

TOTAL IMPULSE



JACKSON MODEL ROCKET CLUB

TOTAL IMPULSE VOLUME 23, No. 3

JMRC
HUVARS

HURON VALLEY ROCKET SOCIETY

MAY - JUNE 2023



CRAPSHOOT IX
MAY SPORT LAUNCH
JUNE SPORT LAUNCH
DUAL DEPLOYMENT SQUIBS
50 YEARS AGO: SKYLAB 1&2



CLUB OFFICERS

President: Scott Miller
Vice President: Roger Sadowsky
Treasurer: Tony Haga
Secretary: Buzz Nau
Editor / NAR Advisor: Buzz Nau
Board of Director: Al de la Iglesia
Board of Director: Dale Hodgson
Board of Director: Herb Crites
Board of Director: Fred Ziegler
Board of Director: Mark Chrumka

MEMBERSHIP

To become a member of the Jackson Model Rocketry Club and Huron Valley Rocket Society means becoming a part of our family. We have monthly launches and participate in many educational events. We encourage our members to actively participate in our club projects, running for office in our annual elections, contributing to our monthly newsletter with articles or tips, and offering services to the club in their area of expertise. We have many members comprised of children, men, women, professionals, lay people, educators and people from many other walks of life.

You may fill out an application at a launch or request an application from one of our board members at scott@sfsindustries.com and mail it along with a check for the annual membership dues (\$30.00 individual or \$40.00 family) to our mailing address:

JMRC/HUVARS
 C/O Tony Haga
 711 Wilwood Rd
 Rochester Hills, MI 48309

Members enjoy participating in club projects, meeting an incredible group of positive people, and no launch fees!

COMM CHANNELS

There are several ways to keep in touch with the JMRC/HUVARS and it's members.

Website: <http://www.jmrconline.org>. Information includes directions to launch sites & schedule, range procedures, and instructions on how to join the club.

Groups.io: The JMRC groups.io site is a place to share files and also serves as our primary e-mail list serv. Follow this link to join, <https://groups.io/g/jmrc>

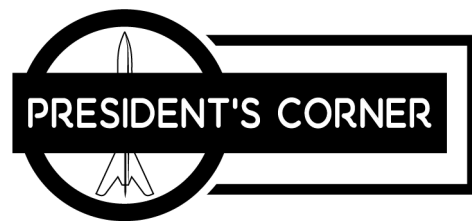
Facebook: If you have a FaceBook account search for "Jackson Model Rocket Club JMRC" and request to be added.

GroupMe: Our new chat channel for broadcasting notifications instantly using a free download client for IOS and Droid as well as by SMS text messaging. You can join the notification chat after creating a free account and following this link, https://groupme.com/join_group/28013422/zc51C1

Fade To Black Rocket Works

Heavy Duty Launch Pads For Every Need
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- Concept Mini \$119 Concept X-treme \$325
- Concept \$285 Ground Pounder \$345
- TARC Pad \$285 Ground Pounder Heavy \$425
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Welcome to the May-June 2023 issue of *Total Impulse*. We were fortunate to have three launches over the past couple of months. In addition to our monthly club launches, there was the annual Crapshoot event in Muskegon. There were plenty of excellent flights despite the weather not cooperating fully. I highly recommend this launch every year. The field is large and the Muskegon Michigan Area Rocketry club does a fine job putting rockets in the air.

Also of note, the NAR's National Sport Launch-East is coming to Pence, Indiana on November 10th through the 12th. Tony Haga has visited this field and he confirms that it is a great place to fly, especially high power with a waiver to 17,999 feet MSL.

See below for the tentative schedule of club launches for the next several months. These dates are based on the farm schedule of cutting every 28 days. Weather may interfere plus or minus a weekend and we may not know until a week or two before the scheduled event.

Finally, big thanks to Herb Crites for his article on dual deployment squibs. It includes a lot of information that is explained expertly. Thanks Herb!

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Launch/Event Calendar - 2023

- WSMC July 1 - 8 (Austin, TX)
- July 22 (Homing 1) *Tentative*
- LDRS 41 - July 6 - 9 (Kenosha, WI)
- NARAM 64 - July 29 - Aug 1 (Lordsburg, NM)
- August 19 (Homing1) *Tentative*
- September 23 (Homing 1) *Tentative*
- October 21 (Homing 1) *Tentative*
- NSL East November 10-12 (Pence, IN)

NOTE: Launch dates are subject to change without notice. Be sure to call the "launch hotline" at 517.262.0510 for the latest weather and field information or sign up for the JMRC Notification GroupMe chat.

Per the calendar, Summer 2023 is officially underway and our club is trying to hit the ground running with launches and improvements. We have two exciting things to share with everyone, although everyone's individual level of excitement may vary... I for one and happy to report that Buzz and Tony will be embarking on a quest in early July to procure a Polyurethane or possibly a Polyethylene throne for all of your bio-break needs at the field! No more renting someone else's unit when we can once again claim ownership to a plastic potty.

The other intriguing development is based around the timing of the Manchester launches. In the past we were able to fly within a week of the alfalfa being harvested; and the harvest would only begin after the plant hit the desired maturity level. The timing post-harvest is the same, but now the harvest schedule is set for every 28 days regardless of the plant height which gives us a bit more predictability on the upcoming launches! Granted a launch date could still slip which in turn would shift all of the subsequent launches by a week, but I personally like the formula so we can help all of our members and guests plan to attend our launches with a bit more precision. We will share the next proposed launch date shortly once we have confirmation from our incredible gracious land owner host.

About Total Impulse

Total Impulse is the official newsletter of the Jackson Model Rocket Club (JMRC), Tripoli Prefecture 96, NAR Section 620. Published Bi-Monthly, *Total Impulse* is a space-modeling newsletter devoted to representing the diversity of interests in today's hobby of model rocketry. This newsletter is in the public domain except where otherwise marked. Unmarked articles, photographs, and drawings may be re-printed elsewhere, but credit to the author and this newsletter is expected. Material marked as copyrighted may not be re-printed without the consent of the author.

The editor of *Total Impulse* accepts material for inclusion from anyone.

Send correspondence to:
 Jackson Model Rocket Club
 Buzz Nau, Editor
 E-mail: USSMidway@gmail.com

On the Cover:

(Front) *Jim McLachlan's Apogee Components Zephyr Level 1 cert flight on a Loki H144* (Back) *Carl Wagner is our member on the cover of the March April 2008 issue of Sport Rocketry.*



MAY SPORT & NRC LAUNCH

13 May 2023 - Horning 1 Field

Buzz Nau

We were able to get in our regular May launch by flying at the Horning 2 field before crops were planted. The dry conditions made for a great field and two-track to the launch site. The forecast winds never materialized and we were also treated to a near perfect flight weather. We also had one successful Level 1 attempt. Congratulations to Jim McLachlan!

Steve Lindeman and his family haven't flown with us in a while and he made up for the absence with 10 flights. He flew the new Estes SST Low Boom as well as some classics like the Red Max and Goblin. He also flew several of his own designs.

Sport Flights

Al de la Iglesia was the top flyer of the day with 11 launches. Included were a lot of classic kits like the MRC Ironman, Estes Nova Scout Ship, National Space Plane, and Big Bertha. He also flew a Super Big Bertha on a D12-3 and Aerotech Initiator on a F44-4.



Steve Lindeman's Estes Goblin

Mark Chrumka also put in 10 launches. First up was a well done Estes Trident for a perfect flight on a B6-4. He flew his Estes Mega Der Red Max on a G74-6 and Pro Series Patriot on a cluster of hour D12-7's. Mark continued flying more 3D printed models including a new Aries and Trailblazer II.



Al de la Iglesia's vintage Nova Scout Ship



Mark Chrumka's 3D printed Trailblazer II

Coming in the 8 flights was Buzz Nau. In addition to several Sky Dart flights, he flew a Semroc SLS Aero Dart and Estes Interceptor E on F39-6's.

Mojave Green, H180 White Thunder, and I180 White Lightning. All were great flights.



Buzz Nau and his Interceptor E

With a lot of persistence, Andy Tomasch notched 7 launches. Six of these were a Big Bertha clone that he was bound and determined to get a successful deployment. His other flight was a Max Q School Rocket on a C6-3.

Michael O'Neal had 6 successful flights including a 220 Swift he was able to recover. Other flights included his Estes Star Orbiter on a D12-3, Sapphire, and Apprentice on a C6-5.



Herb Crites' Mach Schnell SLK 54m on a H220 Blue Thunder



Michael O'Neil's Estes Sapphire

Totalling 5 high-power flights was Herb Crites, 4 with his Mach Schnell SLK 54m and 1 from his Mach Schnell SLK 75M. The SLK 75m flew on an Aerotech I599 Warp 9. The SLK 54m flew on an Aerotech H220 Blue Thunder, H250

Next with 5 flights was Jim and Paul McLachlan, including Jim's successful Level 1 using a Loki H144-8 in his Apogee Rockets Zephyr. They also flew their Tomahawk on a F67-6, Cerberus on a cluster of 3 B6-4's and a successful Venus Probe flight on a D16-4.



Paul and Jim McLachlan after a successful Level 1 flight

Also with 5 flights, Dale Hodgson tested a new 3D printed Sky Ripper I150 hybrid for Scott that worked incredibly well... and LOUD! Other flights included "Samantha's Revenge" on a F31-5, and a staged Helios.

Tony Haga launched 2 including a Sky Ripper I150 test. Again, impressive flight and loud. Tony also flew his "This Goes Up" on a Loki I110.



Dale Hodgson's Helios just after staging

Ryan and Alexa Wood flew with us for the first time and had 4 nice launches. Their Boosted Bertha flew twice on a C6-0/C6-5 combo and they also flew an Alpha III twice with an AstroCam. Hopefully they got some nice footage.



Tony Haga beta test of 3D printed Sky Ripper I grain

Michael Lewandowski put in the third test flight of the 3D printed Sky Ripper grain in his EZI-65. Fred Zeigler also flew one in his "Scrambled Eggs". We think Scott is on to something here as these four flights were amazing.

Competition

The competition flying was pretty light with Bob Always putting up the only official NRC flight, a B Egg Loft Duration flight of 31 seconds. Bob also put in a sport flight with his Vortigo.

Steve Kristal stuck to test flights pushing the envelope of his two-stage altitude design as well as a 7 gram model on a A3-6T that just disappeared. Sorry Steve!

We didn't have a lot of faith that the weather would come through for us, but it did and we enjoyed rather good conditions for a usually unstable time of the year. Our next launch will be in June once the alfalfa is cut a second time, hopefully around the 24th.



Ryan and Alexa Wood's Boosted Bertha Liftoff!



Michael O'Neal and his recovered 220 Swift



Steve Lindeman's Estes Lowboom SST



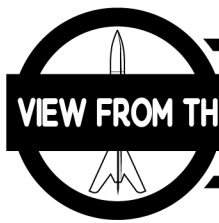
Jim and Pail McLachlan's Tomahawk Cruise Missile



Herb Crites' Mach Schnell SLK 54m on a H250



Mark Chrumka's Pro Series Patriot



VIEW FROM THE FLIGHT LINE

FINISHING TOUCHES

DALE HODGSON

In February I went through several builds including upgrades that were done over the winter. Building these things is my favorite part, next to flying of course. What we'll cover at this point is how I finished them off. Although not quite finished with everything yet, I'm far enough along to at least show a bit of work. In all honesty, painting isn't my favorite thing to do. I attribute that to a couple of things. First, I do not have a lot of patience. Getting a great finish on a rocket takes a lot of work and it is time-consuming. It also starts WAY before the first coat of paint is applied. To do it right there are a lot of light coats of primer, maybe even a little filler depending on the surface, then sanding, then more primer. Depending upon what type of paint is used there may be a waiting period. Some paints like Krylon Fusion must be recoated either within 24 hours or after a week or so. These are enamel-based paints and I learned that when additional coats are applied outside the recommendations results are very bad. Enamels tend to eat a little into the prior coat for adhesion. If it's too soon the undercoat will lift a little and look cracked on the surface. Not a good look. Lacquer-based paints don't do this but at least for me they are a bit harder to work with; I'm always getting runs in the finish. Again, it's a patience thing. To get one good coat of paint applied requires going over the rocket multiple times with very light coats. I think to do this right and get a great finish, it might be best to invest in one of those small air guns that apply very even, light coats of paint. I'll leave that up to the guys that have the wherewithal to do great scale projects. I'll most likely always be a "rattle can" guy and stick with Fusion. Mostly, it's because I am used to working with it. I seem to get very good clean coats on plastic and fiberglass; provided of course they are wiped down with acetone first a day or two before the first coat is applied. It's mostly to remove dust but as I found out with fiberglass airframes there is some type of mold release left on the fiberglass as the part is produced. Not removing this stuff will all but guarantee even Fusion paint to run, bubble up and generally not stick to the surface.

The first two rockets I painted were the LOC Scout 2 and the LOC Goblin. I pretty much painted them the same way. The nosecones of each were black plastic already so I took advantage of that and left them that way. On the Goblin a couple of light coats of white primer were applied to the airframe since I decided to do the "usual" scheme for a Goblin, black and yellow for the most part. The airframe turned out relatively nice but then I had to wait a couple of weeks to paint the fins. This was because I had to use blue tape to section off the airframe and make each fin black. Goblins are usually yellow with a black nose cone and lots of decals applied. I'm a minimalist when it comes to those so I decided that each fin would be painted a solid flat black. Since I was making the fins flat, I didn't do a lot of sanding; sometimes fins at least to me have a little better look to them if they are textured a little. All in all, it came out well. I also substituted a black and yellow X form chute instead of using the supplied black chute. The Scout 2 also had a black nose cone so again I left it as is. I ended up going with a "popsicle orange" color on the airframe and 2 of the 3 fins. The third fin I painted flat black. Same thing for this one, I used a black and orange X form chute to round out the look. Again, not too bad of a job. A couple of runs had to be dealt with; I

*LOC Goblin and Scout 2*

simply sanded those down, waited about a week or so, and re-coated.

The next project was painting the T-Bolt, a retro-looking rocket from Giant Leap. Where I get my inspiration from, I have no idea, but I happen to own (and yes, even wear) a pink and yellow tie-dye tee shirt. Also, very retro to times long past. So, I thought why not? I painted the nose cone and airframe a very bright yellow and the Acme fin can bright pink. Then I let the whole thing sit for a good couple of weeks. I left the nose cone alone but pink flashes and spirals on the airframe just for grins and to mimic the tee shirt. The finish on the fin can came out so well that I didn't add a thing and left them a solid pink. This was all done with Krylon Fusion....again. Of course, this one had an X form chute as well, hot pink and bright yellow.

VIEW FROM THE FLIGHT LINE

FINISHING TOUCHES

DALE HODGSON



A pair of Estes Pro Series Door Knobs

The last two rockets were by far and away the most difficult to do. There are two versions of these Doorknobs, one is a 'traditional' look to mimic the actual paint scheme of the sounding rocket, and the other is a 'sport' version that reminds me of those old stunt biplanes. There is a cheat out there to help with these two schemes, decals are available from Stickershock 23. I purchased both sets but decided to try and use as little of them as possible. The sport version is a bit easier to do, there are just black pin-stripes to do but each fin had a blue checker pattern that must be applied. Stickershock supplied the blue for much of the airframe, but I instead painted that portion the exact color of the cone to get a color match. The base coat of the rocket is white with blue and pin-stripes applied later on.

The 'traditional' version is much more complicated. Again, the base color is white but there are sections of the nose cone and airframe that are orange. It took a great deal of time and masking to pull all of that off, but I managed to complete it. There is some

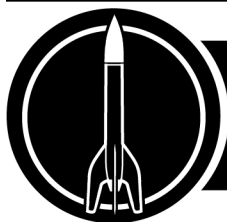
edge cleaning up I must do to get the clean lines I am after but that will happen. To top it all off there is some black pin-striping to be done plus one of the fins had to be painted black. So again, after about a week or so and a ton of masking tape; that part of it was completed. There are fin support panels that can be put on but I'm not sure I will do that. Like I said, I'm not very good at this stuff and don't even want to pretend that I'm a scale modeler. I'm not, that's for sure. But the rockets will look pretty good from 100 feet or so away, so I'll settle for that. The very last thing I will do with both is once all the decals are mounted, I'll clear-coat both rockets to protect them a little. True to form there's a Fusion available in clear as well so compatibility won't be an issue. Of course, sticking with what I kind of do, the sport version has a blue and white X form chute while the traditional version has an X form that's orange and white.

I prefer X form chutes more than any other I've tried since at least for me the rockets come straight down; there is no swaying like I've experienced with more traditional chute canopies. The only difference is that when choosing an X form always go a little bigger than what the decent rates call for. Also, for me, X form chutes are much easier for me to fold, and for the most part, I've not had an issue with them not opening or shroud lines wrapping.

Old habits die hard I suppose.....



Dale and his Giant Leap T-Bolt at Crapshoot IX



CRAPSHOOT IX

10 JUNE 2023 - MUSKEGON

Buzz Nau

The annual joint launch between MMAR and JMRC called *Crapshoot*, was held on the weekend of June 10-11, 2023. The marked the ninth anniversary of the two-day event and no matter what time of year it is held, weather seems to play a role. This year would be no different as Sunday was a washout.

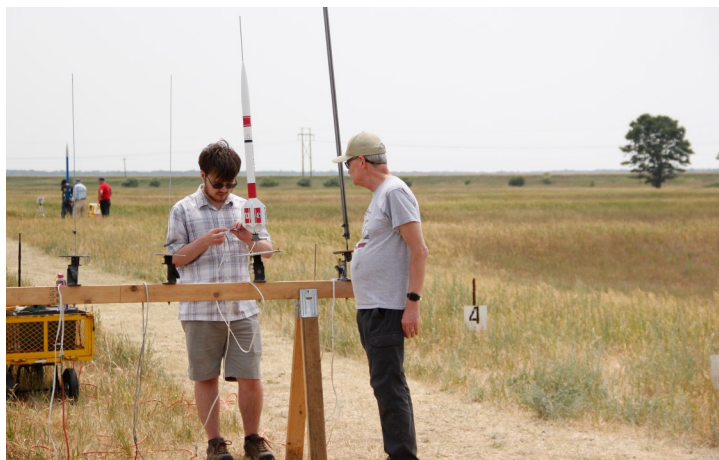
The range opened around 11am on Saturday. There was as steady breeze from the west-southwest and most rockets recovered in the immediate launch area.

JMRC/HUVARS members that attended included Scott Miller, Jim & Paul McLauchlan, Tony Haga, Dale Hodgson, and Buzz Nau.

Jim McLauchlan explained the flights that he and Paul put up; "Paul and I had 5 flights:

Flight 1 was an Estes Venus Probe on a Quest D16-4. The lift off was good, separation and parachute deployments also went well. The landing was memorable with the lander touching down on top of the storage shed. The booster drifted over the pavilion and ended up hanging from the passenger side mirror of Bob Always' minivan. There was no damage to the shed, minivan or rocket. Flight 2 was a Quest Quad runner on a cluster of four B-4 motors. Three motors lit, but it was a good flight overall. Flight 3 was an NCR Corporal on an F67-6 motor. It had a smooth lift off and recovery. Low & Slow. Flight 4 was a LOC Harpoon on a G74-6. It hit an apogee of 979 feet and was an easy recovery. Flight 5 was a "Vega Explorer" (bought from e-bay), tube fin rocket. It is a bit different looking in a good way. It flew on a E12-4 motor, went nice straight flight and then drifted back to the road behind the launch site. Down maybe a quarter mile or so.

We had a good time, unfortunately my wife/Paul's mom ends up working every weekend this time of year. The only thing keeping it from being a perfect day was that she couldn't have been there."



Paul & Jim McLauchlan with their Vega Explorer

Tony Haga went big right out of the gate with his "Smashing Pumpkins on a CTI K520. It hit just 5,700 feet and even with dual deployment it used up nearly all the field on the recovery. Tony's

second flight was his PML Hydra on a J150 Skyripper 3D printed grain. It tipped badly towards the Big Icky. There was a good event at apogee, but the chute did not unfurl. After searching the as fair as one of the ditches near the Icky with no luck, Tony and Buss drove up the rim of the waste treatment lake where we found that it had indeed landed in the Ick and washed to the shore. Needless to say, the electronics are a loss, but the rest of the rocket should be restorable.



Tony Haga's Smashing Pumpkins on a CTI K250

Impulse Buys

On site motor dealer for your rocketry needs

Jay Calvert, Proprietor 03400 22nd Street Otsego, MI 49078	(269) 694-9618 www.impulse-buys.com Jay@impulse-buys.com
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Dale Hodgson had a better luck and got in three nice flights. His first flight was the 75 Dart on a CTI J270 green. It flew to just under 2,000 feet and was easlity recovered. The next flight was Dale's Alien 3D on a Loki G94 Ice Blue and short delay. Another good flight. Third up has Dale's Alpha 4 on a CTI H120 red and a 5 second delay. Once again, a good flight and fairly short walk for recovery. His last flight would have been another 3D grain in a Skyripper, but the preheater failed to ignite.



Dale Hodgson and his 75 Dart



Dale Hodgson's 75 Dart on a J270

Buzz Nau put in eight launches. On the low power end he flew his Cox Shuttle America on a C5-3 which was a successful flight, but the C6-3 remains a better motor for it. He also flew his Centuri Vulcan, Estes Gyroc, Quest X-15, Estes Centurion, and Estes Flutter-By and all were successful. Additionally he flew his Estes Interceptor E on an AT F39-6, which is a perfect motor for that kit, and his Scott Miller 3D printed rocket on a Loki H160-7. That was also a great motor for that model.

Other notable flights included a M6000 flown by Ryan Smith, a successful Level 3 cert flight by and a successful Level 1 cert flight by Alexander Bertzen.

Even though is was only a day, we still had a lot of fun catching up with all our rocket friends in Muskegon. Thanks to Rob Dickinson, Pam and Dave Gilmore, Jay Calvert, and many others at MMAR. Sorry we missed your cheeseburgers on Sunday Pam!



Buzz Nau's Shuttle America and Vulcan

We did get our Chinese food fix though!



CRAPSHOOT IX



And we have a vent!



Tony Haga's Hydra on a Skyripper J150



Ryan Smith's M6000 flight



Matt Johnson's Bomarc



Alexander Bertzen's Level 1 Cert Flight



Buzz Nau's Interceptor E on a F39-6



Dale Hodgson's Alien 3D on a G94



Buzz Nau's Scott 3D Special on a H160


Technical Report

How To Create and Use Dual-Deployment Squibs

HERB CRITES

A Quick to Prep, Compact, and Reliable Alternative to Ejection Charge Cups

Why Dual Deployment?

As a hobby missileman's ambition leads him to building ever larger, heavier, higher-flying, and more powerful projects, the time comes when simple, reliable, single deployment of the recovery system—usually triggered by an ejection charge within the motor itself—becomes too risky, given how far, and how unpredictably *where*, a high-altitude rocket may drift while it slowly descends back to earth under its big, single parachute.

With larger, heavier rockets, too, the lack of precision in motor-controlled deployment often tends to sometimes eject the recovery system either much too early before the bird reaches its slowed, nearly stationary apogee; or much too late after it. Either way, the parachute and recovery harness may be subjected to a damaging bit of shock as the massive chute snaps opens while the heavy rocket is still at speed, either ascending or descending. While featherweight model rockets can easily shake off this kind of abuse, a heavy-on-the-kinetic-energy, high-powered rocket sometimes can't. The shock can rip the parachute. It can break or detach shroud lines or shock cords. Worse yet, it can "zipper" the airframe when the shock cork is snapped tight while the bird hurtles forth head first until the "air anchor" the chute has become violently yanks it 180-degrees back, and the woven shock cord rips through the air frame like the pull-to-open string on a FedEx mailer.

The solution is adopting a dual deployment recovery system. With this scheme, an initial ejection of a small drogue chute (or the drogueless separation of tethered but no-longer-ballistic airframe sections) takes place at the precise moment it should—when the rocket is moving at its slowest, if at all, at apogee. Then finally, in the last 300-700 feet or so of this controlled, rapid descent, the big, main parachute deploys, ensuring a slow, gentle, damage-free landing.

Controlling with precision and reliability the drogue's deployment at apogee, and main parachute's deployment at that final few hundred feet mark, is the job of an electronic dual deployment altimeter. The DD altimeter most commonly uses a barometric air pressure sensor in conjunction with sophisticated, electronic logic to first determine the rocket's apogee, at which moment it fires the drogue circuit. As the rocket rapidly returns to earth (at perhaps 70 feet per second) under drogue (or drogueless), the dual deployment altimeter continues to calculate the rocket's decreasing altitude. When it senses it has reached the altitude the user selected for the climactic recovery event, the altimeter sends that second, main parachute-phase electrical pulse to deploy the larger main parachute. This reduces the rocket's rate of descent to a safe, gentle speed (maybe 15 feet per second) to protect both the rocket as well as anything--or any *one*--it might descend upon.

The energetic component that carries out these dual deployment phases is most commonly one or more pyrotechnic charges that are fired electrically by the dual deployment altimeter. The sub-

stance used to rapidly generate the high-pressure gas that will push apart airframe sections held in place by friction or by shear pins, and yank out the recovery gear so it may catch air and deploy, is usually 4Fg black powder. And igniting the black powder by way of the electrical pulse the altimeter sends is the task accomplished by an electric match--a tiny, electrically-fired "spark plug" of sorts that touches off the black powder.

In preparing most larger rockets for a flight, the correct volume of black powder is usually placed into cups that are affixed to either end of the electronics bay, or e-bay. Then the business end of an e-match is placed into each powder cup. Any excess space remaining in the cup is filled with flameproof wadding. Finally, the cup is capped by a snap-on lid or taped closed with masking tape.

But in the case of slender or minimum-diameter rockets with small bulkheads, ejection charge cups can take up too much space to be both practical and reliable, particularly when the cups compete for space with electrical terminals to which the e-matches will be wired.

A more compact, simple, reliable, and time-saving alternative to field-filling BP cups one can use is the ejection *squib*. This is a separate, prefabricated e-match and powder container in one, that wires directly to a pair of electrical terminals and thus makes no additional space claim on the bulkhead. All that's required to be mounted on the bulkhead is the two (or in circuitry-redundant L3 rockets, *four*) terminals to which the e-match leads will be connected.

Examples of e-match terminals that may be used with squibs



Here's an example of a single set of squib-friendly, e-match terminals for a very slender 38mm rocket



<http://www.millermotorworks.com/>



Here's an example of a pair of terminals on a 54mm air frame rocket (fasteners removed from posts)

2x Heavy Duty Nitrile Gloves. (Cut 1.5" length of fingertips from each glove and discard the rest. Carefully examine each fingertip to ensure each has no punctures or tears.)

10x MJG FireWire E-matches (Trim and straighten each wire 8" from pyrogen end)

10x Pre-measured vials of 4Fg Black Powder (Amount of BP the rocket requires has been calculated, ground-tested, and confirmed.)

- Fine-tipped Sharpie marker
- Fine Wire Cutters
- Ohm Meter

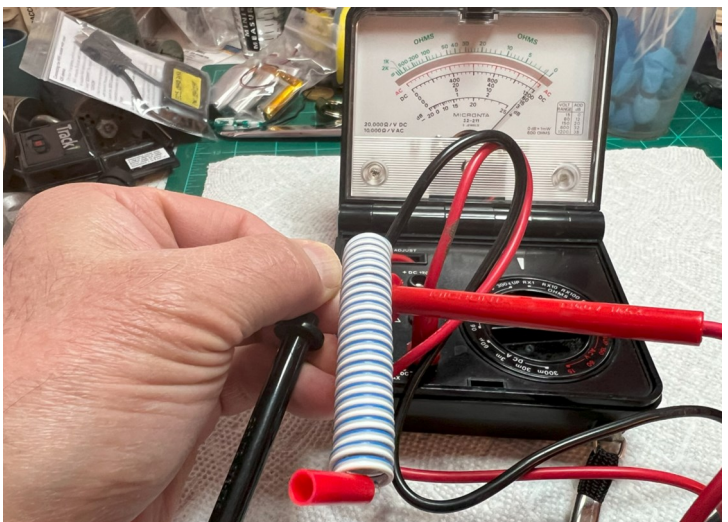
PRECAUTION--Before you start making a batch of squibs, wear eye protection and have a suitable fire extinguisher handy. Ensure your work area is free and clear of ignition sources like smoking materials, candles, batteries, etc. Pre-fill a vial for each squib in advance with the proper amount of black powder, and snap the vial shut until needed. After pre-filling your vials, tightly close up and remove your container of black powder from the immediate area.



And here's an example of a 75mm Level 3 rocket's redundant drogue circuit e-match terminal sets, with a pair of primary and secondary terminals corresponding to two separate dual deployment altimeters and batteries



On the reverse side of the bulkhead mounting the e-match terminals, the heads of the posts are wired to the appropriate connectors on the altimeter



How to make up a batch of ejection charge squibs

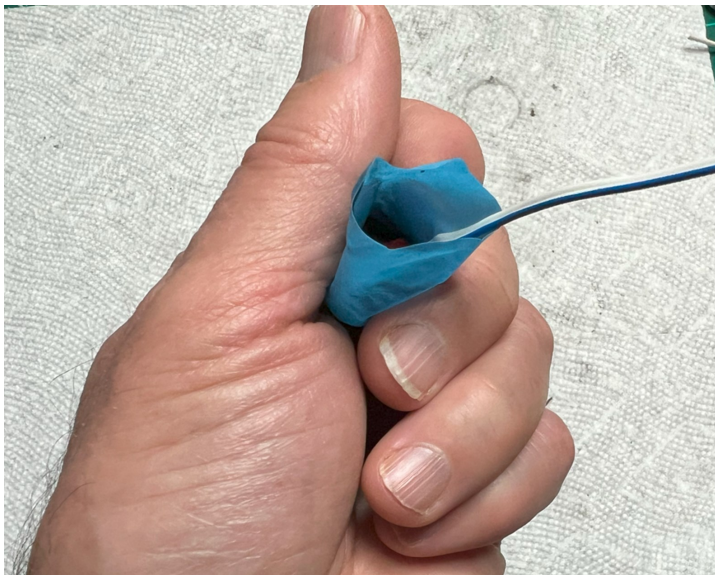
Start by gathering up the materials and tools to make the squibs:

10x 4" zip ties (Slide the tails into the eyes of each tie, advance 1-2 clicks, and form the loop into an even circle)

1. Pre-test each e-match's resistance with a quality ohm meter to ensure it displays about 1 ohm of resistance. **IMPORTANT--** Discard any e-match showing a fully open or fully closed state, or one with much deviation from the maker's nominal 1-ohm resistance spec.



2. Thread each of the zip ties and pull their ends into the pawl to the first or second click, then form their loops into even circles. Fill one nitrile glove fingertip with the pre-measured contents of a BP vial. Roll and tap the powder fully down into the bottom of the fingertip



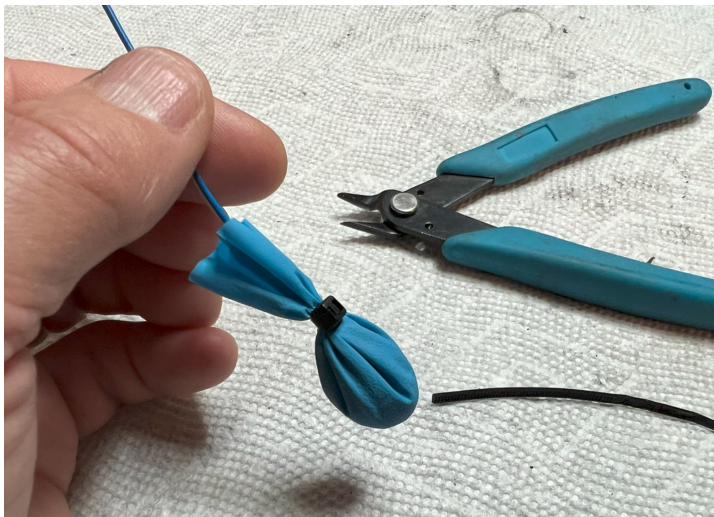
3. Insert the pyrogen end of one e-match into the black powder, pressing it about halfway down into the powder.

NOTE--For L3 rockets that require redundant recovery circuits, use two e-matches, both inserted into the same BP-filled nitrile glove fingertip. (According to TRA and NAR rules, L3 redundancy does NOT require separate quantities of black powder; only its means of ignition must be redundant.)

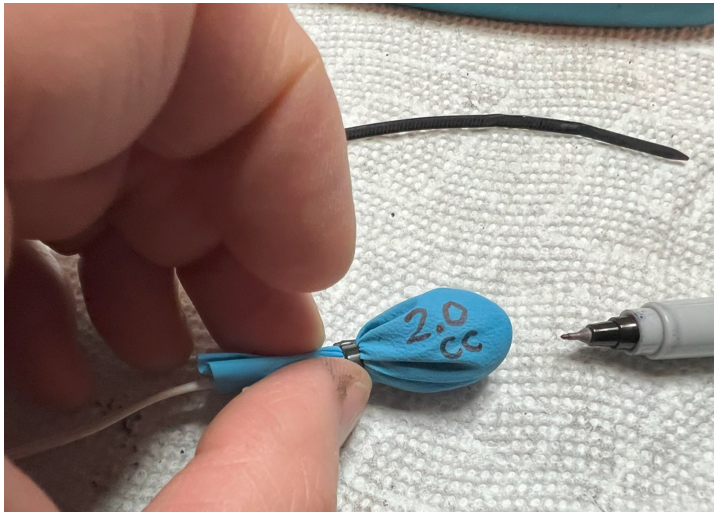
4. Gather the open end of the glove fingertip together over the e-match wire just past its red plastic protector tube, drawing the

excess glove material up to form a taut, non-baggy pouch of powder.

5. While holding the powder-filled fingertip with one hand, slip a looped zip tie under the pouch of powder and lift it up to just below your fingertips holding the gathered nitrile glove tip around the wire. Grab the end of the zip tie by your cuspids like The Duke did his Bull Durham tobacco pouch when rolling himself a smoke. Pull on the zip tie tail while your free hand helps the ratchet end of the zip tie cinch down tightly around the gathered nitrile fingertip. Draw the zip tie tight until it will advance no further. Over a white sheet of paper, invert and shake the squib to ensure no BP more than a few black grains leaks out onto the white paper.



6. Snip off the excess zip tie with the cutter, being careful not to nick the nitrile pouch.



7. With the Sharpie, gently write the volume of BP it contains on the nitrile material.

8. Twist the bare copper wires on the opposite end of the squib one or two turns together to shunt them. Store the prepared squibs in a plastic, non-static jar or bag with all the bulbs gathered on one end and the wire ends on the other. This is to prevent any of the squibs from being punctured by the wires, which could cause it to leak some or all of its black powder. **HANDLE AND TRANSPORT THE PREPARED SQUIBS WITH CARE AND WITH PROPER EYE PROTECTION DURING CLOSE CONTACT! BLACK POWDER IS HIGHLY FLAMMABLE!**

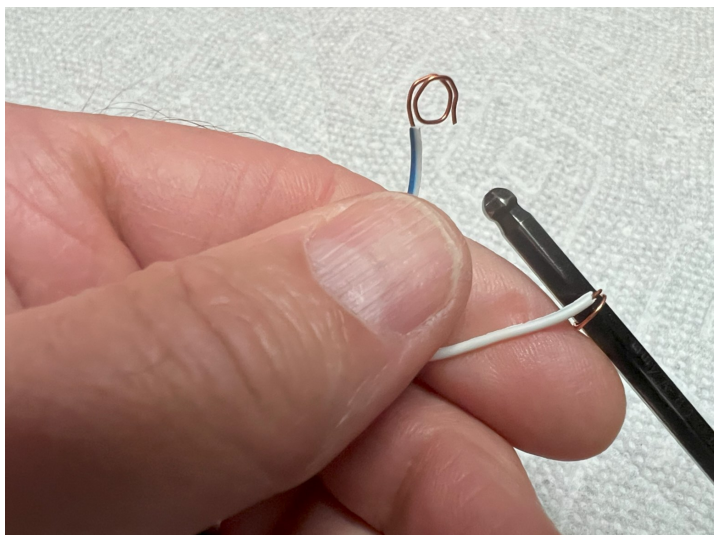


9. Store the prepared squibs in a plastic, non-static jar or bag with all the bulbs gathered on one end and the wire ends on the other. This is to prevent any of the squibs from being punctured by the wires, which could cause it to leak some or all of its black powder.

10. HANDLE AND TRANSPORT THE PREPARED SQUIBS WITH CARE AND WITH PROPER EYE PROTECTION DURING CLOSE CONTACT! BLACK POWDER IS HIGHLY FLAMMABLE!

Installing Squibs onto the Electronics-Bay Bulkhead

1. To install a squib onto the rocket for launch, split the wires and strip about 1" of insulation from each of its copper wires.



2. Using a slim dowel, allen key, or other suitable round tool, wrap one of the two bare copper wires into a tight coil around the tool, then slide it off. Repeat for the other bare wire on the squib.

3. Remove the insulating rubber well nuts from each terminal along with one of the two washers on each threaded post.



4. Slip the coiled wire ends of the squib onto the treaded terminals.

5. Place a washer onto the terminal and press it down to sandwich the squib coil between the two washers.



6. Install and finger tighten the two insulating rubber well nuts, flanged ends UP, onto the threaded terminals. *Check to ensure that no strand of copper wire extends from either terminal that might present a short-circuit hazard with the opposite terminal.*



7. Bend the bulb end of the squib down and nestle it onto the bulkhead, away from any fasteners that might puncture it when the packed recovery gear presses on it.

Using pre-made squibs can be real a time saver on the range, eliminating the need to fill and seal up black powder cups in the field. And for slender and minimum-diameter rockets where bulk-head space is at a premium, using squibs instead of bulky cups is a space-saving solution, too.



JUNE SPORT & NRC LAUNCH

24-25 June 2023 - Horning 1 Field

Buzz Nau

The June date caught me by surprise. I had assumed that because of the lack of rain and growth on the field, that the farm would hold off on the scheduled June cut. I was wrong and that gave us a week to try and coordinate everything. We were unable to acquire a port-a-john rental nor were we able to secure transportation for the trailer to the field. These deficiencies along with the late notice likely contributed to the light turnout. Since the field was available, we decided to fly both Saturday and Sunday to improve the chances of attending.

In total, there were 10 flyers that put up 43 flights on Saturday. Sunday was even lighter with 3 flyers contributing to 14 flights.

Saturday Sport Flights

Leading the pack was Mark Chrumka with 9 launches, though one failed to leave the pad. His 3D printed Gemini Lander suffered a D21 cato when the nozzle blew out the back. Mark will need to print a few new parts, but that's the advantage of 3D printing rockets. Among his successful flights were his X-15 Delta on a F24-4, Boyce Aerospace Apollo Abort Test Capsule on a D12-3, a OSC Pegasus on a F50-6 and Black Brant VB on a G79-6. Mark also had a fun flight with his Edmonds Dee Cee Thunder on a D12-3. Booster and glider hung up in a "Red Baron" for several seconds before the glider finally pulled away and made for a nice lazy glide downrange.

Herb Crites got in 7 flights between his Mach Schnell SLK 75m (2) and SLK 54m (5). True to form Herb used many hard hitting motors like the Aerotech H999 Warp9, H550 Super Thunder, and H242 Blue Thunder. Herb also flew a Loki I210 Red.



Buzz Nau's Argus II

Also with 7 launches, Dale Hodgson flew a mix of low and high power. His upscale "Anti" Swift 220 flew on a H143 Smokey Sam, upscale Mosquito on a E35-5 White, and Bigger Bertha on a F27-4 Red. His low power flights included a couple Baby Bertha flights and two-stage Stars & Stripes on a D12-0 to C6-7.

Continuing the 7 flight trend, Buzz Nau had successful launches of his Aerotech Initiator and Argus II on Aerotech F24-4's. He also flew his Aerotech Mustang on an E16-4, THOY Peacock on a CTI F30-6, Cherokee G on a CTI G88 -8, and SLS Aero Dart on an E22-6.

Al de la Iglesia mostly flew NRC, competition flights for the Escape Velocity team, but also put up two sport flights. His rebuilt Majestic went up on an E16-4 and he also flew his Maxi Alpha on a D12-5.



Mark Chrumka's Quest X-30 on a C6-3



Dale Hodgson's Anti-Swift 220 on a H143



Herb Crites' Mach Schnell SLK54m on a H250 Mojave Green

Michael O'Neal and the clan brought their freshly built Alpha III's Everyone was in on the action with Nathan, Malik, and Jayden flying theirs on A8-3's. Michael outdid them all with a flight using a D16-6. Michael also flew his Estes Star Orbiter on an E12-6.

Tony Haga extended his bad luck streak that started at Crapshoot. His one flight was Binder Excel on a H118. It tipped off badly right off the rail to the west. The Jolly Logic Chute Release worked, but free fall kept the recovery



Mark Chrumka's Dee Cee Thunder on a D12-3



Al de la Iglesia's B Eggloft Duration launch

across the road where it landed across power lines that in turn are across a pond. You can't make this stuff up. Recovery is unlikely any time soon, though the storm that went through the area Sunday pulled the rocket across the line to the far end of the pond.

Saturday Competition Flights

Al de la Iglesia of the Escape Velocity team had five flights including two Super-roc Altitude record attempts. Both were successful, but he only had one altimeter file, so he'll have to try again next month. Al also put in a monster B Eggloft Duration flight over 10 minutes, but you gotta get it back. It just wouldn't fall out of the thermal and likely surprised a farmer in Ohio. He flew 2 A Streamer Duration flights. One was a DQ, no deploy, but the one had a respectable time of 78 seconds. His other flight was for 1/4A Parachute Duration flight of 59 seconds.

Sunday Sport Flights

As mentioned, attendance was light at best on Sunday. The weather was better than forecast for the majority of the day. The wind was stiff early and died around 10am after a front passed. We then had about 4 hours of nice conditions before calling it a day.

Buzz Nau had 7 flights which included his upscale Centuri Stiletto on a B6-0 to A8-5, His Cox Shuttle America on a C6-3, Centuri Quasar on a C6-3, and downscale Vindicator on an A8-3.

Dale Hodgson stuck with low power rockets as well with 6 flights. He flew his Stars & Stripes single-stage with a B6-4, Baby Bertha on a B6-4, and Helios, which separated on a C6-5, but was recovered fine. Dale also had a great glider flight with his Blue Jay on a B4-2.

Tony Haga had a single flight with his Tiny Pterodactyl on a F59-5. The Jolly Logic Chute Release failed to release the chute, but the rocket recovered without damage.

The weather was pretty good, we just wish that we could have gotten the word out sooner and had the usual amenities on-field. The farm is sticking with a 28 day schedule for harvesting the alfalfa regardless of crop growth. Based on that the next launch should be July 22. For now, that is the tentative date, but stay tuned to the website and group email for updates as we get closer to the date. By then, we should hopefully have our own port-a-john as well.



Buzz's Aero Dart on an E22 Smokey Sam



Tony Haga preps his Tiny Pterodactyl



Tony Haga's Tiny Pterodactyl



Dale Hodgson outstanding in his field

JUNE SPORT LAUNCH



Al de la Iglesia prepares his 1/4 PD model



Tony Haga's Excel takes a turn for the wrong side of the road



Herb Crites prepares his Mach Schnell SLK54m for launch

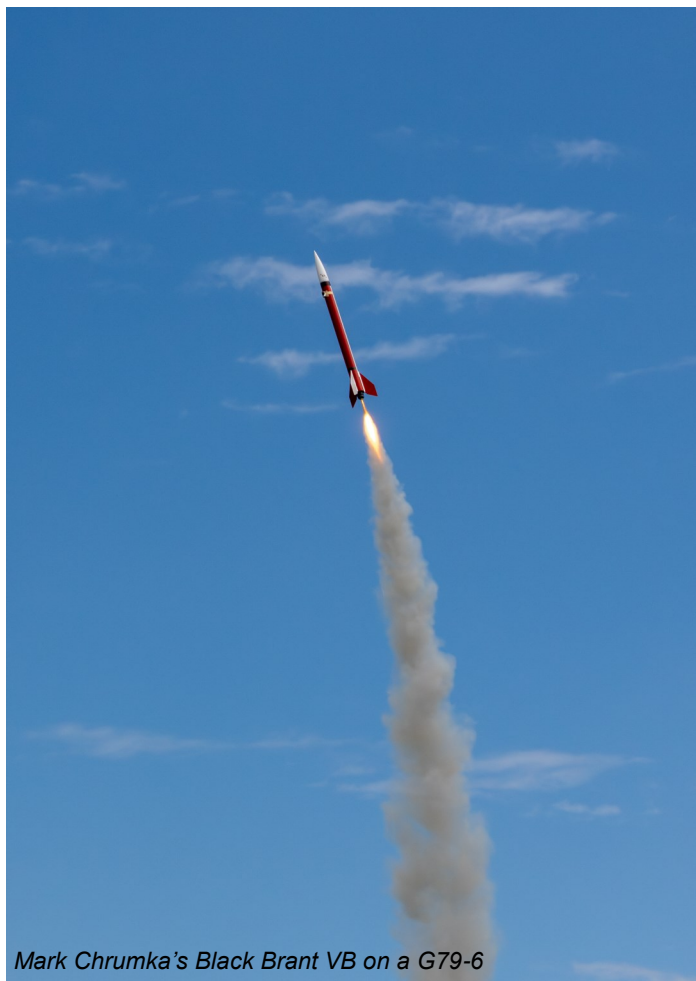


Dale Hodgson's 2.0 Mosquito



Al del al Iglesia's Maxi Alpha on a D12-3

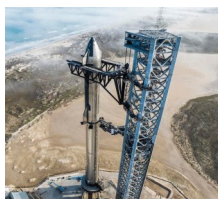
JUNE SPORT LAUNCH



Mark Chrumka's Black Brant VB on a G79-6



Herb Crites' Mach Schnell SLK54m on a H440 Super Thunder



CURRENT EVENTS IN SPACE EXPLORATION

BUZZ NAU

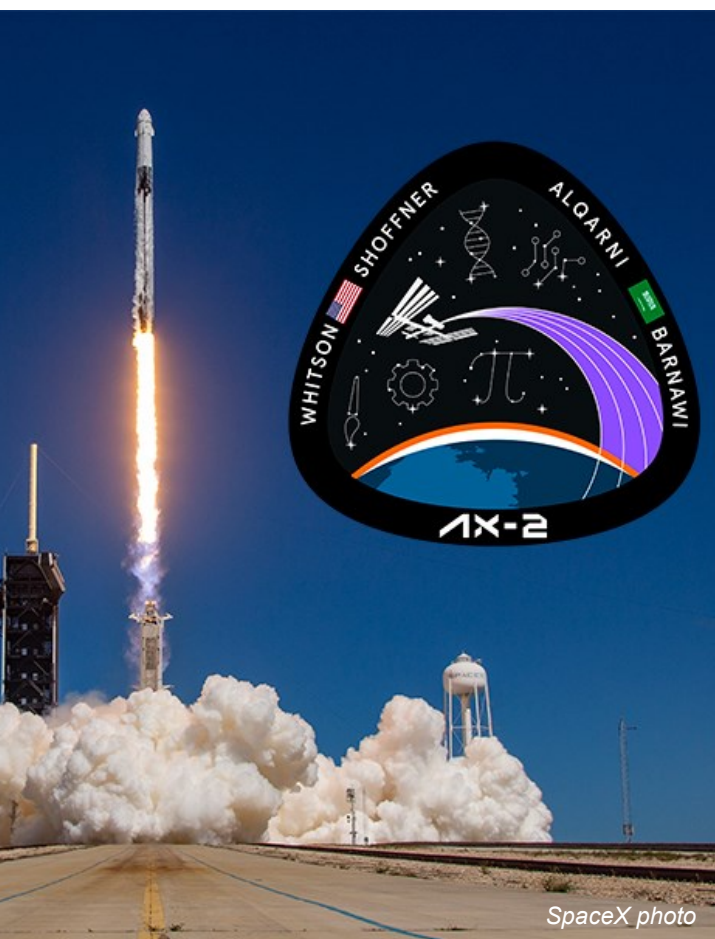
SpaceX continued its high tempo operations with 14 launches over the past couple of months, the majority of which were Starlink launches (see table below). They also made progress in repairing the Starship launcher (stage zero) at Boca Chica after the first test launch on 20 April caused significant damage. In addition to reinforcing that launcher, there has been progress in the construction of the water deluge system. Starship 25 had a successful six engine static fire, clearing a key milestone in preparation for a second test launch.

In other news, the next to last Delta Heavy launched successfully, Rocket Lab had 3 launches including a super secret hypersonic suborbital test, and Virgin Galactic dusted off SpaceShip Two.



On 20 May SpaceX launched the multi-payload Iridium 9 and OneWeb 19 mission from Vandenberg Space Force Base. The Falcon 9 delivered 15 OneWeb internet communications and 5 Iridium-9 satellites to low earth orbit. It was booster B1063's eleventh flight which landed on the drone-ship *Of Course I Still Love You*. Both fairing halves were also recovered.

Axiom 2, the second private funded mission to the International Space Station, was launched on 21 May from Launch Complex 39A at Kennedy Space Center. The Crew Dragon capsule docked with the ISS the following day and returned the crew to a successful landing on 31 May. The crew consisted of Commander Peggy Whitson, Pilot John Shoffner, and Mission Specialists Ali AlQarni and Rayyanah Barnawi, who conducted scientific experiments during their 8 day stay at the ISS. It was the first flight for booster B1080 which returned to Cape Canaveral Space Force Station's Landing Zone 1. It was the first, direct return to launch site landing of a crewed Falcon 9 launch.



Mission	Date	# of Satellites	Launch Site	Booster Flt#	Landing Site	Fairings Recovered?
Starlink 5-6	4-May-23	56	SLC-40 CCSFS	7	<i>A Shortfall of Gravitas</i>	Yes
Starlink 2-9	10-May-23	51	Vandenberg AFB	3	<i>Of Course I Still Love You</i>	Yes
Starlink 5-9	14-May-23	56	SLC-40 CCSFS	11	<i>Just Read the Instructions</i>	Yes
Starlink 6-3	19-May-23	22**	SLC-40 CCSFS	5	<i>A Shortfall of Gravitas</i>	Yes
Starlink 2-10	30-May-23	52	Vandenberg AFB	14	<i>Of Course I Still Love You</i>	Yes
Starlink 6-4	4-Jun-23	22**	SLC-40 CCSFS	3	<i>A Shortfall of Gravitas</i>	Yes
Starlink 5-11	12-Jun-23	52	SLC-40 CCSFS	9	<i>Just Read the Instructions</i>	Yes
Starlink 5-7	22-Jun-23	47	Vandenberg AFB	4	<i>Of Course I Still Love You</i>	Yes

KSC = Kennedy Space Center

CCFCS = Cape Canaveral Space Force Station



CURRENT EVENTS IN SPACE EXPLORATION

The ArabSat 7B mission was launched on 27 May from Space Launch Complex 40 at Cape Canaveral Space Force Station. The optical communications test satellite was built by Airbus to provide telecommunications coverage over parts of Africa, Europe, and the Middle East. It was the 14th flight for booster B1062 which landed aboard the drone-ship *Just Read The Instructions*.

loads that were released over 39 deployment events. Falcon 9 booster B1071, on it's 9th flight, returned to Vandenberg's Landing Zone 4 for a return to launch site landing marking the 200th booster landing.



SpaceX photo



SpaceX photo

On 18 June, SpaceX launched the Satria communications satellite from SLC-40 at Cape Canaveral Space Force Base. Satria will provide broadband internet and communications for public use in Indonesia's rural regions. This was the 12th flight for booster B1067 which landed on the drone-ship *A Shortfall of Gravitas*.

The Commercial Resupply Service Mission 28 (CRS-28) was launched on 5 June from Launch Complex 39A at Kennedy Space Center. This was the fourth flight for the Cargo Dragon C208 capsule. SpaceX plans to reuse Cargo Dragons five times during the life cycle of the capsules. Included in the payload was a pair of solar arrays. It was the 5th flight for booster B1077 which landed on the drone-ship *A Shortfall of Gravitas*.



SpaceX photo

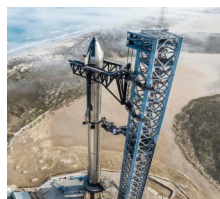


SpaceX photo

Transporter 8, as the name implies, was the eighth dedicated rideshare mission for small satellites. The launch occurred on 12 June from Vandenberg Space Force Base. There were 72 pay-



Rocket Lab launched the *Rocket Like A Hurricane* mission consisting of two TROPICS 3U CubeSats atop an Electron launch vehicle from launch Complex 1 on the Māhia Peninsula in New Zealand on 8 May. This was the second TROPICS mission with the first mission failing to reach orbit aboard the Astra Rocket 3.3 a year ago. TROPICS or **Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats** will measure thermodynamics and precipitation of storm systems in the troposphere. Rocket Lab did not attempt to recover the Electron vehicle which crashed in the Pacific Ocean.



CURRENT EVENTS IN SPACE EXPLORATION



Rocket Lab photo

Coming To A Storm Near You was the follow-up, 3rd and final TROPICS mission launched aboard an Electron on 26 May from the Māhia Peninsula in New Zealand. Pad turnaround for this flight was an impressive 14 days! The payload again was a pair of TROPICS 3U CubeSats. There was no plan to recover the booster on this flight.



Rocket Lab photo

On the night of 17 June, Rocket Lab used a modified Electron for its first suborbital mission called HASTE (Hypersonic Accelerator Suborbital Test Electron) for Leidos. The flight was a test to measure and validate performance of hypersonic glide body components. No photos, Sorry!



United Launch Alliance (ULA) held their first launch of 2023 on 22 June from Space Launch Complex 37 at Cape Canaveral Space Force Station. The mission for the National Reconnaissance Office, NROL-68 consisted of a Delta IV Heavy launch vehicle and a classified payload of unknown size, weight, and purpose.



ULA photo



50 YEARS AGO: SKYLAB 1&2

BUZZ NAU

SKYLAB 1

Skylab was the first and only space station managed solely by the United States. Launched to orbit on 14 May 1973 aboard a modified Saturn V from Kennedy Space Center, the station remained in operation until February 1974. With no options to boost its orbit, it reentered the atmosphere on 11 July 1979 with debris landing in the Indian Ocean and Western Australia. It would host three crewed missions during the two years of operations.

The space station was considered the next stepping stone for humanity's trek into space after the Apollo lunar missions. Early plans included Werner von Braun's rotating space station from his series of articles in Collier's Magazine in the early 1950s. The US Air Force also developed the Manned Orbital Laboratory or MOL which consisted of a Titan IIIM rocket with a converted upper-stage station and Gemini B capsule.

The Apollo Applications Program was developed in 1966 to utilize the specialized workforce from Apollo in efforts beyond the lunar landings. Skylab and the Apollo-Soyuz Test Project would be two programs developed under the AAP.

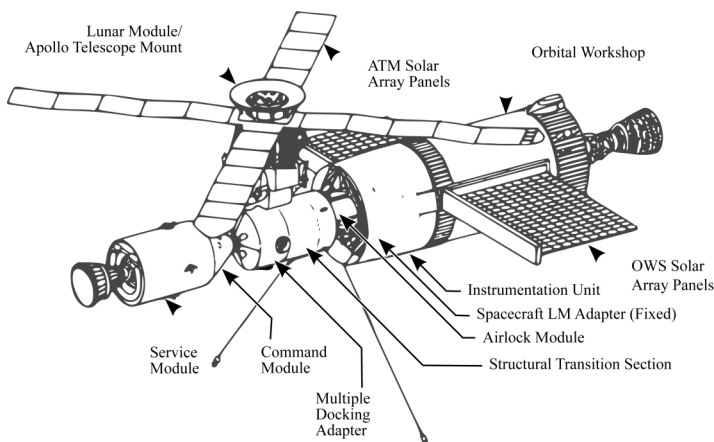
Skylab was launched on 14 May 1973 when the station was severely damaged during ascent. The micrometeoroid/heat shield departed the vehicle with one of the OWS Solar Arrays. This also damaged the second OWS Array, preventing it from fully deploying. Skylab made it to orbit but it was in serious condition. The lack of the micrometeoroid/heat shield caused the internal temperature to a level that endangered supplies and crew. The missing Solar Array and non-functional Array resulted in little power to run the station.

SKYLAB 2

With the Skylab station in dire straits, the planned launch of Skylab 2 on the next day was postponed until 25 May so the crew could practice repair tasks. Commander Pete Conrad, Science Pilot Joe Kerwin, and Pilot Paul Weitz lifted off from Launch Complex 39B aboard Saturn IB SA-206. Upon reaching the station, Conrad maneuvered the Command Module around the station to survey the damage. After a soft-dock lunch break, Conrad placed the CSM near the mostly stowed Solar Array where Weitz performed a standup EVA to try and unbind the stuck array. With Kerwin holding his legs, Weitz attempted pulling on the array with a pole to no avail.

The crew then had to repair the CSM docking probe before they could make a successful hard dock. The next order of business was to deploy a collapsible parasol from the scientific airlock. This succeeded in providing shade from the sun and reducing the interior temperature to a livable level. Two weeks later, Conrad and Kerwin performed an EVA to free the Solar Array using a technique they had practiced in the Neutral Buoyancy Simulator at Marshall Space Flight Center. Using brute strength, they freed the panel and flung themselves from the station (Pete Conrad's telling of this event is quite funny).

The crew remained at the station making repairs and conducting experiments for 28 days. They also used the Apollo Telescope mount to observe a large solar flare and returned nearly 30,000 film photographs. Skylab 2 returned to Earth on 22 June 1973 and was recovered by the aircraft carrier USS Ticonderoga. At the time, Pete Conrad had set the duration record for time in space. The Skylab 2 Command Module is on display at the National Museum of Naval Aviation in Pensacola, Florida.

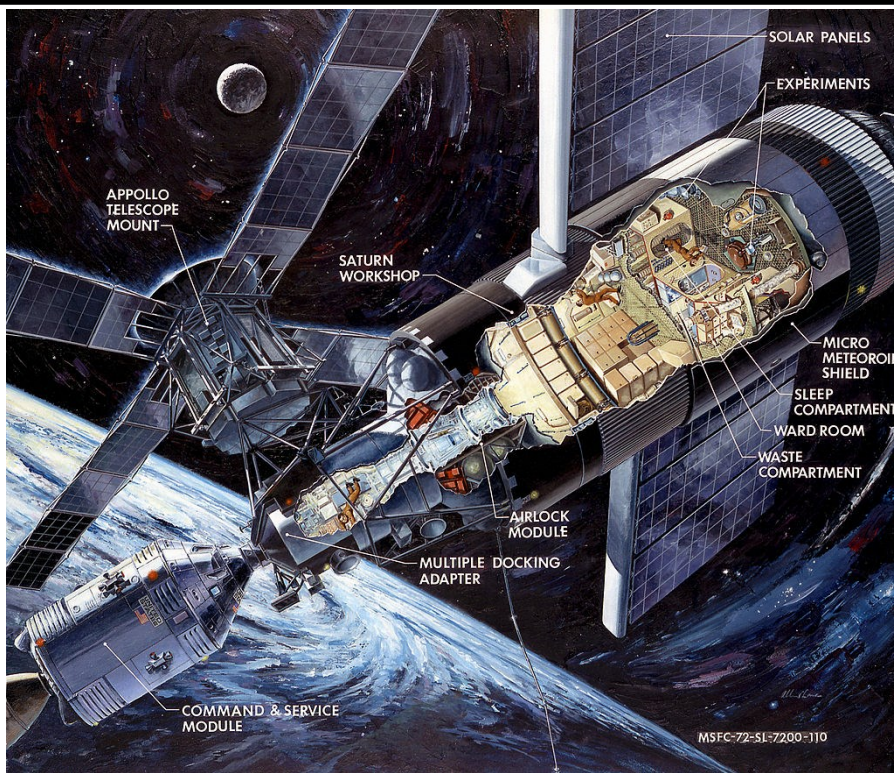


Skylab consisted of a Saturn V with the S-IVB third stage converted into the orbital workshop. It was launched unmanned to orbit and crews would ride a Saturn IB to the station where they would dock their Command Module to the Multiple Docking Adapter. In addition to the Orbital Workshop and MDA, the station included an Airlock module, Apollo Telescope Mount, OWS Solar Array Panels, ATM Solar Array Panels, and a multitude of experiments.





Skylab 2 crew; Paul Weitz, Pete Conrad, Joe Kerwin

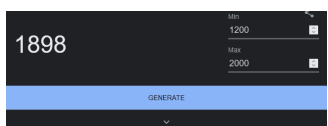


UMARC
HUVERS

Club News

Fun Contest Lineup for 2023

Precision Altitude - Using an online RNG (random number generator), the target for this years precision altitude contest is 1,898 feet. The goal is to fly the closest to the target altitude without going over. The contest will run all season long until our last launch in 2023. The entry fee will be \$5 per attempt and you can try as often as you like. The winner will receive 50% of the pot, second place will earn 25%, and the remaining 25% will go to the club.



Big Bertha Contest - We will be holding this contest during the August launch this summer. Be sure to mark your calendar!



Designed by Vern Estes, the Big Bertha is the iconic model rocket throughout the decades. Make Vern proud and enter your Big Bertha in this fun contest.

Goal

Make three flights with a single model (Big Bertha) and attempt to score the best in four criteria.

Rocket Entry

Per the name, this is a Big Bertha contest. If you don't have a Big Bertha then any rocket with at least 18" of BT-60 and four fins will do. If you wish to build one from scratch you can download the plans here, [Estes Big Bertha #1948](#)

Events

- A Parachute Duration – Using an A impulse motor and parachute of any size, get a longest possible duration. Remember, you need to get it back for the other events!
- B Streamer Duration Spot Landing - That's right, two events in one. Using

a B impulse motor and streamer for recovery get the longest possible duration AND land closest to the target mark that will be placed randomly at the field.

C Altitude (altimeter) – Using a C impulse motor and electronic altimeter reach the highest altitude. I will have a couple of altimeters to loan out if you don't have a suitable altimeter.

Iron-man III - We will be holding this contest at the September launch, so mark your calendar!

Just like the past Ironman contests. Build a single model to be flown in three events. Cost will be \$10 which will get you motors needed to fly the events. The motors for Iron-man III will be 18mm 1/2A6-0's and 1/2A6-4's. The models need to accommodate 18mm motors and be two-stage. Prizes will be awarded to the top three overall performers



Events

- **Double Spot Landing** (booster and sustainer!)
- **Streamer Duration**
- **Altitude** (with an altimeter)

Free Alpha III Kit for Kids

During our last board meeting, several members discussed the need to reach out to more fliers, to increase club activity and the need to attract more youth to our launches.

Al de la Iglesia would like to offer a free rocket kit (Estes Alpha III) to any flier who is 18 years old or younger at our next club launch. The flier (or parent/guardian) must be a club member or join at the launch. Limit one free rocket kit per youth.

Please send an email to Al at aiglesia@gmail.com to let him know that you are interested and how many youth are attending so that he can bring enough rocket kits.



LAUNCH WINDOWS

Launch dates from SpaceFlight.com

July 1, 2023

Falcon 9 - Euclid

Launch Site: Cape Canaveral

A SpaceX Falcon 9 rocket will launch the Euclid mission for the ESA. Euclid is an astrophysics mission with a telescope and two scientific instruments designed to explore the evolution of the dark universe. It will make a 3D-map of the universe by observing billions of galaxies out to 10 billion light-years, across more than a third of the sky. Euclid will be launched to an observing orbit at the Sun-Earth L2 Lagrange point.

July 7, 2023

Falcon Heavy - USSF 52

Launch Site: LC-39A, KSC

A SpaceX Falcon Heavy rocket will launch the USSF 52 mission for the U.S. Space Force. The Falcon Heavy will launch an unspecified military payload on this mission

July 2023

Falcon 9 - Starlink 6-5

Launch Site: SLC-40, CCSFS

A SpaceX Falcon 9 rocket will launch another batch of second-generation Starlink V2 Mini internet satellites.

July 2023

Falcon 9 - Galaxy 37

Launch Site: SLC-40, Cape Canaveral

A SpaceX Falcon 9 rocket will launch the Galaxy 37 C-band television broadcasting satellite for Intelsat.

July 14, 2023

Electron - 'Baby Come Back'

Launch site: Launch Complex 1, Mahia Peninsula

A Rocket Lab Electron rocket will launch NASA's Starling mission, which consists of four CubeSats to demonstrate technologies for future 'swarm' satellites. It will also carry Telesat's LEO 3 demonstration satellite for Space Flight Laborayr and two 3U satellites for Spire Global, carrying Global Navigation Satellite System Radio Occultation (GNSS-RO) payloads which provide data to improve weather models and forecasts.

TBD 2023

Falcon 9 - O3b mPOWER 5 & 6

Launch Site: SLC-40, CCSFS

A SpaceX Falcon 9 rocket will launch the third pair of O3b mPOWER broadband internet satellites into Medium Earth Orbit for SES of Luxembourg. The satellites will provide internet services over most of the populated world, building on SES's O3b network.

TBD 2023

Falcon 9 - WorldView Legion 1 & 2

Launch Site: SLC-4E, Vandenberg SFB

A SpaceX Falcon 9 rocket will launch the first pair of WorldView Legion Earth observation satellites for Maxar Technologies. Maxar plans to deploy six commercial WorldView Legion high-resolution remote sensing satellites into a mix of sun-synchronous and mid-inclination orbits on three SpaceX Falcon 9 rockets.

Summer 2023

Falcon 9 - SDA Tranche 0B

Launch Site: SLC-4E, Vandenberg SFB

A SpaceX Falcon 9 rocket will launch 18 Tranche 0 demonstration satellites for the U.S. military's Space Development Agency. The launch is the second of two Falcon 9 missions to carry SDA demonstration spacecraft for a future constellation of military missile tracking and data relay satellites.

August 2023

1/2 Antares - NG-19

Launch site: Pad 0A, Wallops Island

A Northrop Grumman Antares rocket will launch the 20th Cygnus cargo freighter on the 19th operational cargo delivery flight to the International Space Station. The mission is known as NG-19. The rocket will fly in the Antares 230+ configuration, with two RD-181 first-stage engines and a Castor 30XL second stage. This will be the final flight of an Antares 230+ rocket before a redesign with new U.S.-made engines.

August 2023

Falcon Heavy - Jupiter 3/EchoStar 24

Launch Site: LC-39A, KSC

A SpaceX Falcon Heavy rocket will launch the Jupiter 3/EchoStar 24 broadband communications satellite. Built by Maxar, Jupiter 3/EchoStar 24 is a Ka-band high-throughput ultra high-density satellite for EchoStar's Hughes Network Systems. Jupiter 3/EchoStar 24 will support in-flight WiFi, maritime connections, enterprise networks, backhaul for mobile network operators, and community WiFi solutions across the Americas.

3rd Quarter 2023

Atlas 5 - NROL-107

Launch Site: SLC-41, CCSFS

A United Launch Alliance Atlas 5 rocket will launch the NROL-107 mission for the National Reconnaissance Office. The NROL-107 mission will launch a classified payload

known as Silent Barker. The mission is a partnership between the NRO and the U.S. Space Force, which have disclosed little information about the payload other than it will focus on satellite threat intelligence and space situational awareness.

TBD 2023

Falcon 9 - WorldView Legion 3 & 4

Launch Site: Vandenberg SFB or CCSFS

A SpaceX Falcon 9 rocket will launch the second pair of WorldView Legion Earth observation satellites for Maxar Technologies. Maxar plans to deploy six commercial WorldView Legion high-resolution remote sensing satellites into a mix of sun-synchronous and mid-inclination orbits on three SpaceX Falcon 9 rockets.

August 2023

15 Falcon 9 - Crew 7

Launch Site: LC-39A, KSC

A SpaceX Falcon 9 rocket will launch a Crew Dragon spacecraft on the program's 12th flight with astronauts. The Falcon 9's first-stage booster will land on a drone ship in the Atlantic Ocean. NASA astronaut Jasmin Moghbeli, European Space Agency astronaut Andreas Mogensen, Japanese astronaut Satoshi Furukawa, and Russian cosmonaut Konstantin Borisov will launch on the Crew Dragon spacecraft to begin a six-month expedition on the International Space Station.

August 2023

H-2A - XRISM & SLIM

Launch Site: Tanegashima Space Center

A Japanese H-2A rocket, designated H-2A F47, will launch the X-Ray Imaging and Spectroscopy Mission, or XRISM, a joint project between the Japan Aerospace Exploration Agency and NASA. XRISM will perform high-resolution X-ray spectroscopic observations of the hot gas plasma wind that blows through the galaxies in the universe. JAXA's Smart Lander for Investigating Moon, or SLIM, mission will fly as a rideshare on this launch, heading to the moon to test precision landing technology.

3rd Quarter 2023

Atlas 5 - USSF 51

Launch Site: SLC-41, CCSFS

A United Launch Alliance Atlas 5 rocket, designated AV-101, will launch the USSF 51 mission for the U.S. Space Force. This mission will launch an undisclosed payload for the military.

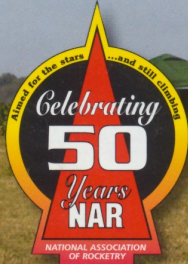
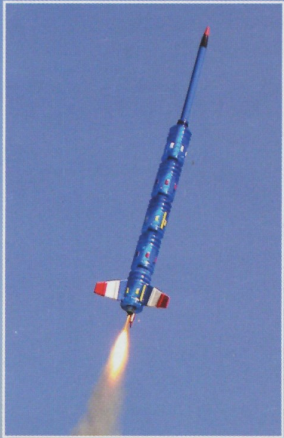


SPORT ROCKETRY

OFFICIAL JOURNAL OF THE
NATIONAL ASSOCIATION OF ROCKETRY

MARCH/APRIL 2008

Launching a
**HIGH SCHOOL
ROCKETRY
PROGRAM**



Part 2
**High Power Two
Stage Rocketry**

Our Members on Sport Rocketry
Carl Wagner