

# ***HIGH POWER ROCKETRY***

**MAGAZINE OF THE TRIPOLI ROCKETRY ASSOCIATION**



**2020-21 COMPILATION ISSUE**

*High Power Rocketry* is the official magazine of the Tripoli Rocketry Association Inc.

Submissions to this publication, in the form of articles, opinions, and photos, are accepted. The editor reserves the right to reject or edit any material submitted.

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# HIGH POWER ROCKETRY

MAGAZINE OF THE TRIPOLI ROCKETRY ASSOCIATION

## 2020-21 COMPILATION ISSUE

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**Cover photo:** Scratch built 60" 4" diameter rocket owned by Ryan Woody (TRA 9647 L2, Denton, TX) takes off on an Aerotech 54/1280 J1799N Warp9 motor. Tripoli North Texas Seymour launch, January 2021. Photo by Harry Spears.

**Inside photo:** Rapid rocket disassembly. Photo by David Wilkins.

Visit Tripoli's website for all the information on high power rocketry, and how to join:

[WWW.TRIPOLI.ORG](http://WWW.TRIPOLI.ORG)



# FROM THE EDITOR

Many Tripoli Rocketry Association members will recall *High Power Rocketry* magazine from the past, when it was a printed publication provided by former TRA President Bruce Kelly. It was an excellent magazine, and quite a few current members have reported how they saw *HPR* in a hobby shop or newsstand, and were amazed at how far hobby rocketry had progressed. Plenty of these people used to fly small model rockets when they were much younger, and decided to join TRA to get engaged with high power rocketry. Thus, many who saw *HPR* magazine became “born again rocketeers” and are among our most avid flyers.

The original *HPR* magazine ended its run well over a decade ago, and TRA then formed a relationship with *Rockets* magazine, a new publication created by TRA members Neil McGilvray and Bob Utley. Neil and Bob worked very hard to capture as much rocketry action as they could, traveling to many launches every year, extensively photographing, video recording, interviewing and article-writing. They turned this into a fine print magazine, and kept it going for several years. Cost considerations eventually forced them to convert the publication into an e-zine format and end printing/mailing of a paper magazine. The magazine maintained a high standard, but ultimately, the pressures of all the work and realities of trying to keep things running made it untenable for Neil and Bob to continue, with *Rockets* wrapping up in 2018.

Until 2020, TRA lacked an “official magazine” either as an owned publication or through an affiliation with a third party. The reality of the publication world today is that printed media is extremely costly to produce and distribute; for those publications with limited distributions, the business model is seldom financially viable. And on the distribution side, much has changed since the original *HPR* days, with brick and mortar hobby shops being fewer in number, and third party magazine distribution company requirements being difficult to meet on a cost-effective basis. Most significantly, the Internet has changed how many formerly paper-based publications are created and distributed; many people today rely entirely on online publications/sites. All this argued that any publication that could be created to fill the lack of a TRA-

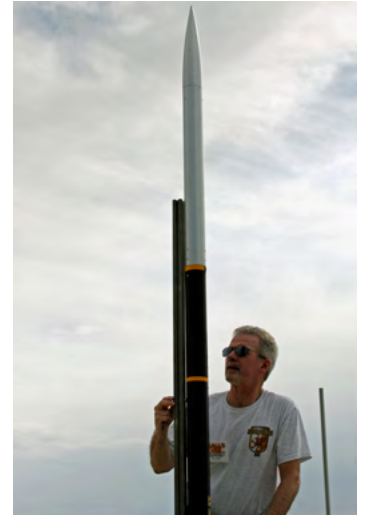
by Ken Good

affiliated magazine would be best created as an e-zine, and distributed through the Internet in some manner.

The lack of an actual magazine was somewhat offset by content enhancement of the *Tripoli Report* – TRA’s official business communication publication. In recent years, the *Tripoli Report* began to include articles of interest, many of which were what one would expect to see in a rocketry magazine. Accordingly, a decision was made by the TRA Board that a new rocketry magazine would grow from the current version of the *Tripoli Report*. Given the grim cost and resource lessons of past experiences, and with the understanding that within the current environment a print magazine was unlikely to be able to replicate the *HPR*-facilitated member recruitment model of the past, the TRA Board favored an e-zine direction. This was supported by member survey results that indicated popular support for this format. Thus, the e-zine direction was agreed upon, although the name of the magazine was not resolved.

That was addressed in 2019, when the TRA Board obtained the content and naming rights of the original *HPR* magazine, thereby enabling the new magazine to revive the *HPR* name. Accordingly, beginning with the final issue of the *Tripoli Report* of 2020, a separate *HPR* section was included. This combined publication is made available only to TRA members. For non-members, and for external distribution, it was agreed that an *HPR* compilation issue would be generated at least annually, containing selected articles from *HPR* without the TRA business content. This issue is the first example of that compilation.

It is hoped the reader will enjoy what is provided here. For those not already members of TRA, please consider becoming a member, and join the high power rocketry community in all the fun and excitement seen on these pages.



# HIGH POWER ROCKETRY

## UR Nuts - UROC at Black Rock

by Kip Daugirdas



**UTAH ROCKET CLUB** TRIPOLI UTAH  
PREFECTURE #6

In 2020 (so far) Utah Rocketry Club (UROC) has not been able to fly at its usual launch areas due to either COVID-19, high fire danger or new military operations. Many of you may think that Utah should be home to several launch locations with high waivers. But despite having many vast and unpopulated areas, up to 50% of Utah's airspace is controlled by the military. In fact, the Utah Test and Training Range (UTTR) is the largest over-land supersonic-authorized restricted airspace in the lower 48 states. Therefore, it can be difficult to get waivers higher than what you may see back East as we are pushed to fly in the already limited areas of commercial airspace. By July, with options to fly in Utah dwindling, UROC tossed around the idea of having a small launch at Black Rock, NV. The response from the club's membership was surprisingly supportive. Things fell into place with the FAA and the BLM and before you knew it, we were planning for UR Nuts (our play on BALLS) for September 11-13, 2020. Due to COVID-19 the launch would be limited to 50 attendees. Some of you may see this group limit as an annoyance but honestly it turned out to be a blessing as I'll get to later.

While I and other UROC members had been to Black Rock many times, we had never put on a launch out there. And I'll be up front to say I had never put on

a launch, gotten a waiver, etc. so I was interested to learn what was involved. And it was about time I gave back to the rocketry community in the form of organizing a launch – particularly I wanted to share the unique Black Rock experience with folks who had never been there. On that note, I'd like to point out that Black Rock is the ONLY place in the world where you as an amateur can go and fly rockets to the edge of space. This makes Black Rock and the airspace that surrounds it incredibly special and valuable to the rocket community. It's why at Black Rock you absolutely must follow ALL the rules (Tripoli, FAA, BLM) because losing the opportunity to fly there would be devastating to the hobby. If you ever travel out to Black Rock, please give it the respect it deserves.

By the time registration had closed, we had approximately 40 flyers. At a club meeting prior to the launch we solicited members on the types of projects they were bringing. Given this information Neal Baker and I decided on the equipment to bring – two 1010 rails and two 1515 rails. Not exactly an Airfest or LDRS type launch. The biggest hurdle we saw was getting our members to the site safely. We choose to use the BALLS launch site and relayed information from on how to get there from the BALLS website. Aeropac had successfully held Mudrock and Aeronaut at Black



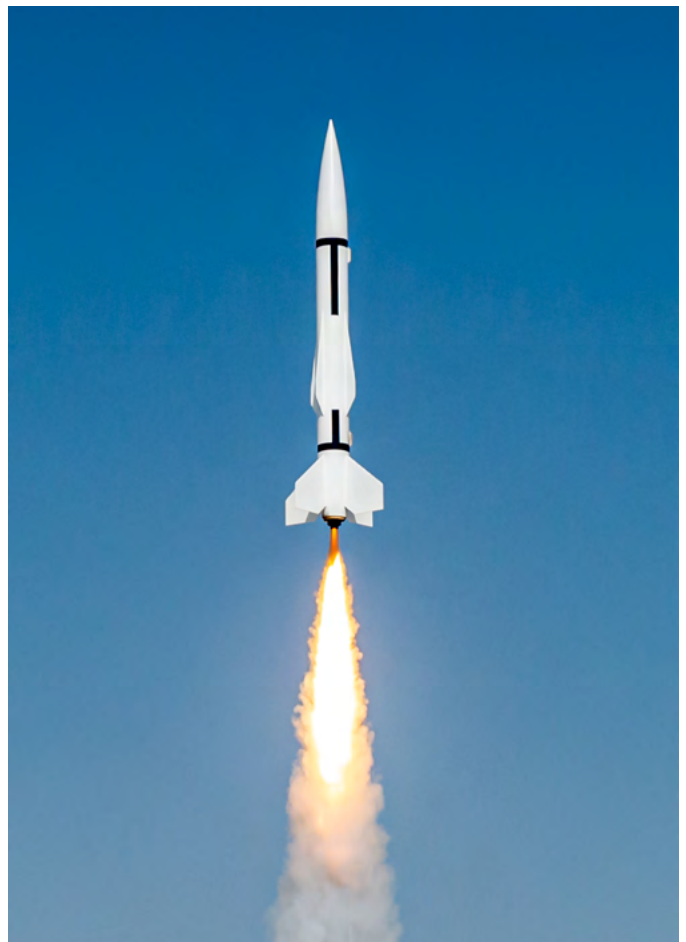
Rock in 2020 and we adopted their COVID-19 protocols. Finally, UROC members are used to hot desert launch conditions and not much needed to be covered there. Nothing of note was really that different from a typical launch other than the attendance cap, and I promised earlier I'd circle back on that point.

**Left: Neal Baker addresses the flyers/attendees.**  
**Center: Maureen Mills with her Level 1 cert rocket.**  
**Right: Tim Boschert with his rocket, ready for flight.**  
**Below: Lorenzo Miller in a pre-flight pose with his Level 3 rocket.**

Fifty, I think, is a magic number and I personally thank the state of Nevada for the group size restriction. There were just enough flights that things didn't get boring while at the same time it never became difficult for a crew of three people to manage the launch (RSO, LCO and pad manager).



**Kip Daugirdas at LCO**



Upper left: Black Rock is the perfect place for sparky motors. Here, Derek David's rocket takes to the air with a fiery boost on an Aerotech K-850DM.

Upper right: Tim Boschert's rocket with a nice, sparky take-off on an Aerotech I-280DM motor.

Lower left: Kip Daugirdas moves Perry Hacking's PML Bullpup into take-off position.

Lower right: Perry's Bullpup climbs on an Aerotech K-550W into the clear skies over Black Rock.

*All photos on this page were taken by, and are provided courtesy of, Jim Wilkerson/Tahoma Photography.*



More scenes from UR Nuts.  
These photos are among those that have been posted to the UROC group collection found on Facebook by several attendees of the event.  
More photos and videos can be found here:  
<https://www.facebook.com/groups/urocfb>





Black Rock is a dramatic, “camera ready” place, both by day and night, even when rockets aren’t flying.

Left: Wildfire smoke puts haze into the air, but makes for a colorful sunrise effect over the playa.

Below: At night the total absence of any light sources nearby - except for what you bring - provide surreal shadow effects, and unfettered views of the stars over the lake bed.

What does this mean? It was a relaxed and fun launch for everyone involved which is a great feeling when you are putting on a launch far from home. It almost reminded me of getting together with a group of friends to launch model rockets at the school athletic field as a kid.

The limited attendance had additional benefits besides reducing the stress on the launch organizers.



- 1) Safety. It is easy to control who/ what is going out on the range. Rockets get a more thorough review by the RSO. Special projects get more attention prior to and during the launch. I think this helps organizers run a safer launch and helps flyers get in the air with fewer delays.
- 2) Flyers get special attention. If your igniter fails, you don’t have to wait to recycle. Given your rocket is likely the only one on the range you can head back out to replace it – immediately.
- 3) No jockeying for pads or prime launch windows.
- 4) Less launch gear to transport. We divided the equipment across several attendees which eliminated the need for the equipment trailer.
- 5) Quick range setup and tear-down.
- 6) Easier cleanup and a reduced environmental burden on the playa.

If UROC turns this into an annual launch, we will seriously consider capping the number of attendees.



# LDRS 39



July 29- August 1 2021  
Bonneville Salt Flats, Wendover, Utah  
[www.uroc.org](http://www.uroc.org)

**UTAH ROCKET CLUB**

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# HIGH POWER ROCKETRY

## AIRFEST 26

by Harry Spears



What a year it has been. The cancellation of LDRS, BALLS, and just about everything else due to the COVID-19 concerns has made 2020 a year we won't soon forget. Kloudbusters did not want to see another big rocket launch cancelled and put a lot of effort into putting on AIRFest 26. The first and ongoing question was if they would be allowed to hold the launch. There was always a possibility the state or county would change their rules, forcing a cancellation. The next question was how many people would attend? Would there be less due to job loss and health concerns? The normal amount? Or with this being the biggest Tripoli launch for 2020, there was talk AIRFest could become a mini LDRS with more people than usual. The answer to the questions ended up being a few more people than a normal AIRFest .

The next question was how to keep the flyers safe on the rocket pasture. Looking back at past AIRFests and LDRSs the Kloudbusters had hosted, they noticed that flyers tend to bottleneck at the RSO process and queue line for the 40 and 50 pads. The away cells were not that much of a concern, since everyone is usually in a vehicle out there anyway. The solution for the bottleneck is what they call the "cattle chute". Three lanes were set up in the circus tent with an RSO for

each lane, one for the model rockets, one for the 40's, and one for the 50's pads. Spots were painted on the ground six feet apart in case a line started to form. The pads were assigned at the RSO check-in, and the flyer was sent to a holding area once approved. The holding area had a marker for each pad, and the flyer stood at the assigned marker until cleared to go to the pads. That worked out so well the Kloudbusters are thinking about using that general setup for future launches.

This year's registration packets were also a little different. Each flyers packet contained the normal materials, plus a baggie with two face masks, some flight cards, and a pen. The masks were provided by Chris' Rocket Supply, and Altus Metrum. This year the flight cards could not be filled out at the RSO table, and no pens were available at the table. A pen for filling out flight cards was supplied by Rail-Buttons.com in each packet. A separate table was set up outside the RSO area with a scale and flight cards for flyers to use if needed. Missing from this year's registration packet was a ticket to the burger blast. The circus tent was being used for the RSO check-in and the burger blast is another activity where people normally would not be social distancing. This raised another concern for the Kloudbusters: the after hour social gatherings.



**Left: Attendees signing in, showing distancing/mask measures. Right: A special Texas notice about mask-wearing rules.**

Over the last few years the Texas clubs have joined forces to create what is known as the Texas Compound at AIRFest. Each year it gets bigger, and it looked like almost a quarter of all the registered flyers this year would be from Texas. With the success of last years LDRS food plan, Tripoli Houston and Tripoli North Texas had been talking about a repeat of the meals since the end of LDRS last year. Kloudbusters had discussions with the Texas group about their concerns and the need for social distancing. The leaders of the Texas group worked on a plan that would accomplish the needed social distancing while still being able to feed over fifty people. The canopies were stretched out, and a large open area was set up in the center. This year all the meals would also be served in

to go containers. That included the shrimp boil which last year was served on a very long community table. While there were no six foot markers painted on the ground, everyone in the food line, when there was a line, did a good job of maintaining social distance. To enter the compound you had to have a mask and were encouraged to wear it except when eating. Those that signed up for the food plan were also given a special Tripoli Texas face mask. The open area was large enough that people could set up chairs in large circles. That accomplished the social distancing requirements that the Kloudbusters were concerned about. This design, like the RSO area, worked out so well the open center area may become a standard feature for the compound in future years.



**Left: View of the "Texas Compound" set-up. Above: AirFest 26 RSO in action.**



**Left:** AirFest activity, as flyers make their way out to the pads.

**Center:** (L) LCO crew conducting flight activities, masks present.

**Center:** (R) Late day gathering for food, drinks and relaxation, social distancing rules observed.

**Bottom:** Jimmy Higham in a pre-flight pose with his rocket Skeeter.



The official start of the launch was Friday morning Sept. 4th, and time to see how well all of the planning worked. The morning was a beautiful, calm, mostly sunny day. Throughout the day there were many great flights. A few CATO's happened including a research O motor that had a really impressive earth shaking CATO.

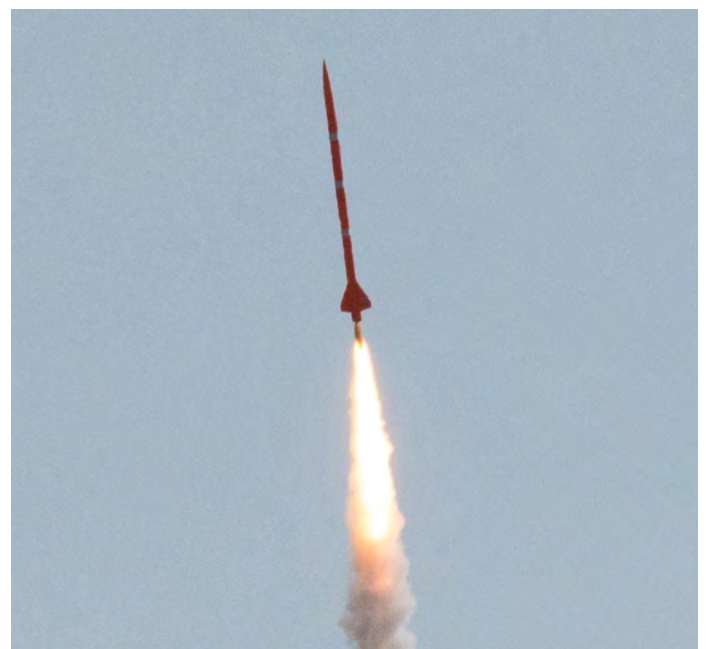
Saturday was another good day to fly and the new RSO check-in process seemed to be working well. Gary Dickinson, Tripoli Vice-president, stated that with the exception of the face masks and the check-in queue, it was like a normal AIRFest.

Sunday started out good once again, but by mid-afternoon the Kansas winds had kicked up and the rest of the day was cancelled due to the winds. During the afternoon downtime I talked to Bob Brown, the launch director, about the launch. We talked about the Kloudbusters concerns on holding the launch, and how their changes were working. Bob said that while they were nervous about the changes and doing something they had not tested beforehand, he was thrilled at how well it had worked out, and additionally, how well the flyers





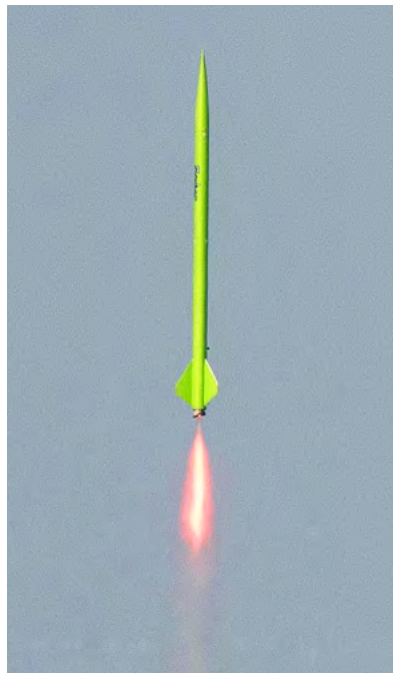
**Upper: Al Gloer with Real Men Fly Pink, a tribute to Marian Hayes. It flew on a KBA M1450W - take off above.**  
**Lower: (R) AirFest flight team member catches a take-off on camera. (L) One of many dramatic AirFest rocket flights.**



had accepted the changes.

Monday morning arrived and the rocket pasture looked mostly empty. There were still a few people flying rockets, but it looked like most people had packed up during the downtime on Sunday.

Despite the challenges of holding a large launch during the pandemic, The Kloudbusters did a fantastic job of putting a plan together and pulling it off. While most of the flyers I talked to would have preferred not to be wearing masks, they were happy and excited at being able to get out and fly at the rocket pasture this year.



This page - more AirFest 26 flyers, attendees and rockets.

Upper left: Andrew and Crystal Grippo with their two-stage rocket

Upper center: Strong rocket take-off on a red motor.

Lower left: Tyler Larsen getting ready to obtain his flyer certification.



Upper right: Jeff Jones with his *Thumper Junior Deluxe*.

Center: Bdale Garbee/Altus Metrum was present too.

Lower right: Nice-looking *Patriot* takes flight.

All photos on this page are courtesy Tripoli North Texas via Facebook.



# HIGH POWER ROCKETRY

## ARGONIA CUP

MARCH 27 - 28, 2021



by Lucas Utley

### Introduction

The Argonia Cup is a recently-founded, Tripoli-sponsored collegiate rocketry competition that takes place each spring and is hosted by the Kloudbusters of Argonia, KS. My name is Lucas Utley, and I've been a member of Tripoli since 2016 when I became active in high-power rocketry through the Oklahoma State University rocketry team. I flew with Kloudbusters throughout my time in college and graduate school, earning my L2 and L3 certifications there. During that time, I also had the privilege of competing in the Argonia Cup, since its inception in 2017. Having participated for 3 years as a student but since graduated, it was especially exciting to return to the competition, this time as a spectator.

During the weekend of March 27 and 28, 2021 the annual Kloudburst launch took place in parallel with the collegiate event, so I also got to fly a few rockets of my own during that time. I loved being a part of what turned out to be a full, exciting weekend of competitive flights at the Kloudbusters Rocket Pasture throughout this early spring weekend.

### Competition Background

The Argonia Cup was founded in 2017 by members of the Kloudbusters, TRA Kansas, Prefecture #34, as a collegiate rocketry competition and to provide a new alternative to other competitions that require multiple days of travel, days worth of presentations and launches, and large budgets in order to participate. This event would be a rocketry competition, rather than an engineering one, and be accessible to smaller, younger college rocketry programs in the central United States.

The objective is to launch a golf ball payload to an altitude of 8000 ft and return the payload as close to the launch site as possible. All flights are limited to a single L motor or less of impulse, each team must have at least one Level 2 certified flyer, and 3 flight attempts are permitted per team throughout the weekend. In addition to the Tripoli Safety Code, a few other rules exist to ensure safe launches and recoveries, and lastly, each team is assigned an L3 safety mentor to serve as the team's RSO and resolve any safety concerns during flight preparations. While adhering to these basic rules, teams are encouraged to develop creative ways to return their payloads near the ground target. The team that lands their payload closest to this target after reaching 8000 ft of altitude is the winner.



Since 2017, various controlled recovery methods by means of autonomous drones, piloted gliders, and steered parasails have been attempted, but basic dual deployment recovery has provided the winning entries in 2017, 2018, and 2019. The 2020 competition was cancelled due to the COVID-19 pandemic. That first year, registration numbers began with 3 teams but have since grown, reaching a new peak for this year's event with 17 teams, representing states ranging from Colorado to Tennessee and many in between.

### Prior to the Competition

In the month prior to the 2021 Argonia Cup, all reg-

istered teams were required to submit a 5-10 minute video summarizing their project and payload recovery strategy. This video requirement is an alternative to the extensive paperwork, posters, and presentations that are a large element in other collegiate rocketry competitions. These videos were made publicly available for all to view and served as a glimpse into the flights and types of payload recoveries that could be expected throughout the competition.

In the days leading up to the event, while the university teams were packing up rockets and launch gear, the Kloudbusters were busy setting up the range. By Friday evening, the Nafziger Rocket Pasture was all set with model rocket pads, 2 banks of high-power pads (one of which was dedicated strictly for college team use for the competition), and a bank of away pads for M, N, and O motors. Several Kloudbusters and a few college team members camped out Friday evening on site, while others stayed in nearby Anthony, Wellington, and Wichita in anticipation of the first day of competition.

## Day 1 - Saturday, March 29

Prior to opening the range Saturday morning, Kloudbusters Prefect Bob Brown assembled all competitors, safety monitors, and mentors for a safety briefing and a quick recap of the rules. Of the 17 teams registered, 12 teams ended up making it to Argonia for the competition, setting a new record for attending teams. Those in attendance included: two teams from Oklahoma State University (OSU), Southwestern Oklahoma State University (SWOSU), Northwestern Oklahoma State University (NWOSU), the University of Oklahoma (OU), LeTourneau University, the University of Missouri (Mizzou), Missouri University of Science and Technology (Missouri S&T), Kansas State University (K-State), the University of Tennessee Knoxville (UTK), the University of Colorado Denver (CU Denver), and Southern Illinois University Edwardsville (SIUE). Each team was assigned a safety monitor that included experienced L3 fliers such as Kloudbusters members, and even Tripoli President himself, Gerald Meux Jr.



*Safety briefing on Saturday morning. Photo courtesy Samantha Huckabay.*



With the waiver open from 9 AM to 6 PM both days, many flying opportunities were made available, and while the weather Saturday was clear, increasingly windy conditions pushed some flights to Sunday. However, despite the higher winds, most teams launched their first attempts of the competition, and other rocketeers took to the skies too.

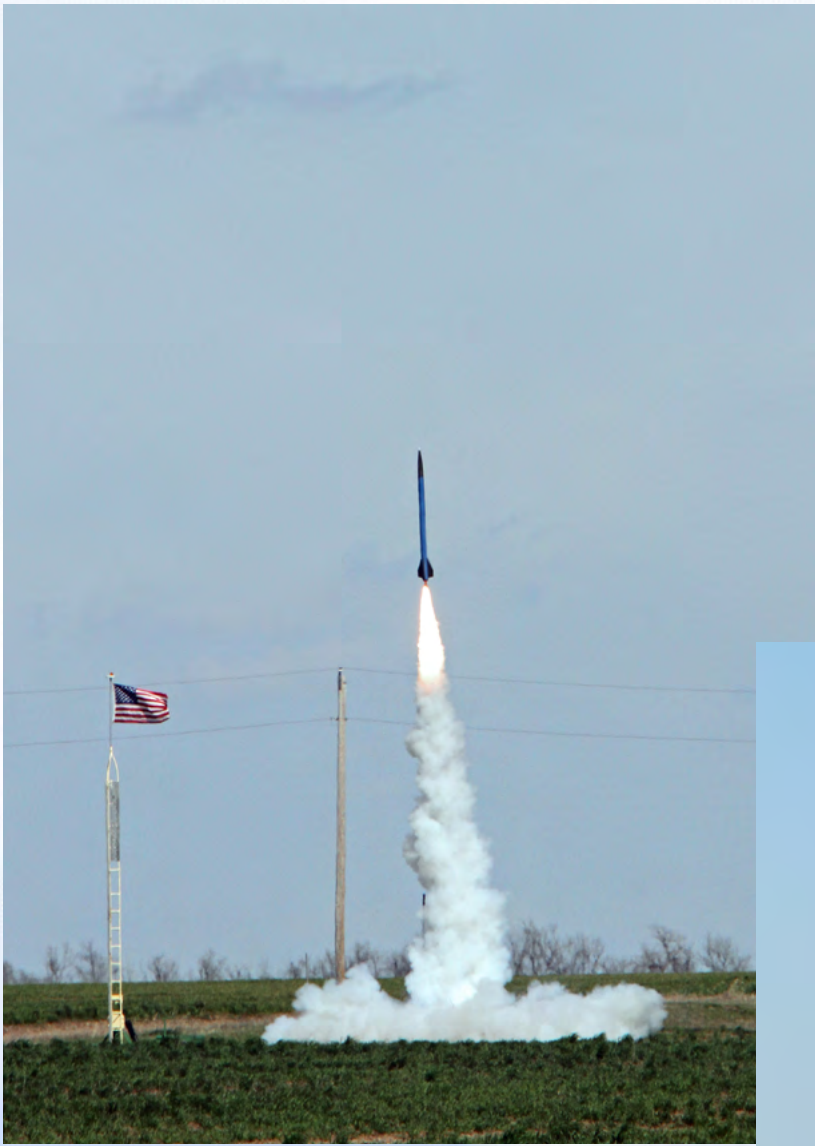
Southwestern Oklahoma State University performed two test flights, aiming for approximately 2000 ft in altitude and a chance to test their recovery drone. Official competition attempts were made by CU Denver, Mizzou, OU, K-State, LeTourneau University, OSU, and the UTK.

Unfortunately many of these attempts were unsuccessful, owing to failed parachute deployment on recovery. However, not only was UTK able to claim the title of first qualifying flight of the competition with their Se-VIIIn rocket on an L1395, they also took an early lead and held first place well into Sunday with a ground distance from the target of 3115 ft.

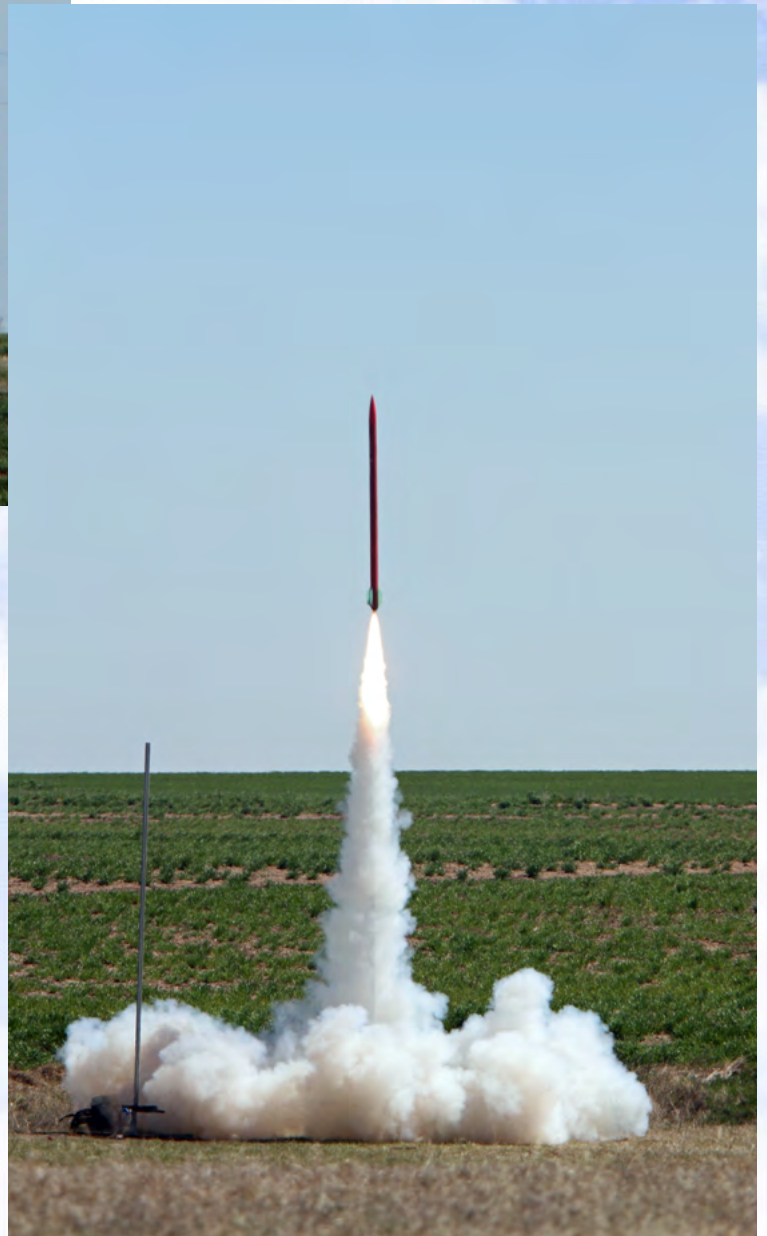
In addition to the competition, some notable flights included TRA Director Chris Short (of Chris's Rocket Supplies - an Argonia Cup sponsor) and his high-altitude N1000 flight, Jamie Weiss with Jam Packed on an M1650, and Justin Farrand with a minimum-diameter L1000 flight to 27000 ft.



*Tripoli President Gerald Meux Jr. performing LCO duties. Image courtesy Lance Lickteig.*



*Left: Chris Short's N1000 flight.  
Image courtesy Lance Lickteig.*



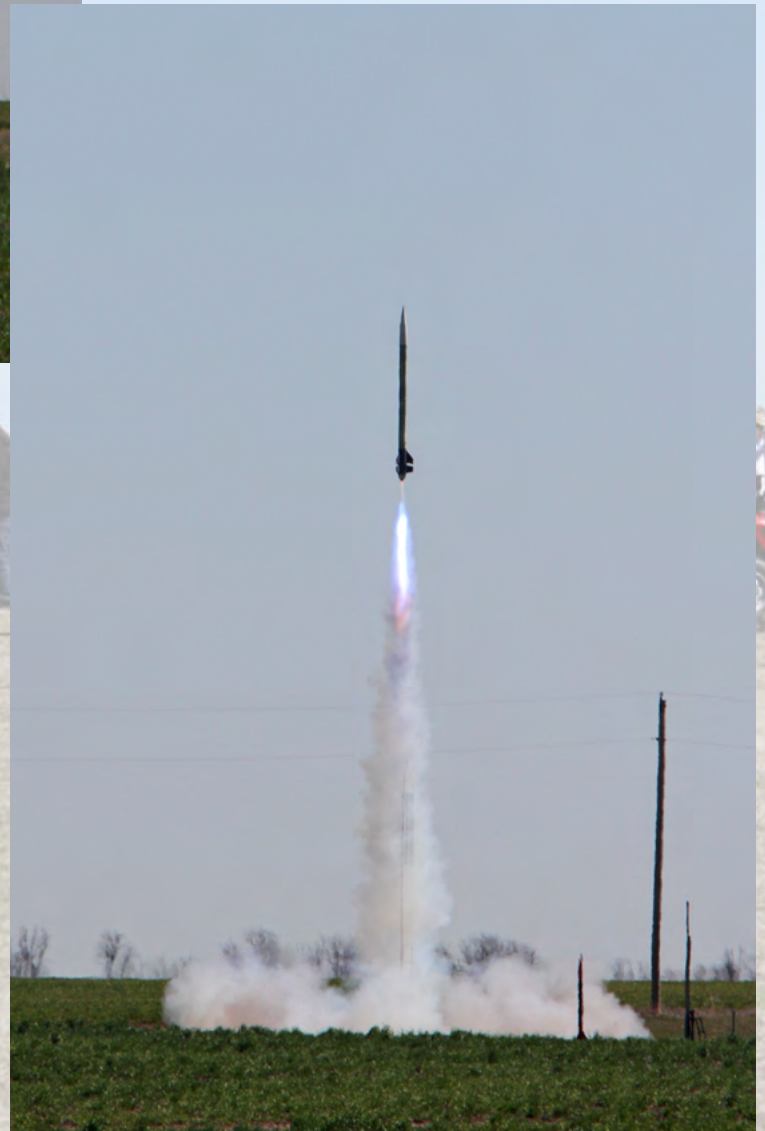
*Right: Image courtesy Lance Lickteig.*



*Left: Katelyn Powell's successful L3 certification attempt on an M1500. Image courtesy Lance Lickteig.*



*Right: Missouri S&T on an N6000. Image courtesy Lance Lickteig.*





*Image courtesy Bob Phelan.*

After a long day in the sun and wind, some of the farthest-traveled teams returned home, but most would return the following day to utilize their remaining launch attempts up to 3. Sunday would turn out to be more favorable, not only for weather, but also for successful flights and sound recoveries.

## **Day 2 - Sunday, March 28**

Sunday morning started with a drag race of rocket-launched Phoenix gliders between Bob Brown and Jay Bailey on G12 motors, and the weather only improved as the day went on. It remained sunny, turned warm, and winds were light. Many took advantage of the great weather, with exciting flights by Jay Holcombe flying his Red Raider on a research N2660, Steve Klausmeyer with a high-altitude flight of I Am Groot on a research N2200 to over 42000ft, and Jim

Cooper with a Rattworks tri-brid K400. There were a couple flights by university teams unrelated to the Argonia Cup, including Missouri S&T launching their 120 lb Killer Queen Remastered on an N6800 and the University of West Virginia with a Spaceport America Cup (formerly IREC) test flight of Mountain Mama on a research O3527 flying to 30000 ft. Finally, the whole weekend was full of certification flights, too. There were 9 Level 1 Certification attempts, 5 for Level 2, and a pair of successful Level 3 attempts by Katelyn Powell and Joshua Anderson.

Sunday also represented the busiest and most exciting day for Argonia Cup flights. Launches were made throughout the day by the two OSU teams, SWOSU, Missouri S&T, OU, SIUE, and K-State, many of whom attempted more than once on Sunday alone.



*Above: Missouri S&T preparing Dioscuri prior to flight. Image courtesy Bob Phelan.*

*Below: Missouri S&T at the bank of dedicated competition pads. Image courtesy Bob Phelan.*



Following up their test launches from the day before, SWOSU had an exciting flight up on an L1420, and then returned from apogee by means of a piloted quadcopter that landed just 568 ft from the target, unfortunately falling short when the on-board battery died early. To make this even more impressive, a glitch in their controller reversed all flight controls to the pilot; the fact that they still landed so close with reversed control input makes their attempt even more significant. This successful flight put them in first place for the weekend. Other quadcopters were attempted by other teams but either came down uncontrolled, landed too far away, or were lost altogether.

OSU's Space Cowboys launched Skittles on an L1350 and also had an exciting recovery attempt, but rather than a piloted quadcopter, they utilized an autonomous glider. After serving as the rocket's nosecone, the glider ejected at apogee, deployed spring-loaded wings, and flew laterally to the target zone before circling downwards just above the edge of the flight range. As the glider descended, team mentor Andrew Walsh walked near the LCO table, pointed upwards, and said, "It's circling directly overhead." Sure enough, a black dot grew in size as it circled toward the ground, eventually landing between the first bank of high-power pads and the model rocket pads, just 349 ft from the target. With less than an hour remaining in the waiver, this successful flight nudged them into first place, just ahead of SWOSU's flight from earlier. A few other launches took off before the range closed, and unfortunately 2 final flights didn't make it to the pads in time before 6 PM rolled around.



*Missouri S&T's Dioscuri on an Aerotech L2200.  
Photo courtesy Bob Phelan.*



***Oklahoma State University Space Cowboys recovering their autonomous glider.  
Image courtesy Bob Phelan.***

With the window for flights officially closed, teams finished recovery of their rockets, and the winners and prizes were announced.

## **Results**

In the 2021 Argonia Cup, third place was earned by Rocket Top of the University of Tennessee Knoxville by reaching an altitude of 8930 ft and landing 3115 ft away.

Second place was awarded to the Southwestern Oklahoma State University Bulldogs who launched to 10034 ft before piloting a quadcopter down and coming within 568 ft of the target.

Finally, first place went to the Oklahoma State University Space Cowboys for reaching an altitude of 10100 ft and their autonomous glider drifting down, landing just 349 ft short of the target zone.

Other qualifying flights by the Southern Illinois University Edwardsville, University of Oklahoma, and Missouri S&T reached the 8000 ft altitude mark but were recovered further away. Of these qualifying flights and additional attempts by other teams, recovery methods included various designs of quadcopters, gliders, dropsondes, and simple dual-deployment recovery. This was the first year that controlled recovery during payload descent was accomplished, so next year should be even more exciting for closer recoveries and higher altitudes.

## **Sponsors and Prizes**

This year's Argonia Cup wouldn't have been the same without its numerous sponsors who not only attended the event and served as safety monitors, but also provided prizes to be awarded to the top 3 finishing teams. These sponsors included Wildman Rocketry, Chris' Rocket Supplies, Altus Metrum, Top Flight Recovery, LOC Precision, Honeywell, and Glynn Kovarik.



***3rd Place: University of Tennessee Knoxville Rocket Top. Image courtesy Lance Lickteig.***



***2nd Place: Southwest Oklahoma State University Bulldogs. Image courtesy Lance Lickteig.***





**1st Place: Oklahoma State University Space Cowboys. Image courtesy Lance Lickteig.**

Each of the first 10 registered teams was awarded an Altus Metrum EasyMini flight computer just for registering and attending the event. For the 3 finishing teams, third place received \$650 cash, (2) LOC Precision Forte kits, an Altus Metrum TeleMetrum flight computer, and a Top Flight Standard 120 in. parachute. Second place received \$1200 cash, one of each of the LOC Precision EZI-65 and Forte kits, an Altus Metrum TeleMetrum flight computer, and a Top Flight Ultra 120 in. X-Type parachute. Finally, first place received \$2000 cash, a LOC Precision EZI-65 kit, (2) LOC Precision Forte kits, an Altus Metrum TeleMega flight computer, and a Top Flight CF120 in. Crossfire parachute. Thank you to each of these sponsors for their generosity, contributions, and involvement in this year's event.

## Conclusion

The 2021 Argonia Cup made for an outstanding and memorable weekend for the college team participants, rocketeers attending Kloudburst, visitors, and spectators alike. We look forward to next year's event, and we hope you'll consider either participating if you are an interested college team, joining as a flyer for this early spring launch, or checking it out just to see what the weekend holds! More information can be found at [www.argoniacup.com](http://www.argoniacup.com). Thank you as well to all volunteers and especially the Kloudbusters for their efforts in setting up and taking down the range, coordinating the event, and hosting the entire launch. See you in 2022 at the Rocket Pasture!



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# HIGH POWER ROCKETRY

## IF YOU BUILD IT, THEY WILL LAUNCH THE REBIRTH OF TRIPOLI NORTH TEXAS (TNT)

by Steve Taylor

### The Old Dogs

We had become a lunch crew instead of a launch crew. Every week the club would meet for lunch and talk about rockets. When I joined I became the new guy and got exposure to some of the most exciting and advanced rocket builders in Texas. All were very accepting and dedicated to helping and supporting new flyers. All were Level 3 flyers except me, a lowly Level 1. Several years earlier the club had lost its launch site and had teamed up with Tripoli Waco to hold joint launches at their field. I got my Level 2 at Waco, but unfortunately we lost that field soon after. We became a club without a field.



The loss of our field accelerated the clubs' focus away from the smaller stuff and on to bigger, faster, higher, and larger projects. These were BALLS projects, and I was fortunate to work with this group and get my level 3 at a BALLS launch. So now what?

The group had great chemistry, enjoyed weekly discussions at lunch, and pretty much exclusively focused on BALLS. If anyone wanted to launch just a regular old L motor, we traveled to Tripoli Houston or Tripoli Austin.

It continued like this for several years. Our website, hosted on one of our member's home servers, grew stale, with the last sign of any update was our BALLS trip in 2014. One of our members built a wireless launch controller, which worked great, but the pad boxes only had one channel, basically for BALLS launches. We only had two pads capable of H-J motors with one member-owned pad, capable of K-M motors. We were down to a handful of members and had no active recruitment of new members.

## The New Blood

We did have one thing going for us: Harry Spears – The Motor Man. In addition to being a professional photographer/videographer, Harry is the motor vendor for most Tripoli Texas based launches. He has a website and is physically present at all the launches. I could ramble on about Harry and his contributions to the hobby, but I want to focus on how he channels new blood into the club. Every time a motor order came from North Texas, Harry would talk about our club and offer them an invitation to our lunch meetings if only to pick up their order. That hooked a number of members who would play integral parts in our rebirth.

Enter the new blood: Matt Bukin - the first new guy. Matt was a BAR like most of us that got started as a kid, shared it with his kids, and was looking to get back in. In addition to real estate, Matt manages a large deer lease in the Rolling Plains of Texas. Second up is Erick McDaniel - the new, new guy. Erick is a commercial/private jet pilot and an aerobatic pilot and instructor. Erick is very comfortable talking to the FAA; he speaks their language.

We were starting to get some excitement as even more members were beginning to join. We added another pilot who became the new, new, new guy and finally became just ‘new Dave’. The last piece was fortuitous for me because it is right around this time I became the new prefect.

## Launch Site(s)

The most glaring issue that we needed to address was the acquisition of a new field. Our new members were just at the beginning of their journeys towards becoming high power certified flyers. We needed to get them the experience they needed to advance in the hobby.

Erick became the hero – he had a great relationship with the owner of a private airstrip where he flew his aerobatic airplane. The field already had an aerobatic box waiver and it was close to the Dallas Forth Worth Metroplex. Erick worked with both the landowner and the FAA and we “landed” our new field. It was about an hour’s drive for most of the members and was assigned a nine-thousand foot waiver. A perfect field for level one and two flyers to cut their teeth.



Next up was a field where we could fly higher. Matt has managed a deer lease for the past 15 years in Seymour, Texas – perfectly suited for a high power field. Seymour has a population of under 3,000 and Matt seemed to know everyone. He worked with his neighbors and got them to agree to let us use their land to launch and recover rockets. Matt and Erick then contacted the FAA and secured a 2-year, 16K waiver as our initial, out of the gate altitude.

Seymour is about a three-hour drive for most from the DFW Metroplex which is a long way for only a one-day launch. So we decided to run two-day launches

since we have plenty of space for RVs and camping, as well as great accommodations in nearby Seymour. Additionally, Matt has been gracious enough to open the deer lease facilities to the group, where we gather for meals and socialize during the evenings.

The response from the landowner and the town have been overwhelmingly supportive. The launches are an event with a large local draw, media coverage, and a positive impact on the local economy. A real win-win, including several younger members of the town building and launching their rockets with us old timers.



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Thursday, July 2, 2020 - Vol. 125, No. 5

Seymour, Texas 76380

5

## No Cases of CCP - COVID 19 In Baylor County

As of June 30, 2020, there have been no positive test results reported for Baylor County residents tested through Seymour Hospital

### OVERALL

(Includes any local resident as well as any out of county patients that were tested at Seymour Hospital.)

94 Collected  
87 Negative  
2 Positive (Knox county)  
5 Pending

### BAYLOR COUNTY

(resident of)  
75 Collected  
70 Negative  
0 Positive  
5 Pending

EXTENDED WEATHER FORECAST FOR SEYMOUR TEXAS

THURSDAY JULY 2

MIDLEY SUNNY



High 97

## Rocket Association Visits Seymour

The Tripoli North Texas Rocketry Association came to Seymour last weekend to hold their first event in this area. The group enjoys going places where there are less air restrictions and the wide open area helps to view the rockets and to recover them. Matt Bukin, amateur rocket enthusiast and manager of Cache Creek Hunt Club which leases the Dannie Fancher Portwood Trust land near the Orsaks had invited the group to this area. He had made arrangements with the Orsak family to use one of their fields nearby for the launch. Approximately 30 members gathered to practice their hobby. The group set up shade tents in the middle of a field where they assembled and prepared their rockets. All types of rockets are welcome. According to their website, Tripoli is an organization where there is no "little guy". At TRA launches you'll meet both novices and experienced rocketeers, all open and friendly to newcomers, eager to share knowledge. The group spent most of last Saturday and part of Sunday enjoying their hobby and fellowship.

Several of these rockets had computer systems on board to record details about the flight and to help recover them. Mr. Bukin's rocket "Rat Fink" recorded the highest altitude at 12,800 ft.

Tripoli is a non-profit organization dedicated to the advancement and operation of amateur high power rocketry. Members are drawn from the United States and 22 countries across the globe. The Association is made up of "Prefectures." These are local groups geographically, that organizes meetings, events and launches for the benefits of their members and those from other prefectures.

Courtesy Photos  
Harry Spear  
- Amateur Rocket Enthusiast



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## Area News..

**The Iowa Park Legend**  
- An 18-month old boy drowned last Monday despite efforts of his dad and first responders performing CPR as she was found floating face down in a swimming pool. The child appeared to have climbed a ladder going to the above ground pool, fell in, according to a police report.




## Club Infrastructure

As we gathered steam re-establishing the club it became clear we needed more resources to support our activities. Fortunately, we have a great relationship with the very successful Tripoli Houston club, and we followed their example for setting up our internal club infrastructure. Ray Shepard became our president, and through Ray's leadership, our club took off. But unfortunately we needed basically everything to support large launches again.

Leveraging our relationship with Tripoli Houston and to demonstrate the unity between our clubs, we asked and got permission to use a modified version of their logo. Over the years our combined presence at Air-


fest had drawn our clubs together, sort of like brothers from a different mother. The new logo was essential to give the club the new look and feel we were seeking.

Logo in hand, it was time to replace our front end to the world with a new website and club management software. Ray evaluated several packages that could do the job, and after careful review, he chose Club-Express. It gave us our new web presence - an area to post news, an event calendar, photo albums, membership sign up and management, the ability to collect membership dues and launch fees, and communicate with our members through email. Tony Huet, our past prefect and current graphics guru, was tapped on the shoulder to manage our website.





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# TRIPOLI NORTH TEXAS


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Welcome to the Tripoli North Texas Rocketry Association





## TRIPOLI NORTH TEXAS




Next Rocket Launch

Jenn McDaniel not only took on the role of our in-house counsel, but also the challenge of marketing the club on social media. Jenn set up and manages the official Tripoli North Texas (TNT) Facebook and Instagram pages. TNT now has followers from all over the world. You might recognize that last name, as Jenn and Erick are one of our five high power certified husband and wife teams.





## TRIPOLI NORTH TEXAS



**Tripoli North Texas (TNT)**

Public group · 117 members

The last piece of our communications infrastructure is our direct communication with members through email updates. We regularly send out club progress updates that outline the club's priorities and capital improvement programs. Our goal is to keep our members on board with our mission and be as transparent and responsible as possible with their dues and launch fees.

## Launch Infrastructure

Our first event was a test launch at our new Akroville field. We hadn't hosted a launch in a long time and all the equipment needed to be vetted. We also had a new landowner to introduce to high power rocketry. The landowners could not have been better hosts – they stayed with us for most of the launch and even helped us recover rockets in the field with their mule. They appreciated our focus on safety and our respectful attitude towards their property. At the end of the day we presented them with a rocket kit to build and some liquid inspiration. The relationship foundation we were building was starting nice and solid.

The equipment, on the other hand, needed some attention. We only had three high power pads which had been enough because our launch control equipment could only support three pads. But we had no model or mid-power pads, our PA system was circa 1980s, and our LCO popup was decrepit. The club needed to focus on the infrastructure required to hold larger launches.

Step one was to take advantage of the phenomenal prefecture improvement program (PIP). The Tripoli board makes a grant available for any prefecture that needs money to improve its infrastructure. We had a lot of needs but what's first? Because the club's focus was geared towards the big stuff, we needed to rebuild sup-

port for first-time and mid-power flyers – if we were going to build our membership, we needed to support all levels from beginner to certified level 3 flyers. We bought mid-power pads and rails with our PIP grant and one of our members, Al Gloer, was kind enough to build a model rocket pad bank and donate it to the club. Although not yet complete, our infrastructure could now support all experience levels for a small launch.

## Club BoD and Quantum Leap to a 501(c)(3)

Let me pause for a minute and talk about our new president, Ray Shepard. Ray does not do anything small. If you have ever been to an Airfest in Argonia, Kansas, run by Kloudbusters, you might have run across the Texas compound. Ray, in conjunction with some of the other Texas prefectures, has created a fantastic rocket experience. It involves three nights of feeding upwards of sixty people catfish, jambalaya, and a last night blowout shrimp boil, accompanied by hydration from his redneck margarita machine and the infamous Wile E. Coyote rocket filled with his homebrew beer. The excellent music and great conversation complete “The Texas Compound” atmosphere. This experience led to one of the club's founding principles and a new mission statement for TNT: “To offer our membership the absolute best launch experience that we can deliver. Period.”





It became clear that if we were going to meet the goal set out in our mission statement, we would need more launch infrastructure to support it. That would take capital and a formal club structure including a board of directors and a 501(c)(3) non-profit organization. We selected a good mix of new and old members to sit on the board and through the kind donation of an anonymous donor we incorporated the club in the state of Texas and filed for our 501(c)(3) status. The non-profit status serves two primary purposes – it enabled members to donate to the club and give them a tax deduction, and for those who have a corporate matching program, help them double their donations.

In the first newsletter of this year, Ray outlined the club's priorities for capital improvements. We needed a minimum of six high power pads, a new launch control system, an upgraded PA system, a club generator and a club trailer. These are significant improvements that would usually take years of launch fees and membership dues to acquire. But with our 501(c)(3) status, we have been able to significantly accelerate our equipment purchases thanks to our members' incredible generosity, several of whom have made large anonymous donations.

We worked with club member and owner of Frankum Performance Rocketry Products, Royce Frankum, to manufacture the six new high power pads. Next on our list was a Wilson FX launch control system to handle the increasing number of pads. Once again, a new member stepped up with an extremely generous donation and we were able to order our new launch control system. Ray took on the PA system himself. He refurbished our old electronics and combined them with new technology and housed it all in a carrying cabinet he refurbished to create a state of the art PA system complete with Bluetooth connectivity, FM transmission, and power supply and distribution.

### **Giving Back to the Hobby**

Another guiding principle for the club is to give back to the rocket community. We have a couple of different pathways: support for all members that want to become certified and by mentoring academic teams that seek

to participate in national or international competitions.

We will be rolling out a program for our members to make it easier for them to get guidance on building and climbing the certification ladder. Working with several vendors, we're creating a Level 1 certification package complete with an assigned mentor. As Ray's brainchild, the programs designed to remove the apprehension of building your first high power rocket and provide the support needed on the journey to certification.

To contribute to students and the academic community, we focus on supporting all academic rocket competitions. We will support any team from middle schoolers through college that request our help. Several members already support the Experimental Sounding Rocket Association (ESRA) International Rocket Engineering Competition (IREC) held at the Spaceport America range in New Mexico. We mentor local university teams and participate in their critical design reviews as they prepare their projects. We also review progress reports and technical design documents for national and international teams to help ensure they meet the Tripoli Research Safety Code.

As a member of the ESRA board, I am the launch operations director for the competition and ensure that all 150 teams safely get the opportunity to launch their projects. Harry Spears is part of the range safety team and the university teams' final safety check before heading out to the pads. And Tony Huet is out at the pads working as a pad manager helping teams safely rack their rockets.



## Thumper

We can't talk about the club rebirth and not give some credit to our dubious, unofficial club mascot, Thumper. Thumper is "awarded" to anyone that thumps their rocket. The rules have been hotly contested, mostly by the flyer that takes custody, but whether it be a CATO, a shred, deployment failure, hard landing, etc., if the rocket can not fly again SAFELY with minimal repair – it Thumped. This tradition has been around since the prefecture started and it is a right of passage for new members (whether they want it or not!). Heck, Al Gloer even built a shelf for the darn rabbit in his new rocket workshop.

It's been a rewarding two-year journey. The club has grown from a handful of lunch buddies to sixty-nine paid members supporting all flyer levels. We've built a scalable infrastructure that will only grow in the future. We have a focus on our flyers' experience and the community. We are leveraging many of our thirty-one Level 3 flyers by actively mentoring and supporting the academic teams. Finally, we have a dedicated group of club members making this all happen and I can't thank them enough.

Look for an announcement soon for what we hope will become one of our annual traditions, "The Texas Shootout" and let us show you some Texas hospitality.



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# DURANGO AND SOUTHWEST COLORADO PREFECTURE ORIGINS

*by Charles Hakes*

Greetings from Durango and Southwest Colorado. I was asked to write a bit about the formation of Prefecture 164 Tripoli Southwest Colorado/Durango – who we are, and how this prefecture came to be. In a sentence, I wanted a local place for Fort Lewis College rocket teams to launch high-powered rockets. I hope writing more than a sentence and giving some details of how this got started won't get too tedious.

I am a faculty member at Fort Lewis College, and have been the affiliate director of the Colorado Space Grant Consortium since 2009. Space Grant is a nationwide, NASA-funded program that gives college students hands-on experience with all sorts of STEM activities. One of the more active Space Grant programs in Colorado is called Demosat, where teams from around the state build small payloads to launch on high altitude balloons.

While Durango is one of the best places in the country to live, a downside is having to drive seven hours one way to get to one of these front-range activities. I wanted some way to have students launch a payload without the long drive, and without having to chase it for 100 miles for the recovery.

On the rocketry side of things, my background is typical and not too exciting – I launched some small rockets as a kid, and also launched vicariously when my son launched rockets at Scout camp. I began attending (and taking students to) the 4 Corners Rocketry Association (4CRA) National Association of Rocketry (NAR) club launches in New Mexico in 2016, and got my Level 1 and Level 2 certifications there in 2017.

Also in 2017, I was asked to be the advisor for a team participating in the First Nations Launch competition,



***Figure 1 – The Fort Lewis College team gathered in Limon, Colorado, with other Colorado teams to launch their payloads on a weather balloon. Here the teams are lined up with their payloads on the flight string preparing for launch. These balloon launches are with the support of the Edge of Space Sciences (EOSS), an organization we need to thank regularly.***

sponsored by the Wisconsin Space Grant Consortium. The rocket team called themselves the Spacehawks, a variation on the Fort Lewis College Skyhawks mascot. The team entered in the American Indian Science and Engineering Society (AISES) division and traveled to Wisconsin to compete.



**Figure 2 – In 2019, the Spacehawks team, with Jodi James as a returning member and team lead, had much more success and came in second place. Here are Charles Hakes, Alastair Luna, Brook Hampton and Jodi James just before launching the competition rocket at the Richard Bong State Recreation Area in Wisconsin.**

The 2019 team has been the most successful and earned second place. As part of the weekend activities in April 2019, there was a second day of launching, and all three students were sponsored to join Tripoli Rocketry Association; all three earned their Level 1 certifications after building Madcow 2.6” cardboard rocket kits. Alastair and Jodi built their rockets ahead of time, but Brook built her rocket the night before it flew.

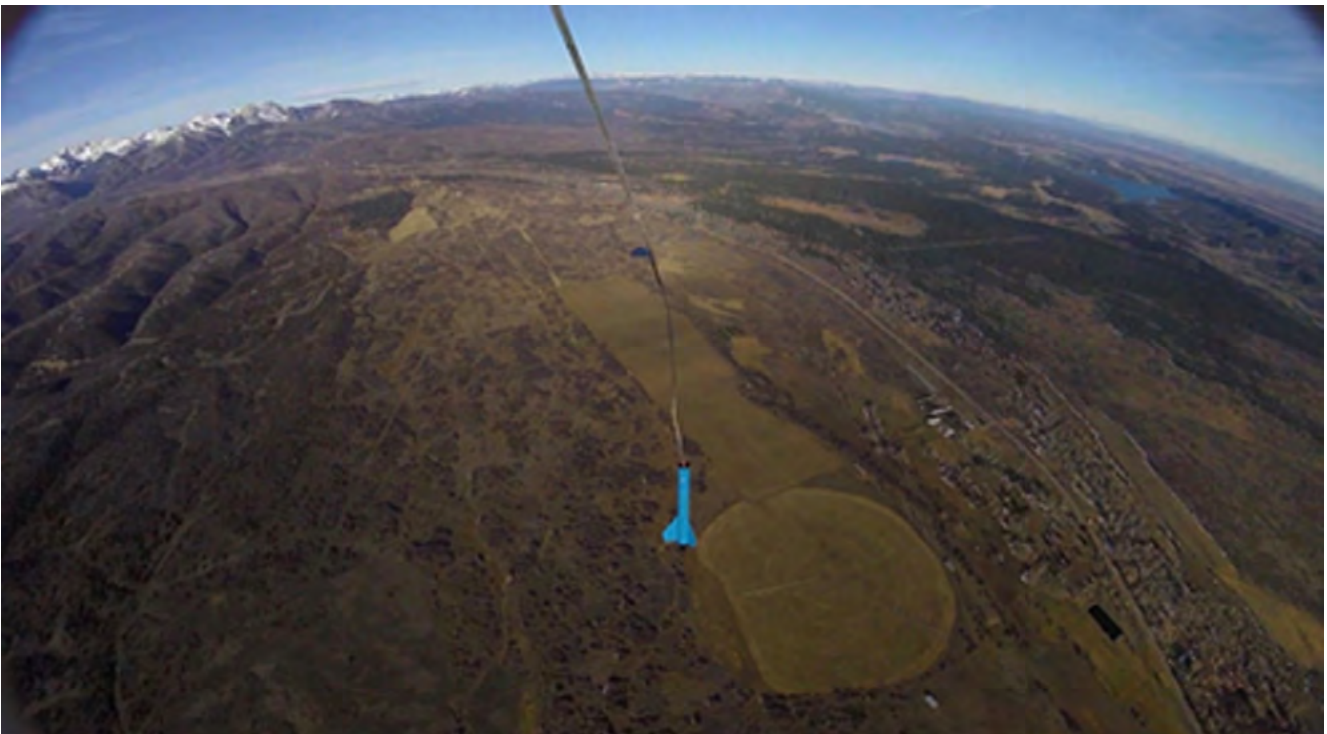
This Durango prefecture really had its start that day in Wisconsin in 2019. I joined TRA a month later. As of 2021, the 2019 team members are all recent graduates of Fort Lewis College. Brooke, the prefecture secretary, received her BS in Physics in 2020, “during the strangest semester of her life” with a pandemic lockdown. She is currently working at a local law firm, and keeping busy while social distancing with reading, cooking, and exploring local trails. Jodi received her

BS in Physics in 2019 and is working for a local model train manufacturer. She says she received a soldering station for Christmas and is assembling electronics to include in a payload that will go in her level 2 rocket. Alastair, a 2020 General Engineering graduate is a graduate student and research assistant at the University of Wisconsin-Madison in the Department of Mechanical Engineering.

The local high-powered launch site is at what is now known as the Old Fort Lewis. It was a 19th century military fort that became a Native American boarding school in 1911. That school eventually moved to Durango and became the Fort Lewis College of today. Native American students from around the country attend tuition-free. The Old Fort site still hosts many college field activities, so it was an obvious choice to look for a launch site.



*Figure 3 – The Spacehawks rocket was a Wildman 4” Drago, shown launching here on an Aero-tech K550. The rocket had small payloads in the avionics bay, the nosecone, and in the tiny space between the motor and body tubes.*



*Figure 4 – View of the Old Fort Lewis from the air, with the La Plata Mountains in the background. The site is five miles south of Hesperus, Colorado, and about fifteen miles west of Durango. The wide-open irrigated hay fields have been and still are used for low- and mid-power launches. The high-power launch site is on the left side just below the field of view.*

When picking a site for high-power launches, we went to Google maps and found a spot that gave us a 4000' radius to any road or building and used that as the center of our cylinder for an FAA waiver. On the upside, it is in the middle of nowhere. On the downside, it is so far into nowhere that it can be inaccessible with too much snow or mud.



**Figure 5 – Three masked members of the 2021 Fort Lewis College Spacehawks NASA Student Launch team are from left to right, Daniel Sandner, Mark Heltman, and Roxie Sandoval. The La Plata mountains make a picturesque backdrop for launching their subscale demonstration rocket on a G motor. A big activity this year has been clearing sufficient sagebrush far enough from the site base to launch the 6” rocket they are building on an L motor.**

The 2021 Fort Lewis College eight-member team is composed entirely of rocketry rookies and potential TRA members. They are making the huge step of competing in the NASA Student Launch, which will be held virtually this April. At least two team members are also working on their Level 1 rockets.

This is the time when I should invite everyone to come launch with us, but that isn't going to happen while this pandemic is in full swing. Hopefully everyone will get vaccinated and we won't be having virtual competitions next year.



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# FINDING YOUR ROCKET: THE LAST CHALLENGE

By Guillermo Descalzo - TRA # 14649 - ACEMA/Tripoli Argentina Prefecture # 151

Once a rocketeer has achieved some reliability in his launches and in his recovery systems, the biggest new challenge he faces is to FIND his rockets.



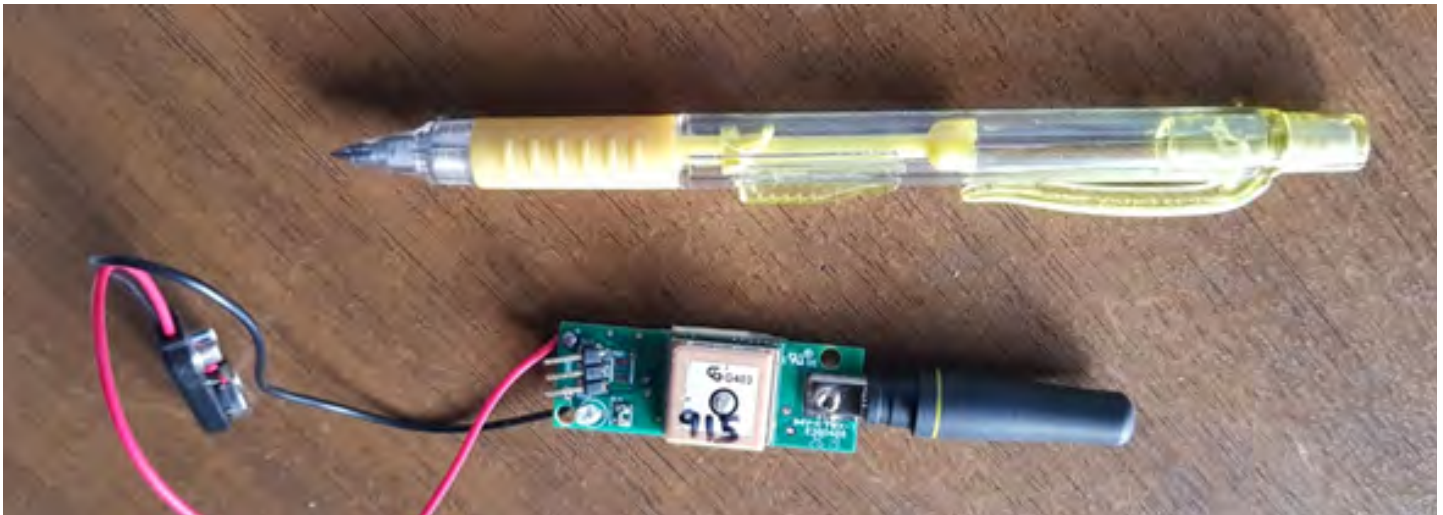
In the plains of the province of Buenos Aires, in Argentina, the place where I live and do most of my launches, the meadows are flat but they usually include high grass and groups of trees and groves, here known as “mounts.” In fact, this is just a name that the people give them, but they aren’t real mounts or mountains, and from afar, they are seen as little woods. But this presents a new challenge: even with a little and humble rocket, if it falls behind one of those “mounts,” AND if the place is covered with high grass... you are in trouble. That’s the reason why most Argentinean rocketeers - as in the rest of the world, indeed - are looking for a GOOD, cheap and reliable tracking system (such a combination!).

In my case, as an old electronic technician and as a professional systems integrator for a long while, over the years I have tried several methods, from “fox hunting” type systems, consisting of using highly directional “Yagi” type receiving antennas, tracking an audio tone modulated from the rocket... to heavy, bulky, complicated and very expensive systems that used commercial GPSs (mostly from the Garmin line) connected to a HF transmitter, that reports the position of a rocket in flight. As anyone can see, any option of this style of setup creates very cumbersome situations... In the middle of that, I found and tried several APRS tracking systems, but none of them seemed to be THE solution. At least, not for me.

But around 2013-2014, I landed on a web page named “Eggtimer Rocketry”... Immediately, I thought “What? ‘EggTimer’? Will you boil an egg in a rocket? What the heck is that?”

Taking a deep breath, I splashed into this web site, and... surprise!!! I found A LOT of





*The EggFinder Mini, the tiniest rocketry GPS ever!*

great ideas and offerings from a nice guy named Cris Erving, that could lead to a real solution for rocket recovery and the tracking drama.

The concept of this site is to sell the parts and instructions to build your own rocketry electronics, all designed by a very seasoned engineer and rocketeer, as Cris Erving is. Great idea!!! The first thing I bought from Cris was his tiny but powerful dual recovery altimeter, named “Quark.” The device turned out so well that we made an informal arrangement to buy him the parts in bulk (but in small numbers, in fact), make the device here in Argentina, and sell it finished, with a Spanish-language instruction book and special packaging as “SkyTec Quark Recovery Altimeter, by EggTimer.” It was a great success. As many of you already know, SkyTec is my own little rocketry company here, in Argentina. I have my part in SkyTec with my partners Roberto Müller (another Black Rock “veteran”), and Emiliano Lopez Marando.

If I recall correctly, I met Cris Erving in person at LDRS 35 at Lucerne Dry Lake, CA, in 2016; we met again at LDRS 37 in Helm, CA, and finally in 2019 in Las Vegas, NV, prior our trip with Roberto Müller and Mario García to BALLS 28. In each encounter, he shared bunches of information with me.

In fact, over several years I bought and built a lot of devices from EggTimer Rocketry, but in this article, I will describe briefly some of their tracking systems, generally named “EggFinder GPS Tracking System.” It is a complete GPS telemetry system that uses NMEA-format data received from a transmitter located on your rocket, by means a receiver on ground.

The purpose is to track the rocket in flight and, more importantly, recover it. Using one of the most modern GPS “engines” you can find in the market, powered by SIRFstar IV technology, the Eggfinder TX transmitter sends a position update once per second, giving you the exact latitude and longitude of the rocket. The Eggfinder LCD receiver has a display that shows the coordinates of the remote GPS, the altitude calculated by that GPS and some other data so that you can easily retrieve your rocket, even updating the location as you get closer. You can “load” this lat/long info into a map in your cell phone or into a commercial handheld GPS, and that’s it.

With the advanced version of the LCD Receiver (more on this later) you will also know the distance from your position to your rocket, the compass direction in relation to you... and you even will have an arrow on the LDC display that will indicate the course to your rocket. Follow the arrow and it will literally take you to the rocket, as the system error is less than TWO METERS (six feet)!!!

My first approach was building the basic version of the LCD receiver and the TX Transmitter exactly as their instructions specified. It was a resounding success.

It is really exciting to build your own GPS transmitter and send its NMEA format data position to a handheld receiver... that you made as well. I spent several afternoons and nights building the EggFinder designs, and - believe me - I have had really a good time.

The first real test I performed was with a very little rocket, named “QMax”, built specially for this experi-

mental tracking system. It is very tiny, is a minimum diameter rocket, and it flies with an Aerotech G40 motor. It flew several times, and it is today in mint condition. As calculated, the rocket reached well over a one-kilometer apogee (3200 feet), and with a little wind, it drifted away, despite just using a streamer. Well... suspense!!! It literally skyrocketed upwards, and (go figure) nobody saw it anymore. But following the indications of the simplest EggFinder tracking System configuration (just the LCD receiver, the TX Transmitter and nothing else), we found the rocket on our first attempt, nearly one and a half kilometer away (one mile), behind several tree “mounts.”



***“QMax” rocket, just a GPS carrier. I am holding the LCD Receiver, in its first “square” cabinet design.***

You can see in the images above how tiny this rocket is!!! And you are seeing the whole system: the receiver (I am holding it) and the little GPS / transmitter that, of course, is inside the rocket. The recovery procedures were done in the middle of a high grass location, as you can see surrounding me. The rocket was found in the middle of a low grass area, but... look at the whole scene!

Roberto Müller and I brought these electronic gadgets to Black Rock, and we flew it in our “Proteus II” rocket (this rocket is right now “parked” - waiting for us at Chuck Duffy’s garage, in Gerlach. OMG).

After the success of several tests made with our “QMax” and “Proteus II” rockets, I decided to give a twist to the idea: first, the new goal will be building one more handheld LCD receiver. In fact, I finally built more than this, because I also built an EggFinder dongle, that allows any notebook to act as a GPS NMEA data receiver from any EggFinder GPS transmitter.

Second, both handheld LCD receivers would have an option that EggTimer offers: an additional internal GPS, so, in combination with the rocket GPS, the system can resolve the relative positions of the operator and the rocket and tell the direction you must walk to do a proper recovery. It also provides, in real time, the distance between the operator and the rocket, as well. A marvelous thing. It is not exactly as Vern Knowles’ “Kate” provides (obviously, it doesn’t speak), but... you know.

One of my LCD receivers would have wired external connectivity (the idea is use it as a ground configuration device for all our EggFinder GPSs fleet) and the second one should go on Bluetooth connectivity, to use it as a “repeater,” to see the rocket position not only at the LCD display, but also in a map in my cell phone in real time, if needed.



*Here, you can see the “guts” of one of the two new re-styled LCD Receivers, along with the other.*

Both receivers worked very well, with both connectivity methods, and we tested them in several different conditions, always with success. The EggFinder GPS transmitters are as reliable as the receivers.

I decided to go with more sophisticated cases, so I bought two cabinets from a local manufacturer. The new cabinets are built by the old but proven thermoforming technology, and as you can see, they are very nice. Additionally, I made some “Apollo style” buttons and switches for both handheld receivers with my Creality 3D printer, and all the lettering and indicators were made in Laser Color printing, on good quality illustration paper. Really simple... but it works!

After several flights, I can tell that the whole system is very accurate, reliable, simple to operate and relatively cheap, even for a “poor” Argentinean! Great outcome from EggTimer!

Drawbacks? In fact, none. Well, you must BUILD the entire system, and this involves soldering multiple surface mount devices (SMD). EggTimer gives very good advice, but I don’t recommend this as a first project in electronics. It requires some experience and very good eyesight... which I no longer have, but that was solved with good - and cheap - technical glasses.

In summary, I highly recommend these kind of approaches, if/when you dare to “fight” with electronics. If the reader finds these topics to be matters of interest, I am open to writing further details about this tracking system and other electronic gadgets.



*Old and new receivers, on my desk*

el limite es tu imaginación  
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## Shoot the Shot: Cameras and Rockets

# ARTICLE 2: ONBOARD SHOTS

### Introduction

Onboard shots can be some of the most dramatic and eye catching of all rocket images. And in no other way can we see some of the events that occur during flight. Only with cameras onboard can we get these shots and this article will present some methods and solutions to the challenge of getting great onboard shots.



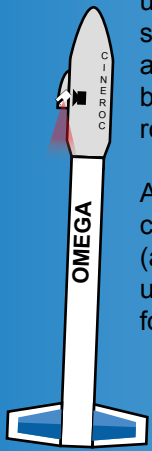
By TR Garman

## Rocket Introduction

What type of camera we use and how we mount that camera determines the shot that we make. In this article I'll present a number of ways to mount a couple of different cameras and what the cameras will view during launch.

Each of the rockets below illustrate different mounting methods and camera types. I'll expand on each model on the following pages.

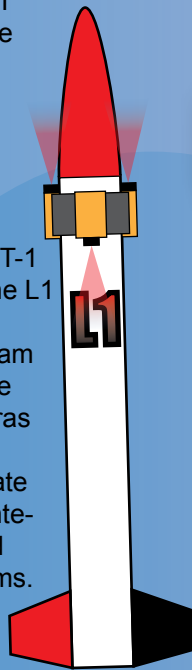
The CINEROC / OMEGA from Estes used an integrated super 8 film camera and shot down the body tube of the rocket.



As this is the first camera ship for me (amongst others), I use it as a baseline for comparison



The ET-1 and the L1 use RunCam orange cameras and illustrate non-integrated systems.



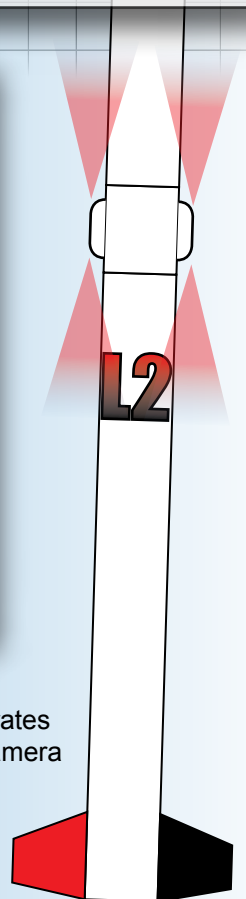
## Camera Symbol

Throughout this article I'll use the standard symbol for a camera to indicate location and direction. The red cone indicates what the camera "sees" in its view. The Camera View angle in the illustrations will not necessarily be to scale or accurate to the different lenses that we may use.



Camera View

Camera Symbol



The L2 illustrates integrated camera systems.

## Non-Integrated vs Integrated

**Non-Integrated** rocket/camera systems can be added to existing designs. A non-integrated system will use "complete" cameras that contain batteries, cases and switches for control.

**Integrated** rocket/camera systems use "incomplete" cameras (aka, Split) and the cameras are Integrated into the rocket design from the beginning.



The basic RunCam orange model is well suited for a **Non-Integrated** installation.



The RunCam Split model is well suited for an **Integrated** design installation.

## The CINEROC

The CINEROC shot views down the body of the rocket from the nose cone. We have all seen this classic view of rocketry.

The CINEROC was offered by Estes back in the mid 70's and is a good example to use to illustrate mounting a camera in the nose of a rocket. The CINEROC could be purchased alone or coupled with a two stage, D motor rocket kit called the OMEGA. Semroc Industries offers a reproduction of the OMEGA with a dummy CINEROC nose cone today.

For me (and others, I imagine) the CINEROC was my introduction to onboard photography (motion picture film), despite my lack of success. I mentioned the CINEROC in the previous introductory article and I'll use it as an example throughout this article, and others.

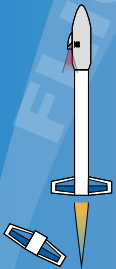
The CINEROC had a super 8mm film camera in which the lens and shutter were situated to shoot out the side. A mirror reflected the view down the rocket. See the section "Using Mirrors" for more.

The transition not only reduced the larger payload to fit the smaller tube of the OMEGA but also provided a small amount of viewing clearance for the camera. Keep this in mind when designing your own camera/rockets.

In this instance, the CINEROC is less likely to view the sustainer and other ejecta.



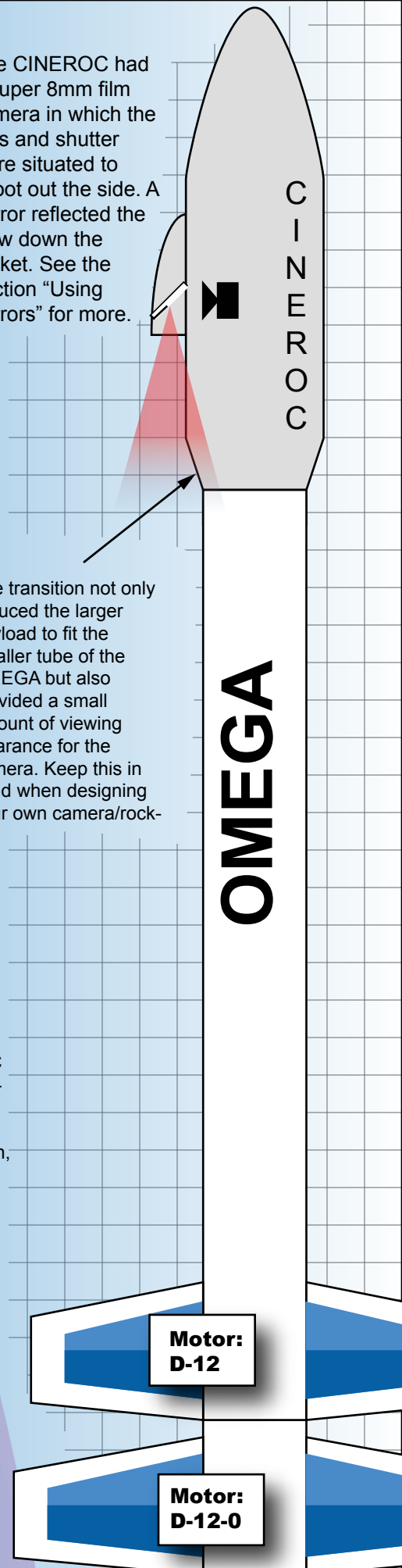
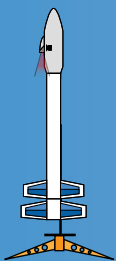
In this instance, the CINEROC is more likely to view the booster drop away.



What the CINEROC views under deployment (later Phases) depends on rigging. See the next section, "Rigging the CINEROC"



On the launch pad and during ignition, the CINEROC views down the body of the rocket.

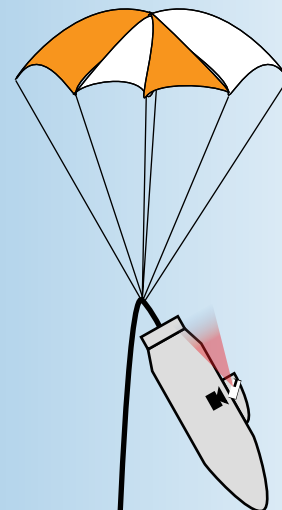


## Rigging The CINEROC

During launch the CINEROC views down the body of the rocket but what it views during/after deployment depends on the rigging of the parachute/CINEROC nose cone.

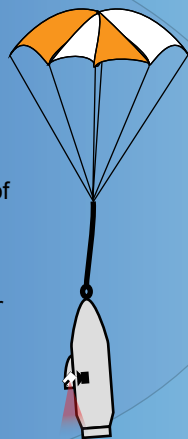
While few of us will actually fly a CINEROC, the principles illustrated here apply to any type of downward viewing, nose cone mounted camera.

Personally, I don't prefer the nose mounted camera. The rigging issues illustrated here are some of my gripes. The following designs/pages will show some of my solutions.



Rigging the parachute/shock cord in the typical "Model" rocket fashion will result in a view up towards the parachute.

Estes referred to this as a "Carrier Parachute." The extension line wraps over the nose cone and tucks into the body tube. The body of the rocket deploys a separate parachute.



Rigging in this manner results in a shot toward the ground.



Estes called this rigging method "Panorama View."



## Stick and Tape

The most basic way of mounting a camera on a rocket booster or nose cone is what I call the *Stick and Tape* method. Use some double sided tape and stick the camera on the side of the rocket. Done. Well almost. Double sided tape will often not be enough to hold the camera in place, so wrapping electrical tape or duct tape around the entire diameter of the rocket will be enough for fairly high power type sport/club flights. I have seen this method work on J powered flights, and have heard of larger.

**CAUTION:** Any tape strong enough to hold our cameras will likely remove paint/decals/finish/sanity.

A slightly improved model of the *Stick and Tape* is shown here. In the selfie shot, the author can be seen holding the L1, a typical 4" diameter certification type rocket.

The grey 3D printed ring holds two basic orange Runcam cameras. The black version of this ring in the selfie holds four cameras. For the flight, double sided tape was used on the large flat area of the ring and a bead of hot melt glue was added along the seam between the camera and the mount. For a hard hitting H motor flight, this setup worked flawlessly.



Double sided  
tape here.

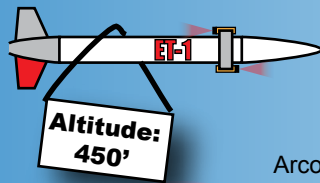


Bead of glue  
along here.

## THE Flight of the ET-1

I wanted to test an idea I had for a 3D printed mount for the basic RunCam orange so I designed a variant on a system of rockets that I have been working with over the last year+. This model I dubbed the ET-1 and it carried two RunCam orange cameras mounted near the top of the booster, one pointed up and one down.

Two RunCam Orange cameras mounted externally on the ET-1.



Arcover perfect with one slight exception: ejection charge fails to fire.

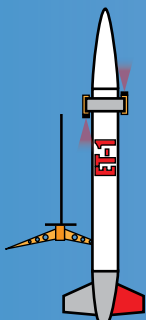


Launch and ascent perfect.



The ET-1 Plugs into the ground.

Cameras survive, test of mount successful. Ejection charge fires 2.6 seconds after impact.



Motor:  
E-28

ET-1

## The Flight of the ET-1...End

Of course the drive home was filled with “Why this...” and “What that...” running through my head, and more that I shouldn’t even save for a later article. But in the end I learned a great deal from the one and only flight of the ET-1.

One of the things that I learned was that the RunCam cameras that I used could take quite a beating. Of the two onboard cameras, one of them continued to record after impact, the other recorded just until a point before impact. This page shows some of the results.

I learned quite a bit more from the ET-1, but that I really will reserve for a later article.



Take pictures before launch, it may not look quite the same minutes later.



## The Elephant in the Room

A photographer shooting a herd of elephants gets caught up in the stampede. Awakening in the hospital, the doctor says,

“You have two broken arms, a broken leg, 3 fractured ribs, a punctured...,” when the photographer interrupts,

“Yeah, but did I get the shot?”

OK, so what does an elephant gag have to do with our rockets? Well, there is an unfortunate reality to photo/video work: the riskiest situations can create some of the most interesting images. And in order to capture those images we must risk life and limb. Well, our cameras anyway. Please don't risk limb.

Sometimes rockets don't work quite right and they get a little scratch here and there. Some of you might know what I mean (see the ET-1 page).

In order to get some of the best shots of our rockets, we must sometimes put cameras in risky situations. But if we treat them as just another piece of onboard equipment, then the risk is no more than the rest of the rocket. I realize this does not help much when our rocket noses over at apogee and picks up speed.

Years ago while hiking through the woods to find the smoldering remnants of my time/effort/money/sanity a buddy remarked,

“Did you bring a bag to take it home?”

Once the chuckles and snickers calmed, sheepishly I responded, “Yes.”

Back in the shop another buddy commented,

“That was a beauty this morning... looks like a pile of s\*!% now.”

To which I replied, while sifting through the wreckage,

“Yeah, but did I get the shot?”



An *unscheduled reconfiguration* of a Yi Action cam.

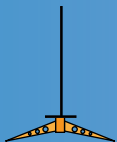
## Right and Wrong way of doing it

I must admit that I tend to bristle when I hear someone refer to something as the Right way or the Wrong way. To me, there is no Right or Wrong way.

I like to look at it as there are ways of making it work and ways that don't work. Everything is in the Doesn't Work category until we make them work. Everything starts in the Doesn't Work category. Only once we make it work does it move into the Works category.

For me, in order for something to move into the Works category it has to work well enough that I can check it off the list and move on to the next challenge of the project. How well it works and how we accept its success can be interpreted as preferential. Which is my whole point here.

What I present in this article works for me to get what I want (well, it is about the best I can get for now but I am rarely happy with ANYTHING. Future article perhaps.) And while it works for me, it may not work the same for you. Perhaps you prefer a different camera. Maybe you would rather use mirrors (see page on Mirrors.). I say “Great.”



## The L1 Rocket

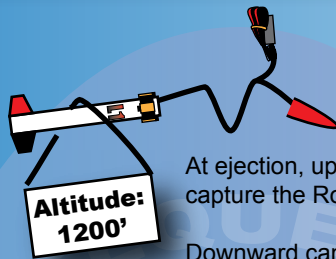
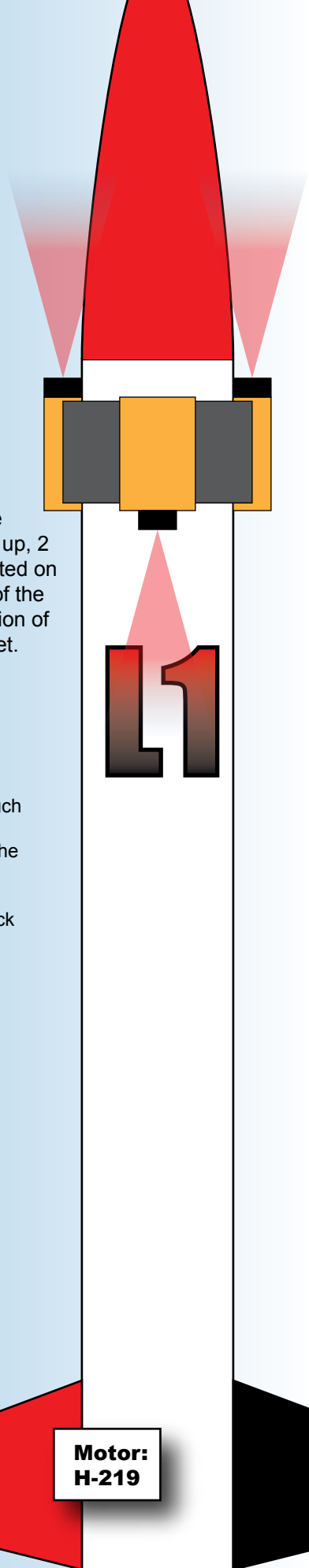
The L1 is based upon a 4" diameter tube with a 38mm motor mount and illustrates a non-integrated camera design.

Four basic orange Runcam cameras are mounted on the booster section of the L1. A 3D printed mount was used (see next page) that houses each camera in a slot that allows the camera to be mounted either up or down.

One feature of this type of design/installation is that it can be used on existing rockets or easily added to kits prior to building. Integrating into the design is not necessary (although helpful).

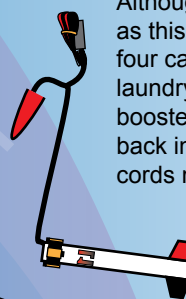
Using a 3D printed mount (as is used here on the L1) is a slightly improved version of the Stick and Tape method of camera mounting.

Four Orange Runcams (2 up, 2 down) mounted on the outside of the booster section of the L1 Rocket.



At ejection, upward cameras capture the Rocket Action.

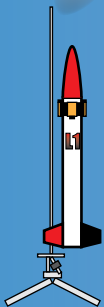
Downward cameras view the cloud.



Although rare, situations such as this can arise where all four cameras lose view of the laundry and nose. The booster will usually swing back into view. Longer shock cords may help.



On the launch pad and during ascent, Downward cameras view down the rocket (at the ground) similar to the CINEROC shot.



Upward cameras view the nose and sky.

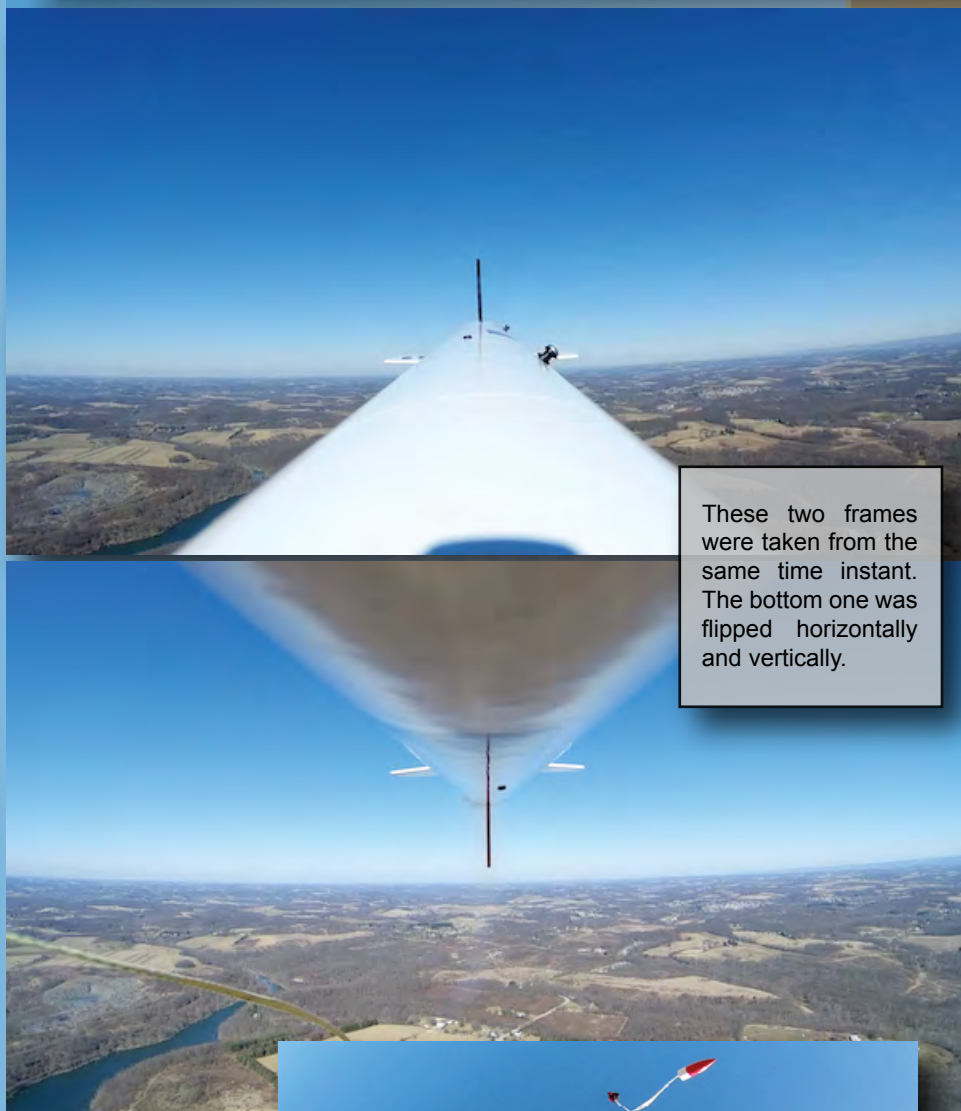


Once the parachute deploys, the downward cameras point down and the upward cameras point up.

## The L1 Rocket - Downward Cameras

The L1 has two downward (and two upward) facing cameras mounted towards the top of the booster. During ascent the downward shots are similar to the CINEROC type of shot but differ once the ejection charge fires.

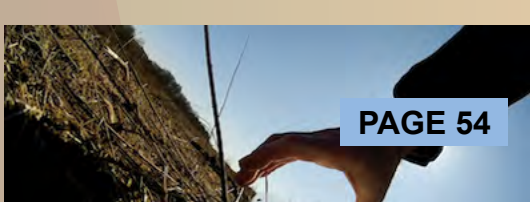
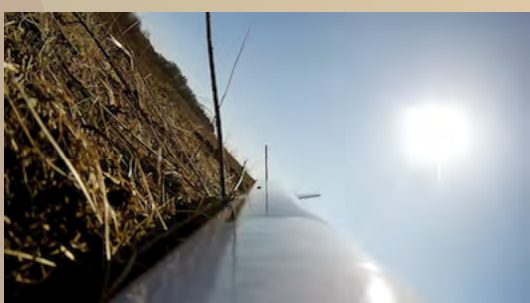
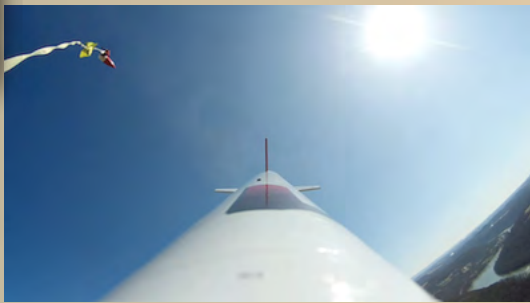
Note that the position of the rocket within the frame NEVER changes during this entire video. If your rocket moves within the frame, check your camera/mount as it might be loose.



These two frames were taken from the same time instant. The bottom one was flipped horizontally and vertically.



Oops... the shock cord wraps around the rear and hooks onto a fin. Luckily it slipped clear.

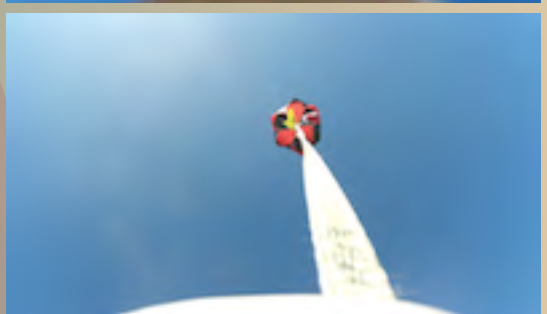
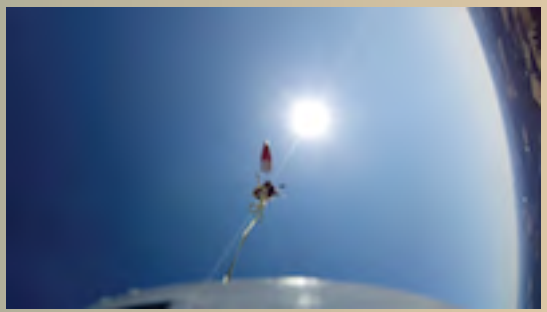
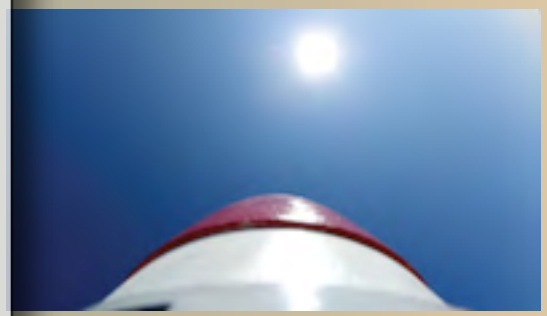


## The L1 Rocket - Upward Cameras

The L1 has two upward (and two downward) facing cameras mounted towards the top of the booster. Sitting on the launchpad we see the rail and sky, and during ascent we see sky. We see sky for about half of the flight. It is once the ejection charge fires that the upward cameras capture the action.

If the flight goes as planned, only the upward cameras will capture the rocket action of the goodies blasting out of the top on this type of rocket/installation (see "L1 Downward" page for more).

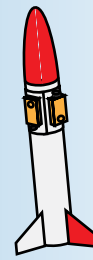
A shot like this (from one of the upward cameras) is often a good starting place to make a finished picture. More on Post Processing in a future article.



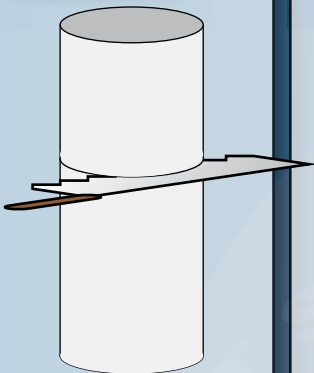
## Make a Camera Sled

In lieu of 3-D printed solutions, a sled type mount can be made easily with a section of body tube. Note that this may not work with all tubes but the sled can be made with other materials as the design idea is sound.

Another method uses dowels and plywood or fiberglass plate (see below).

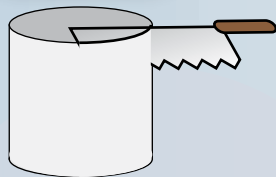


### Step 1



Cut a section of tubing that is the same diameter (or optimally slightly larger) as your rocket.

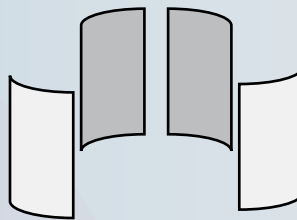
### Step 2



Cut the section down along the length.

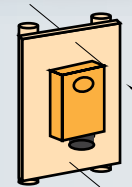
This may be all that you need. A single cut makes a ring that can be slipped over the existing rocket tube. If not, proceed...

### Step 3



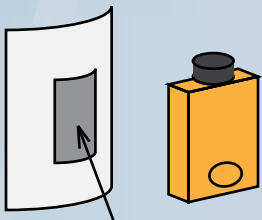
Continue cutting into quarters (or whatever size works for your application).

### Alternate



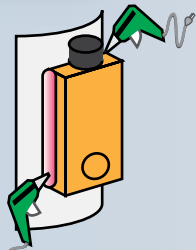
Use dowels and thin plywood or fiberglass plate .

### Step 4



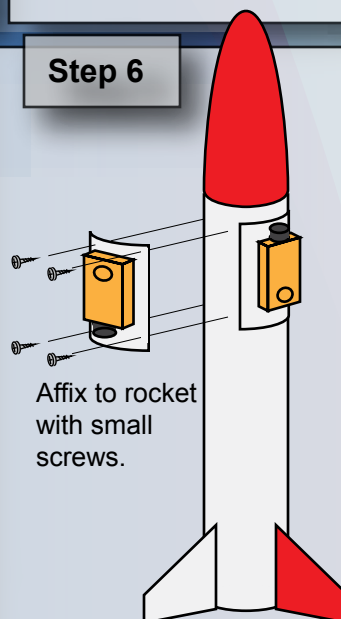
Double sided tape works well to position and hold the cam in place for gluing.

### Step 5



Apply a bead of hot melt glue or epoxy to both sides where the camera intersects with the sled.

### Step 6



Affix to rocket with small screws.

### Step 7

Fly and MAKE PICTURES!

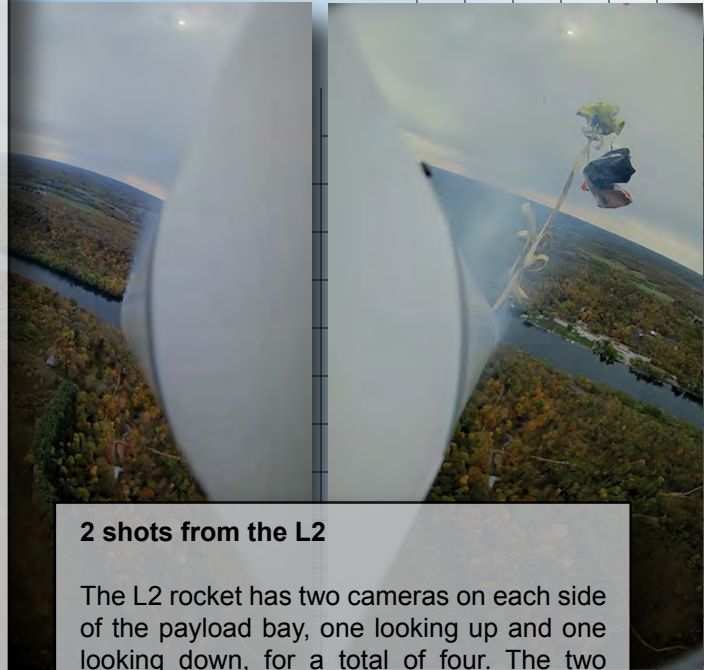




## The Case for Multiple Cameras

There are a number of reasons to use multiple cameras.

1. Coverage. A single camera may not capture the action. In the case where a single camera is mounted in the CINEROC fashion, the action can be blocked by the nose itself. A second camera mounted on the opposite side in the same orientation will increase our chances of getting the shot that we want.
2. Individual Perspective. Each camera views or “sees” its own perspective. The same action may appear different from different views and camera angles. A ground shot does not look the same as an onboard shot.
3. The Singular Event. Each rocket launch is an individual, one-of-a-kind, Singular Event. It CANNOT be repeated. You may be able to load up the same motor and launch it again, but it is a different flight. If you are looking for footage of a particular flight, you can only get it once. And if you don't have a working camera pointing in the right direction and recording the action that you want, you miss it.
4. Balance. Onboard installations benefit from cameras mounted in pairs as mass distribution (weight) and aerodynamic drag balance.



### 2 shots from the L2

The L2 rocket has two cameras on each side of the payload bay, one looking up and one looking down, for a total of four. The two images here are from the upward facing cameras. Note that the two images are taken from the same time (a few frames after the MAIN ejection charge fired).

Once the laundry dumps out of the top of the upper tube, it all swings toward one side of the rocket. One camera (right) catches all of the action, the other misses it completely (left).

### 3 Shots of the Same Chute

Each of these shots (below) came from almost the exact point in time. From left to right: ground shot handheld looking upward, onboard looking straight up, drone shot tilted slightly downward.



Can you guess this one?

As a hint, it is not handheld. I'll reveal more in the next article.

## The L2 Rocket

Altitude:  
2750'

The L2 Rocket has four external RunCam Split Nano 3 cameras integrated into the central payload bay. The cameras are located on opposite sides of the bay, one up and one down on each side. Deployment of the lower section occurs at apogee and the upper section deploys at 500' for the main parachute.

Integrating the cameras into the design allows for reduced protuberances on the outside of our rockets. In addition, all of the cameras can be powered by a single switch (see wiring diagram).

I wanted something that would provide good visibility on camera for my apogee event, so I chose a long streamer over a drogue chute. The streamer changes depending on the flight phase and the wind and is easier to see at a distance. Something like a streamer can add one more element to our imaging toolbox. Think about these things as you design/build/rig your own rockets.

Streamer deploys at apogee.

Streamer points up during freefall.

The two RunCam boards are mounted on a vertical partition inside the L2.

The two RunCam cameras are mounted on the outside of the body tube.

Included Spacers.

Streamer points in wind direction once parachute deploys..

On launchpad and during ascent, downward cameras view down rocket aka CINEROC. Upward cams view up rocket and sky.

Motor:  
J-570

## Same Shot, Different Day

These two images from the L2 were shot on different days and at different times of the year. Note the differences between the clear day on the right and the grey day on the left. Furthermore, the landscape is bright green during the summer shot on the right and dominated by autumn colors in the shot on the left. Like many of us, I too am working on a weather machine to control atmospheric conditions (waiting on parts), but until it is complete, I'll have to stick with what I have. In other words, sometimes I have to do one of the hardest things any of us can do and that is not fly. At least if I am looking for that pretty postcard shot. There are some benefits to shooting on the grey day which I'll leave for a future article.

Colors almost get lost under grey day lighting at left. Something else gets lost in the bright image on the right.

Can you find the booster?

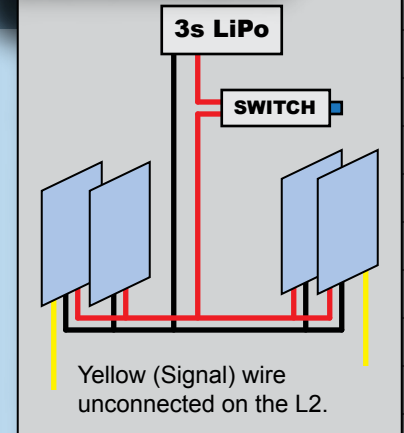
Note this facility along the river bank and how different it looks under differing daylight conditions.

## The “Split” Camera

Small and lightweight, the “Split” type of camera is particularly well suited for integrated camera/rocket designs. Split cameras consist of a camera module and a small circuit board. If we remove all of the non-essential components of a camera, we have a Split.

Split type cameras require us to provide a battery and switching. We can use a 2 or 3 cell Lithium battery or other various powering methods (check your cameras’ requirements.) By wiring all onboard cameras together, all can be powered up with a single switch. For the L2 I used a latching push button (diagram at right.) Note that this wiring method has no safeguard against battery drain. If the system runs long enough to drain the LiPo batteries completely, the LiPo’s may require replacement. So don’t get stuck in the tree overnight.

## The L2 Wiring



A RunCam Split Nano 3

Split cameras from RunCam include a variety of mounting hardware and other goodies.

One of which is a cable that can be used when wiring your own system. The wires that I received had a micro JST, 3 pin plug on each end. In order to use it for our systems, the wire needs to be clipped somewhere in the middle. While the plugs are standard micro JST, be aware of wiring if you use third party connectors. I purchased some that had the same color wires but in the wrong order.

The Split Nano 3 also comes with a clip for the micro SD card. This clip holds the memory card in place and while not required for recording, it is highly recommended.

Be cautious of heat! Split cams are designed for racing drones so airflow is assumed. Heat sinks and/or small fans may be required to keep the temps down. A tiny heat sink stuck on the main processor may be all that is needed for your installation. I used sinks and fans on the L2 (one fan per pair of boards) and all is kept cool.

Connecting the red (+) and black (GROUND) wires to battery power is all that is necessary for the camera to function. The yellow signal wire outputs a composite video signal that can be connected to a video transmitter for live viewing. More on that in a future article.

## Tips and Tricks

Don't forget extra batteries and memory cards.

## Mirrors

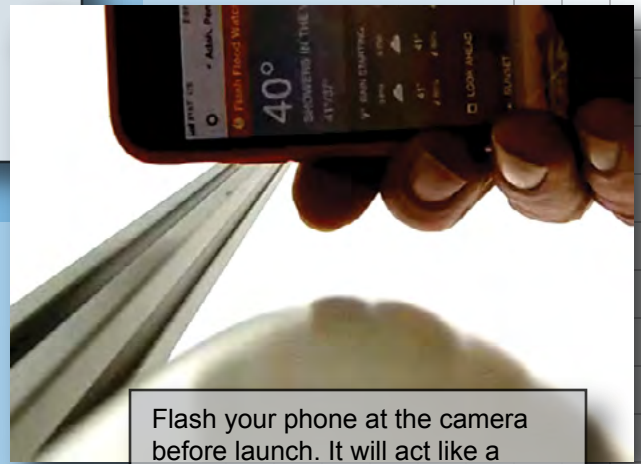
Mirrors can be used to get shots that would not ordinarily be possible. We can use a mirror to redirect our camera view from a side view to a CINEROC type view down the rocket. This is in fact how the CINEROC works.

That being said, I do not recommend working with mirrors unless you have a specific application that requires a mirror.

Mirrors have a number of issues to consider:

1. Obtain Mirror. Finding or making a mirror of just the right size and shape can be difficult. Also, using a cheap mirror can be like looking through a dirty window. A high quality mirror should be used.
2. Position and Alignment. There are a number of factors to consider: distance from camera to mirror, angle of mirror relative to camera, angle of mirror relative to rocket, angle of camera relative to rocket, etc. It may be tricky to determine some of these values let alone align them onboard.
3. One more lens to clean. Mirrors make lens cleaning difficult if not impossible. And the mirror has to be cleaned also.
4. Mirrors flip images. This is less of an issue as our computers and software can transform our images as we please but it's one more thing that we must deal with.

While mirrors can be a great way of diverting our image, users should be aware of the issues involved.



Flash your phone at the camera before launch. It will act like a Hollywood clapboard recording date, time, and whatever you like (here I have the weather).

## WiFi

Many newer cameras come with WiFi connectivity. WiFi provides us with the ability to control a number of functions of the camera wirelessly with a smartphone or other device. Like anything, WiFi has its advantages and its disadvantages.

On the plus side, we have the ability to control various functions of the camera without the necessity of a physical button.

On the minus side, WiFi EATS batteries. Most of the WiFi cameras that I tested had increased current consumption on the order of 2-3 times. This translates to less time before the battery goes dead on us. For me, that is usually just as the igniter is about to fire.

I find the electrical cost to be excessively high for my own uses, but give WiFi a try when you fly. You may prefer using WiFi.

## We don't TAKE photographs, We MAKE photographs.

We choose the type and make and model of camera that we shoot the picture with. We choose the subject matter, composition, lighting, camera orientation and other factors affecting the image. We choose when to press the shutter button. We press the shutter button. We post-process the image. We choose how and in what format to view and display our images.

All of these decisions contribute to the final image, MADE by us.

## Conclusion

Onboard shots are some of my favorites. And the only way to get onboard shots is with onboard cameras. Whether you integrate the cameras into your rocket design from the beginning or you stick a camera on the side of an existing bird you can get great shots. I hope this article has demonstrated this in a useful way.

In future articles I'll bring back the L1, the L2 and eventually the L3. The L2 has additional cameras and systems that I'll detail later. Even the old core digger ET-1 may have some secrets to reveal.

Upcoming articles will feature ground shots, handheld and drone shots with more coming in future articles.

I hope that the material I have presented in this article and the series itself is helpful to any who read to this point and I appreciate your time. I give you credit if you have made it this far. There will be an exam later.

### Contact Information:

In the previous article I neglected to include my contact info. Feel free to get in touch with me at:

[trgar@pitt.edu](mailto:trgar@pitt.edu)

Can you tell how this picture was shot? A couple of hints:

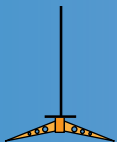
1. It is not a composite. That is, it was not put together with multiple images. This is what it looked like out of the camera, I just selected a part of the frame to make this pic.

2. There are hints in the photo itself. If you study it a little, you may be able to figure out quite a bit.

I'll reveal more in the next article!



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# ROCKET FINISHING MATERIALS

by Tom Blazanin TRA #00003

**This article covers surface finishing materials of applicable use on bare metal, fiberglass and carbon fiber, up to the final color paint application. It does not cover polyester & epoxy resins. While many people do things differently, the materials presented here are basic and time proven. Note that while specific products are discussed, this is not intended to be an endorsement or advertisement for such products. They are however, products with which the author is most familiar and have provided good results when used as indicated. Surface paint will be covered in a separate and unrelated article.**

When building rockets one puts a lot of work into learning all about how they operate and how they go together. But there is more than just that. Finishing high power rockets is as different as building, compared to ordinary model rockets. Model rockets use basic white glues and light weight putties and primers to obtain their smooth look. Weight is a major factor so you really have to build light.

High power rockets require more structural integrity, and weight in some cases can be an asset. Epoxies are the adhesive of choice. There are several good adhesives and epoxies you should become familiar with which are covered in other documents. But in addition to these there are other building materials you should also become familiar with. High power rockets are subject to massive stresses and need materials that can stand up to them. Keep in mind you are also no longer working with cardboard.

Many people approach high power building using materials of their own choice. In some cases, these are items not readily available to the average high power builder. We'll try to keep our selection to stuff readily available without special ordering. All of the materials presented here are available in most any auto parts store or body shop store, which are plentiful and located in nearly any town of size. Despite the title, a "body shop supply store" is open to anyone walking in off the street. Prices are the same for anyone but unlike a professional body shop you will likely have to pay tax.

## FILLERS

The first item we'll present is DURAGLASS. This is a product of USC. It is an epoxy filler; a thick green colored substance that has unbelievable bonding character and strength. It bonds great to metal, fiberglass, carbon fiber, phenolic and wood. It comes with a small



tube of hardener for curing, and if not over-used the little tube of hardener will last the whole can of product.

The hardener usually is blue for DURAGLASS however any color, red or white, will work the same, as they're all the same. The color is there to aid in the mixing process.

There is a similar product called TIGER HAIR, which is DURAGLASS, or equivalent epoxy filler, containing fiberglass fiber strands. While this is good in the automotive industry, for building rockets its aggravation factor outweighs its usefulness - don't use it.

When DURAGLASS hardens it is really HARD. It is best to shape-sand it with 30 or 40 grit dry sandpaper just after it begins to set. Work your sanding process onto a finer paper, 80 or 120, as the final shape nears.

Keep in mind this is not a finish product so your desired shape need not be perfect, but good enough that a final top coat of filler will be needed. The DURAGLASS is best used, once a fin is secured with epoxy,

as a fillet on a motor tube or a small fillet on a fin-to-airframe application. Remember most to sand it while it is still somewhat “soft.” Once it hardens, it can still be sanded but it takes more work.

DURAGLASS can be purchased in a smaller can for convenience. Since you do not use a lot of this when building a rocket, there is no need to buy a whole gallon when a quart will last quite a while.

Once you have a solid DURAGLASS fillet shaped, you can move to another filler from the automotive industry. The good old stand-by is BONDO. This is a grey colored polyester filler used for finish shaping. It also comes with a small tube of hardener, and even though it’s polyester, the hardener is the same as used with DURAGLASS. Usually it is red but again the blue or white works the same and helps aid in mixing.



There are several versions and brands that all work well. BONDO was one of the first, and its name became a generic term for polyester filler. To top it off, it is probably the cheapest and yet far from the worst. There are versions given the title LITE or GOLD or FINE. These are specially formulated to actually make them light weight and also easier to sand. The problem is they cost more and you actually get less.

Unlike epoxy fillers, polyester fillers can be shaped just after kicking off with a rough sandpaper, however if left to sit overnight you will find BONDO sands best when actually hard. This also works well when re-

skimming to fill low spots. The new soft BONDO will sand easily while the hardened stuff maintains shape, and you can even things out quite nicely. If sanding continues you will work into the older layers applied so pay attention and sand with fine paper.

There is a second polyester filler you might be interested in. Made by USC it comes in a large tube and is called ICING. It too uses the same hardener as DURAGLASS and BONDO. It is a very smooth fine textured “bondo” material used best for final skimming. Called a finish putty; it is no more than a Lite version of BONDO taken to the extreme. It is very smooth to work with and ideal for filling sand scratches and “pin” holes in the work you’ve already smoothed.



The three items thus far mentioned all have one thing in common, and most important to their proper use. Never apply any of them over primer or paint. They work best, getting a good etch bond, when applied directly to a raw well sanded surface. Again, the surface can be fiberglass, wood, metal and even cardboard.

These fillers are mixed and spread using plastic squeegees. Rubber squeegees and even pieces of old leather belt will also work. You want to use something that will conform and shape the filler to the desired surface required, for us usually a fillet. Repairs on nose cones and airframes are also subject to curves and a good flexible squeegee is necessary.

Also with these fillers, be careful with your sanding. Without experience you can very easily over sand and end up constantly reapplying filler to bring up to shape. When your finished surface does require a re-coat of filler, identify the exact area and circle it with a pencil. This will make it easier to find with a squeegee full of filler in hand.

Another trick for finding imperfections, with filler or final finish glaze, is running your fingers over the surface - with your eyes closed. Looking at the surface



while feeling it doesn't work as well since your eyes tell your fingers everything "looks" good. With eyes closed your fingers are more sensitive and it is amazing how much you will find.

Last note for fillers is that their finish need not be final. Strive to get it really good but keep in mind that fillers are not the final surface.

## PRIMERS

We cover primer paints next as they are actually the next step. We will only cover primers here as finish paints are an article to themselves. As stated, never put fillers over primer or paint. The next most important thing about primers and paints, both, is avoid using RUSTOLEUM!

RUSTOLEUM is a product developed by Norwegian whalers to protect their ships from rust and sea corrosion. It is fish OIL based, which means while it's great for rust protection and re-coating with other RUSTOLEUM products, making your lawn furniture and railings look good for a long time, they will not be compatible with GOOD and expensive "real" paint. In most instances your use of RUSTOLEUM primer will cover your project perfectly and you will be thrilled - until you apply your good paint final coat, and all hell will break out with what is called, in the paint business, fisheyes. RUSTOLEUM paint also has a very long soft life. This is due to the oil contained. Handling newly sprayed RUSTOLEUM creates havoc to your finish. While it may seem dry and you can handle it, you will find even slight pressure will leave permanent finger prints - even days after spraying. It seems RUSTOLEUM never really dries! Best advice, if you take advice, is never use RUSTOLEUM on rockets.

The best primer is regular automotive primer used in commercial body shops. It comes in various colors, gray, red, green, yellow, etc. While ideal and very usable, their cost is up there. Besides the primer you'll need thinner and a spray gun and a compressor, all of which the average rocket builder may not have.

Spray cans are the answer. They're relatively inexpensive and readily available. They also come in various

colors: Gray, Red and Black. There are also two types of primers: Sanding Primer and Filler Primer. KRYLON Primer will work but their coverage and build are limited. DUPLI-COLOR is available in AutoZones, Advanced Auto, PepBoys and most auto parts stores across the country. DUPLI-COLOR makes both sanding primer and filler primer, along with compatible color top coat paint for the automotive industry. This is your best bet. Be sure to read the information on the can. One emphasizes the need to look for the words "filler primer" and "sanding primer."



Sanding primers form a hard surface finish, very thin and with almost a highlight shine. This primer is best used as the surface coat before the first color coat of paint. It is sandable but they never tell you to sand it with steel wool or an extremely fine dry paper just to break the surface, so the color paint can bite in and bond. Anything more and your nice smooth surface will have more scratches and need recoated. Sanding primer can be wet sanded to a nice smooth finish, but again using extremely fine wet paper only.

Filler primer is what works best when working for a smooth uniform finish. It has a high build up of product when sprayed which fills scratches and pin holes, leaving a soft looking matte finish. You can put on several wet coats and it will build up thickness. Sanding primer does not build up thickness - it actually goes on much like paint in thin layers. Filler primer builds up material and is easily sanded using wet or dry sandpaper, from about 320 grit to 600 grit. It dries, the same as sanding primer, very quickly.

When sanding, a light pressure works best. It not only lets the sandpaper clear itself, it also helps in leveling high and low spots.

When buying spray paint in a can, look to see if it has a fan nozzle. This creates a vertical fan pattern when spraying. It can be turned horizontal if needed. Unlike "normal" spray can buttons that send the paint to the surface in a round pattern, susceptible to runs and banding of color, the fan button imitates a regular spray gun pattern for a more uniform covering.

The photo on the right shows a Can Gun mounted on a spray can. This is a handle tool available in almost any hardware store, auto parts store, Wal-Mart, Harbor Freight or Home Depot. It lessens finger fatigue when pressing the spray button and actually allows for better control of your spray pattern.



Glazing putty will sand really easily if little pressure is applied. It is ideal for sand scratches, imperfections and pin hole filling less than 1/16" deep. Again, do not try to use it as filler. When applying glaze use a rubber squeegee and drag the product toward you. The second squeegee of glaze should be dragged onto the first application.

## GLAZING PUTTY

Glazing, sometimes called Stain, is usually a nitro-cellulose product. That is, it is very very very thick primer. It is made by 3M under the DYNATRON name and sold as a BONDRO brand product. It is available in Auto Parts stores anywhere you can buy BONDRO products.



A similar product called NITROSTAN is an equivalent, although they do the same thing somewhat differently. NITROSTAN is considered "old school" by the automotive industry today, even though it is a superior product. You will find the BONDRO brand glaze to be more readily available and cheaper.

Never apply this material to a bare surface. Body filler is considered a bare surface. Glaze requires primer to be applied first for a compatible bonding surface. It does not work at all with RUSTOLEUM. It also, unlike fillers, requires thin layer application. Putting it on thick will require a very long drying time, if it ever does, and when sanding it will crumble and rip open.

Do not start on the first and drag away. You'll crumble the glaze and rip open what you've already got smooth. See the diagram at the bottom of the page.

The BONDRO brand glaze dries with a soft look. It is best dry sanded using 320 grit sandpaper or finer. It can be wet sanded however. If it is too thick or gets too wet, when it dries it will actually crack and you'll go crazy trying to re-glaze it. Sometimes the "dry cracking" will not show up until after you begin applying your finish color paint.



NITROSTAN, on the other hand, dries with a smooth hard shell look. It is best wet sanded. It can be dry sanded but only with experience. After wet sanding it does not crack upon drying unless you've applied it too thick. With both products a little bit should be all that is required. Remember these are finishing glazes. What you see is what you will end up with.

Once the glazing operation is done, apply one or two coats of sanding primer. When this is dry you can wet sand with 400 grit paper or dry scuff with steel wool to break open the surface for paint bonding of your color coat. Many people have their own ways of doing things and have their own favored products. The products mentioned and shown here are basics, and should perform well to meet anyone's expectations.

*The diagram to the right shows the proper way to apply both BONDRO and NITROSTAN glazing putty.*

