying! With all the recent ATFE actions, the loss of the field, propellant shortages, vendors going under, etc[1]., it's easy to get discouraged. One reliable antidote for such discouragement is to fly! Do something different! Build a boost glider! Get an old rocket and put a bigger motor into it! Scale something up or down! Do another NARTREK level! But whatever it is, fly it!

The more variety you build into your flying diet, the less you will be affected by any temporary--and they *will* be temporary--disruptions we may face. And the more fun you'll have!

Gotta go; need to get Quantum Leap ready to fly again!

Aim high,

Ted Cochran, MASA Planet Editor

[1]Does the economy count? How about the crash of my Saturn V? :-)

Outreach

Rocket League Wrap-Up

Fifteen teams, five trophies, fifty -three medals

Ted Cochran

Innovations in Science and Technology Education (INSciTE), assisted by MASA and Hub Hobby store of Little Canada, sponsored the second year of Rocket League this spring. Fifty-three middle-school students in 15 teams completed the competition this year.

Teams designed and flew probes designed to make up to twenty separate actual and simulated measurements in their landing area. Eleven teams chose to compete in the entry-level Mercury Division, three teams in Gemini division, and one team in the challenging Apollo division.

This year, INSciTE worked with the GEMS (Girls in Engineering, Math, and Science) program to recruit students, and twelve teams from Olson, Green, and Field schools in Minneapolis signed up.

Glen Overby and Ted Cochran ran a final launch on the afternoon of May 29 at Bryn Mawr Meadows park in Minneapolis. The accompanying photos show some of the fun. Twenty-five kids from six teams made their final contest launches, increasing their scores by adding improvised instruments including dandelions (wind indicators) and hair (humidity sensors) taped to the sides of their rockets. The Field *Ingirls* even found a piece of hard plastic and claimed that as a thermometer, "because if it melts, you know that it's really hot out!" We also learned that Estes Alphas remain amazingly stable, even with externally attached dandelions on board!

The *F.L.E.E.T. Feet Flyers*, mentored by MASA member Dave Fergus, won the Gemini Division by flying the innovative probe shown on the right. It included a working anemometer at the top, a self-righting compass in the middle, and a number of simulated sensors. In addition, the nose cone probe was designed to stick in the ground, providing a measure of surface hardness.

Saturn 6, led by MASA member Seth Cochran, made 9 actual measurements (temperature, surface feature height, pH, humidity, magnetic field, atmospheric dust, wind speed, surface slope, and surface hardness) along with five simulated measurements to qualify in the rigorous Apollo division.

INSciTE hosts the Rocket League Web site at www.hightechkids.org/IRL/. It has more information, including scores, standings, pictures of all of the rockets, and lots more pictures of the Bryn Mawr launch.

Activity Summary for '02-'03 contest year

NAR's practice is to review the activities of sections on the same annual basis that is used for competition. Below is a partial list of MASA's activities during the past year. There are some pretty significant contributions represented here!

- Fall '02-Spring '03Team America Challenge: 2 mentors for local teams (both of which made the national finals), 4 regional launches, four additional launches witnessed, six teams qualified, two club volunteers at finals.
- Rocket League: 15 teams, 53 student participants, four launches conducted (Two at Minneapolis Olson Middle School, one at Minneapolis Green Middle School, and the finals at Bryn Mawr Meadows park in Minneapolis).
- 4H Aerospace Judging: Stearns and Washington County Fairs (7/02), Minnesota State Fair (8/02).
- Stearns County Fair 4H Rocket Launch (8/02).
- Cub Scout launch in Eden Prairie (9/02).
- 4H Rocket Building workshop (11/02)
- Cub Scout exhibit in Little Canada (1/13/03).
- MASA rocket display at Lego League (1/25/03).
- MASA exhibit at ScienceFest at the Bell Museum (2/1/03).
- Supported 125 scouts launching at a camporee (5/17/03).
- School Launches in Blaine (build and launch), Andover (build and launch), and Burnsville (demo launch), about 150 students total (5/03).
- Girl Scout launch and exhibit in Bloomington (6/25/03).
- Nartrek awards: 8 Bronze, 1 silver, 1 gold.
- NAR High Power Certifications: Level 1: Dave Fergus, Dave Whitaker, Rick Vatsaas, Stuart Lenz, Mike Erpelding.
- Contest year launches: 15 launches burning 1693 motors in 1486 flights, 28.7 kNsec (an O motor!), $6.5K estimated dollars burned.

Team America, continued from page 1

since I read about it on Rocketry Online last year.

Ted and I stayed for the Contestant briefing before heading back to the hotel.

The next morning was off to an early start. We were suppose to be on the field at 6:30 A.M. (5:30 A.M. MN time) ready to get to work. The weather was overcast with barely a breeze. Ted went to help set up the Safety Check-In tent and I headed down to help set up Returns.

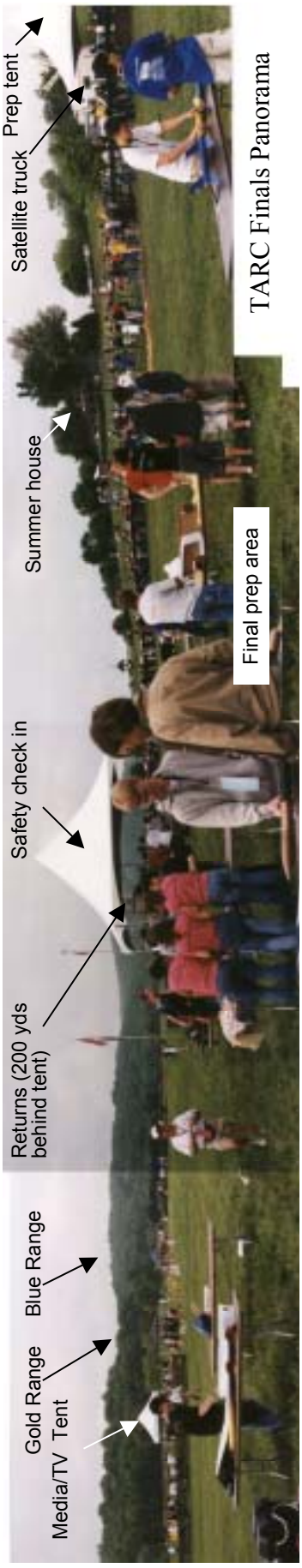
The field was a large steeplechase track (horse racing on turf with jumps--think "National Velvet" --Ed.) I was assigned to Returns, and was the first one there. Returns was located under a three-story gazebo-style announcers booth. The bottom level was made out of concrete block and housed the jockey's changing rooms and rest rooms. Everything was damp from the rain the night before. I put out the "Returns" sign and started to set up some tables under the deck.

Then I headed back up range to see if Ted or anyone else needed help. I got back in time to see the demo flights for the CBS Early Show. We "professionals" had as much trouble as the kids. I think there was a separation on one rocket. I remember one BP rocket didn't light all of its booster motors on lift-off. It successfully staged and back lit the unburned booster motor(s) for a "fiery re-entry". The launches were used in the background during TV interviews of Jay Apt.

The ceiling started to lift but it started to drizzle on and off. The Egg Council (The "Incredible Edible Egg" people) was serving omelets for the contestants only. Due to a communication error most members of the range crew went hungry.

The ceiling continued to improve to at least 2000 feet, but now a few rain clouds appeared.

I headed back to Returns, in case the impending rain lasted a while. I almost made it to Returns before the rain started. The bottom of the deck, which was the roof of the first floor, was covered with corrugated fiberglass like what's used as skylights in pole barns, and it started to leak at the seams. After sitting there a while, listening to FRS channel 6 for NAR range communications,



I decided to move our supplies and especially the laptop computer inside the jockey's area where it was drier. Not long after this the other Returns volunteers showed up, and we decided to move one table and the chairs inside.

Then it started to lightning; with about 8 seconds to the thunderclap. A decision was made to send everyone to the cars where it would be safer. Over the radio we heard a couple of volunteers were going to try to prep their rockets for the 9:30 A.M. CNN spot if the weather let up. I kept thinking, "20 below wind chill and snow is a lot better rocket flying weather."

Since the forecast for Sunday was for the same weather, a decision was made to continue with the contest. The thunderstorm moved out and the students were allowed to check in their rockets. Because of the delay, the schedule was changed from one hour prep and flight windows to just 45 minutes. The next demo launch went off in the rain, right on time. It continued to lightly rain off and on all day.

The first contestant launch went well and landed about 75 feet from us at Returns. The team of kids came running down the steeplechase track with red clay and water flying everywhere. They picked up their rocket and were anxiously waiting to find out from us their results. Needless to say their flight card didn't have a chance to beat them here. Mark Johnson from Kansas took care of candling all of the eggs all day. This team's eggs survived.

The contest was finally under way! Joe Woodford and Chris Kidwell listened to most of the altimeters, although sometimes Mark and I listened to them. The event rules required two NAR staff people to listen to the altimeters to confirm that the beeps were read correctly. Mark's wife had the hardest Returns job of the day. She took care of the results board. Lesson learned: dry erase marker boards don't work very well in the rain. The wind also kept trying to tip the results board over. Whenever it started to rain harder, we moved the results board under cover behind the announcer and a blue tarp hanging over the gazebo window. My job was to calculate the final score on the flight cards, carry the flight cards out the back door and up the muddy hill to the results board, pick up the flight cards recorded on the results board, and organize flight cards into piles based on score and if they were DQ's.

One disadvantage of mainly being in " the concrete bunker" most of the day was that I missed most of the launches. I did get to see the results and sometimes the carnage afterward. I don't remember each one individually; because they usually came in swarms of 3 or more teams at a time.

Some of the most memorable ones were:

The all girls team--They were extremely excited! They all let out one of those squeals when their first egg was okay. And when they found out that their second egg was okay, they screamed so loud that I was told the VIP's in the summerhouse could hear it! I wouldn't be surprised if Ted heard it too. It easily went over 120 decibels! All of our ears hurt after that one!

The team that dropped their second egg on the table before handing it to Mark for candling. It broke. DQ.

I do remember Apple Valley's return. They came through a little while after the egg dropping accident. I think I was more worried about their eggs as they handled their rocket than they were. Sorry guys, I forgot they were that tightly packed in there <grin>.

One team had a camera crew following them. I had to get out of the way, so they could get " a good shot ", as they filmed every step from listening to the altimeter to the candling of each egg.

I also remember the 1st place team from Boonsboro, MD. They had one reporter following them with the classic notepad. Everyone in Returns got a chance to listen to a perfect 1500-foot flight. The eggs candled perfectly. Wow! Hard to beat a score of zero points off! We answered several questions about the contest for the reporter. Afterward we told the team to go show Trip Barber what a perfect flight looks and sounds like. [It turned into quite a parade--everyone in Check in got to listen, too! --Ed.]

Beep! Beepbeepbeepbeepbeep! Beeeeeeep! Beeeeeeep!

I happened to see one scary flight while I was up on deck at the results board. It was the "Lazarus" flight that Ted wrote about. From my perspective it looked like it went unstable and power pranged by Safety Check In, then staged- leaping into the air, headed my way, bounced off the field, flew over or through the spectator chain link fence, and successfully ejected the parachute about 6 feet off the ground in the spectator area about 30 feet from me. Fortunately there wasn't anyone near that area. Maybe it was safer in the "bunker" :-). I saw the pieces of the rocket afterward as the team was carrying it away. The rocket's wood nose cone even had a one inch strip missing!

Pizza was served to the contestants and some of the staff courtesy of Lockheed Martin. Once again a communication error on how much food to order happened. Some sandwiches were made and brought with drinks to Returns later.

A few reflights were permitted at the end of the day for rockets that were unsafe to retrieve. One of these reached an altitude of 1520, and edged Apple Valley and two other teams out of 25th place.

The awards ceremony was held at the gazebo as soon as the contest ended. This was when I got to see Homer Hickam, Senator Mike Enzi, NAR President Mark Bundick, and several NASA and AIA officals.

After the ceremony Ted and I helped clean up and pack up the range. We then headed back to the Holiday Inn for a NAR staff social.

There is talk of doing this contest again next year. The actual altitude goal will be somewhat different.

Ted went to visit his parents on Sunday, and dropped me off at the Best Western, where the Apple Valley team was staying. After brunch, we went to see the Manassas battlefield where the first and second battles of Bull Run were fought in the Civil War. We went on a tour with a park ranger. She did a great job telling us the story of what had happened. Next we headed back to Dulles to catch our flight home.

I had a great time and I'm looking forward to hopefully doing this again next year!

References

About 1000 pictures are online (including the one below), linked from the bottom of this page:

http://www.aia-aerospace.org/aianews/press/tarc/ta_photos.cfm

The 2004 contest site is here:

http://www.rocketcontest.com/

Apple Valley's entry rises on five C6 motors. AIA

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/

Submissions may be made to the editor at: masa.planet@mn-rocketry.net. (Volunteer quickly, lest you be asked to alleviate the impact of urban development on rocket flying!)

If your email address, U.S. Mail address, or phone number changes: Please send notice of your change to masa@mn-rocketry.net. Include your name, old email address, and new address. We depend on email for communicating important information. When an email address starts "bouncing", we lose contact with you.

Welcome New MASA Members!

Steve Buganski
Kevin Cox
Donald Weibold

New Level 1 Certifications

Rick Vatsaas	*Evil Grimace*, April 12, 2003
Mike Erpelding	Aerotech *Sumo*, H128, April 26, 2003
Stuart Lenz	PML *Phobos*, H238, April 26, 2003

Uh Oh....

The source of asymmetric thrust is rather easily diagnosed in this memorable flight of Martin Dietl's two (?) motor cluster Exocet last Fall. As this month's *Safety First!* column explains, other causes can be more subtle. (By the way, the Exocet was repaired to fly again by Spring!)

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