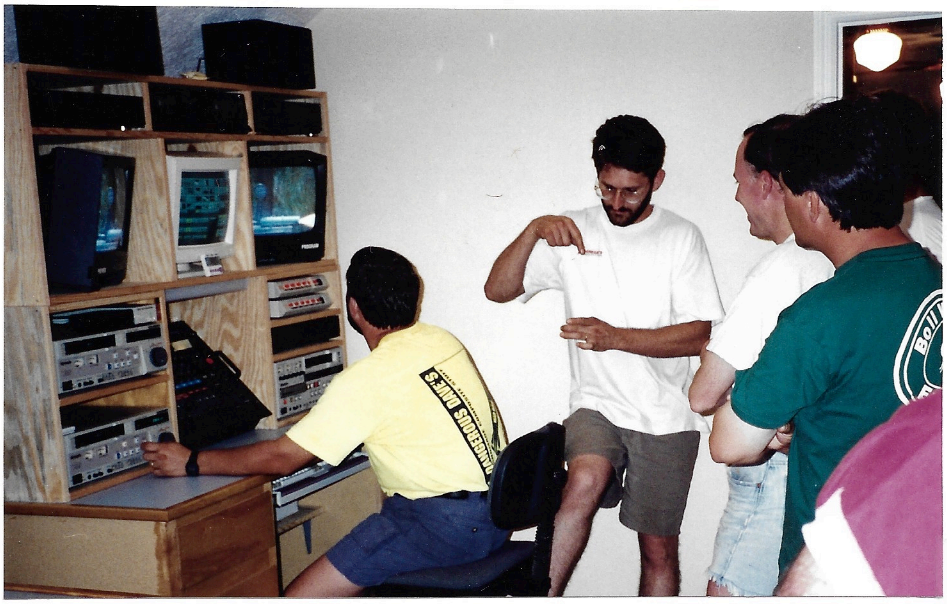
MAX-Q HARA

Newsletter of the Huntsville Area Rocketry Association Volume 9, Number 2&3, Mar/Jun 1995

Huntsville Rocketeers Successfully Fire Own Amateur Hybrid Motor

by Tim Pickens
HALO Propulsion Lead



Rocketeers review video of a hybrid firing.

Since March 25, we have had a total of six hybrid rocket motor test firings. I would like to inform you on our past progress and current development pertaining to our hybrid research development program.

First Hybrid Motor Test Day

It was Saturday, March 25, and the day of reckoning had finally arrived. Much work had been performed preparing for this day. The test facility was to be christened with an asphalt and nitrous-oxide (N_2O) hybrid rocket motor (in the middle of the stand test) capable of achieving a total impulse of 2000 lb-sec (200 pounds of thrust for 10 seconds), which we estimate could loft a balloon-launched rocket into space. The large gauge would monitor the chamber pressure inside the motor, while the smaller one would monitor the pressure inside the oxidizer tank (protruding above the test stand). Electronic monitoring was also to be performed using a circuit board (inside the metal box) to relay data back to a computer in the 'HALO control room' (that is, the barn of Herman Pickens).

INSIDE MAX-Q

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Preparing the First Hybrid Motor

There were many unknown factors. Although asphalt is a common roof coating (and road material), it was difficult obtaining an exact chemical formula and other pertinent design information. Asphalt offers an affordable way for us to develop, produce, and test our instrumentation, flow system, ignition system, and other motor-related components. HAL5 is very fortunate to have talented people as members of Project HALO to allow us to do 100 percent in-house design, construction, and testing.

The major theoretical motor design aspects were accomplished by Steve Mustakis, who is a propulsion major about to earn his Bachelor's degree from UAH. He has been very instrumental in all aspects of design and construction.

Our hybrid motor casing consisted of a 2.5-inch diameter, 23-inch long steel pipe. Each end (injector and nozzle) was threaded for screw-on caps, which

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From the President's Pad

Catch-up Issue

HARA members have been very busy this year! I've been remodeling my house all spring. Greg Warren finished building his house and having his second child. Brian Day moved into a new house. Robert and Dorothy Burdine had their first baby. Joe and Sondra Robertson are expecting their first in September. Neal Redmond has been traveling a lot for work. Ed Stluka had a stroke and is making good progress in rehabilitation. With all this going on, rocket stuff like newsletters (this is the first *MAX-Q* since February) and meetings get left behind.

But not flying! There's been some great launching this year. Spaceweek had an expanded rocket contest, SOAR got good flights off, SEP had another massive season, Project LASER's training sessions continue, HARA assisted in the Manchester launch, and our regular monthly launches are working well alternating from the old airport to Athens.

We've also had five new members sign up. HARA welcomes Lary Christian, David Gannett, Gene Hornbuckle, Richard Waller, and Malcolm Weathers. All are interested in the high power aspect of the hobby.

Unfortunately, as soon as we thought we were set in the excellent flying field in Manchester, accessablity to Spears range went away. Mid-Tenn Tripoli is searching strongly for another space in that state.

Hybrids Are Here!

The advanced rocketry world is currently being introduced to model rocket motors that use a gaseous oxidizer injected through a solid fuel core. Tim Pickens has sidelined his steam rocket to develop and build his own hybrid system. Tim and several HARA specialists have joined with the HAL-5 group for their Project HALO. The hybrid motor will loft a rocket from a balloon to an attempted record altitude. A test launch of a "model" is upcoming. This is really wild stuff, but it is being systematically accomplished in the same spirit as the *Verein fur Raumsciffahrt.*

SEP in NAR

Greg Warren has been nominated for NAR Education Director. This is a position appointed by the trustees that has been essentially vacant for years. Greg has an excellent plan for incorporating SEP concepts into other NAR sections if NAR will help him.

Jerry's Girls

The photos of the girls modeling rocketry in the last issue got some response. Mary Roberts of Estes wrote, not about the girls, but about my picture next to them in the overalls. She said, "the overalls have to go!" I assure you, gentle readers, I shall never appear in any photo without pants, (but thanks for asking.) Overalls are very functional on the flying field as many modelers know and wear them. Hence, I'm going to show pictures of as many people in overalls as I can get.

<u>MAX-Q</u>

VOL 9. NO 2&3. Mar/Jun 95

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<u>Max-Q</u> is the official newsletter of the Huntsville Area Rocketry Association (HARA), NAR Section 403. Subscriptions are included as part of membership dues, or available to non- members for $10.00 per year (six issues.) The editor welcomes any material submitted for publication. Send all items or payments to 11108 Argent Dr., Huntsville, Al, 35803.

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COUNTDOWN '95

HARA meetings are second Thursdays (except December) at the Huntsville Association of Technical Societies (HATS) office, Suite 29, Building 4900, University Square, (off the Boardwalk.) Launches are 9:30 am Saturday mornings at the Old Huntsville Airport, or at the Athens field.

JUN:
8 Thurs; HARA Meeting 7:30 pm HATS
24 Sat; HP Launch, Athens

JUL:
13 Thurs; HARA Meeting 7:30 pm HATS
15 Sat; Launch , Old Airport
29 Sat; HP Launch, Athens

AUG:
10 Thurs; HARA Meeting 7:30 pm HATS
12 Sat; Launch , Old Airport
26 Sat; HP Launch, Athens

SEP:
14 Thurs; HARA Meeting 7:30 pm HATS
30 Sat; Rocket City Classic XIV Model Contest and Exhibition

OCT:
8 Sat; Science Saturday 10-2pm ASFL
12 Thurs; HARA Meeting 7:30 pm HATS
28 Sat; HP Launch, Athens

NOV:
9 Thurs; HARA Meeting 7:30 pm HATS
11 Sat; Launch, Old Airport
25 Sat; HP Launch, Athens

DEC: 9 Sat; 7:30 am Launch Marathon Start Von Braun CC

For more details call Vince Huegele at 881-2904 or Joe Robertson at 721-1338. Call Greg Warren, 232-0830, for Athens launch site information.

.... HYBRID FIRINGS ... continued from page one

allowed for quick assembly and disassembly. The fuel 'grain' consisted of a 15-inch long cylinder of asphalt with a 1-inch core down the center. The separate motor nozzle was a 3-inch long Delavel design carved from solid graphite (in Tim Picken's garage). Separating the asphalt fuel from the nozzle was a 4-inch, post-mixing combustion chamber.

Preparing the Oxidizer Flow System

With the initial fuel grain weighing in at 1.6 lbs, Steve calculated that about 10 lbs of N_2O would be required to achieve the best rocket performance (based on the optimum fuel-to-oxidizer ratio). To achieve the desired 200 lbs of thrust for 10 seconds, we needed an average oxidizer flow rate of 1.0 lb/sec. We first tried to design an oxidizer injector with a single central port (hole), but calculations showed that the oxidizer would not expand properly and might cause fuel regression problems near the injector. We chose to go instead with a multi-port injector design, which proved to have very good expansion properties. A cold flow test of our test injector showed that we could achieve the desired flow rate.

At the HALO Rocket Motor Test Stand, our oxidizer flow system was oriented vertically above the motor, a 'flight-ready' configuration. This was done to allow us to gather realistic flow data. A pressure tap allowed us to examine the N_2O blow-down characteristics during the test. The flow system was to be driven by the vapor pressure of the N_2O inside the oxidizer tank; no pumps were to be used. This was one of the factors in selecting N_2O, although there are some performance penalties. N_2O is very safe and easy to work with, and can survive the projected two-hour balloon trip to the launch altitude.

The oxidizer valve we used (for its simplistic design) was a ball valve that was spring loaded to fully open. A string was wrapped around a pulley attached to the valve to hold the valve in a closed position. A squib was placed near the string. Once the squib ignited, the string would break and the spring would pull the valve open. Many successful ground tests of the valve were performed. A high altitude test of the valve never occurred due to a cold battery aboard the balloon.

Preparing the Ignition System

Our ignitor would be a very critical area of our hybrid test program. Faulty ignitors are the most probable cause of past rockoon failures. We needed an ignitor with low power requirements because we were attempting to keep the future rocket weight at a minimum, and batteries are relatively heavy. The ignitor would be required to burn for a minimum of three seconds, generating enough heat to vaporize the surface of the fuel grain near the injector and ensure a good ignition when the oxidizer started flowing past. We needed a considerable amount of heat (about 570F) in order to disassociate the oxygen from the N_2O.

Our ignitor design of a cylindrical wire mesh wrapped in Thermalite achieves all of these requirements. The squibs which ignite the Thermalite can be fired using a common watch battery. Our ignitor burns for about five seconds, then is totally consumed by fire once the motor itself ignites.

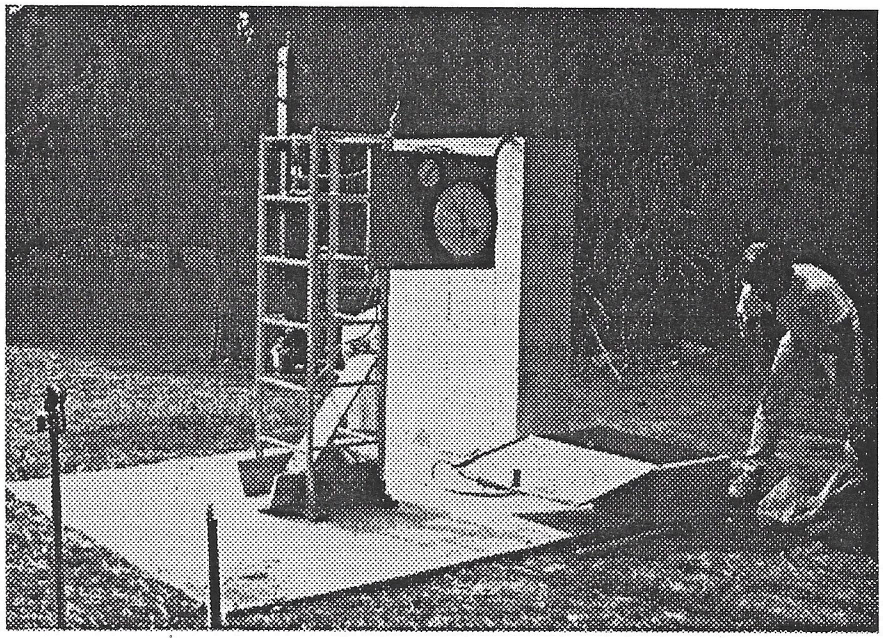
Preparing the Data System

All data was to be recorded on a Macintosh computer inside the control room. HALO member Larry Larsen had set up a very nice system (using **Lab View** software) that would make data acquisition a 'state of the art' affair. The command controls would be manual by toggling a series of switches. The switches were connected to a relay card, which would allow us (eventually) to run the controls via the computer.

The motor had sensors for monitoring thrust, starting and flow pressure, and chamber pressure. HARA & HALO member Gene Hornbuckle built amplifiers to increase the millivolt output of the sensors up to 10 Volts. Gene packaged the amplifiers and relays onto a single board which sits in a metal box next to the test stand when in use; and can be easily removed after. Gene, Larry, and Steve worked long hours refining and calibrating the equipment.

The First Rocket Motor Test

The ignitor was slid into the motor, then the motor was strapped to the test stand and connected to the oxidizer tank via the oxidizer valve mechanism. We then sounded an alarm siren briefly to clear the immediate area so that we could begin loading the oxidizer tank. This was a safety issue because we wanted to test a lightweight tank that we could later use for the flight vehicle. We wanted as much data as we could obtain on all aspects of our designs.



Tim at his Hybrid Test Stand in Gurley

The N_2O supply bottle was kept safely behind a concrete wall at one end of the test stand. Two people (Steve and myself) stood next to the bottle and filled the tank from behind the wall. (We plan to eventually go with a much safer remote loading capability.) The bottle sat on a scale so that we could monitor the change in weight as we filled the oxidizer tank. Knowing the internal volume, pressure, and mass of the oxidizer in the tank, we could compute the tank ullage (the amount of relatively useless gaseous N_2O floating above the thrust-enabling liquid N_2O below). After filling the tank, we removed ourselves to the safety of the control room.

Our rocket motor test system is completely safe until the oxidizer tank is loaded. Even then, two events must occur to start the test. First, the ignitor must be triggered; second, the oxidizer valve must be opened. We even had a backup for the oxidizer valve; a long string between the valve and the control room, which could be used to yank open the valve if the squib failed.

After a second and final siren warning, we counted down five seconds, then threw the switch. With a loud 'snap', the ignitor squib fired and started the ignition process, heating the asphalt and filling the combustion chamber with fuel vapor. Two seconds later, we fired the valve squib, which successfully opened the oxidizer valve and allowed the N_2O to enter the chamber. Whoosh! Motor ignition! All eyes were focused on this historic moment for Project HALO.

The test looked great! This test seemed to burn forever, although the video recording proved that the actual burn time was only eight seconds. Motor ignition was very good and thrust quickly climbed to a peak. Chamber pressure went as high as 700 psi, 300 more than our design requirement (we would later correct this). It was evident from our pressure gases that there was coupling ('chugging') taking place between our chamber pressure and our blowdown pressure.

Unfortunately, our data acquisition system still had a few bugs, and our data was very noisy. (We later corrected this by replacing the power supply in the metal box.) We believe we achieved a thrust of about 125 lbs at a specific impulse (Isp) of about 210 seconds. All data indicated that we were with 25% of our theoretical predictions.

The only casualty of the test was a wooden flame deflector, which looked like burnt toast after the test. The motor flame burned a hole right through the deflector and gouged out a small crater in the concrete pad! All in all, however, we were very pleased with our first test firing.

Second Rocket Motor Test

To lower the chamber pressure and also increase the thrust, we carved the graphite nozzle (which survived the first test extremely well) more to increase the throat diameter. We cast another asphalt fuel grain and assembled another test motor. We also built several ignitors (in case one failed), and prepared the oxidizer valve assembly.

Three weeks after the first test, on Easter Sunday, April 15, we began the second test. The crew came out early to correct the data acquisition problems, and were getting very clean (non-noisy) data by 1pm. Meanwhile, others prepared the motor for firing. We also laid out rows of bricks over a steel plate as our new flame deflector. We inserted an ignitor into the motor, strapped the motor to the test stand, and loaded the oxidizer tank.

After the final siren warning, we counted down five seconds, then threw the switch. With a loud 'snap', the ignitor squib fired and started the ignition process.

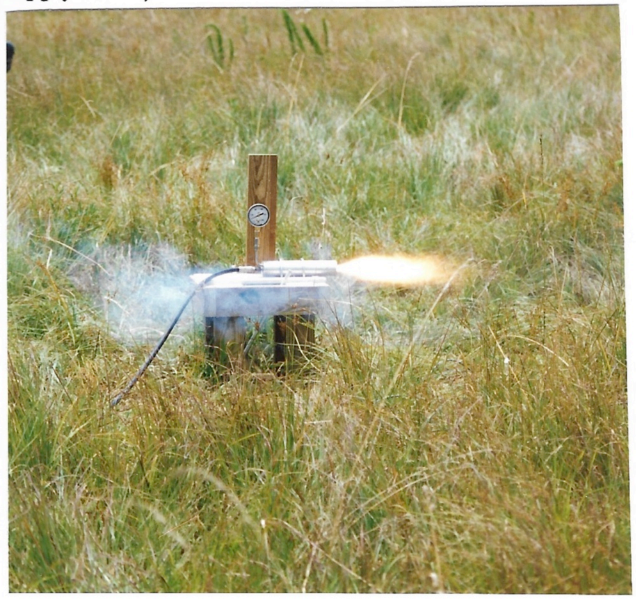
In my eagerness, I threw the oxidizer valve switch too early (only one second later). Raw N_2O shot from the motor nozzle and rolled along the ground like a dense fog. Eventually, the oxidizer pressure dropped low enough that motor ignition finally occurred, but only about 50 lbs of thrust was produced. All was not lost however. Data acquisition this time was great and Steve said that he could use this cold flow data to verify the mass flow.

Since we had another ignitor and the motor fuel grain was still mostly intact, we decided to try again. But first, we feasted on a meal of hot dogs, cokes, and Mel's delicious cookies, provided by Tim Pickens, and prepared by our hosts Herman and Chris Pickens.

By now, night had fallen, but we were ready to try again. After the 'snap' of the ignitor, we were determined to wait a full two seconds before opening the valve. We did so, but nothing happened after we heard the 'snap' of the oxidizer valve squib firing. The valve was still closed and the ignitor was still burning away creating more fuel vapor.

As soon as I realized what was happening, I pulled hard on the string serving as our backup, manual release. By now five seconds had elapsed, and the chamber was filled with excess hot fuel vapor. When the fuel and oxidizer finally mixed, the chamber pressure rose so high that it blew out the copper tubing running to our big pressure gauge. The rocket motor roared to life, but some of the thrust went sideways out through the $^1/_4$-inch hole of our chamber pressure tap. The test lasted for 16 seconds.

It was quite a sight to see, especially at night. Since we had no way of stopping the test (this was later corrected), we just watched in awe as the powerful vertical thrust slid aside our flame deflector bricks (so much for <u>that</u> idea), while the less powerful (but more exciting) horizontal thrust spewed arc-welder-like sparks across the test stand where they bounced off the concrete wall (thankfully protecting our N_2O supply bottle).



Firing of smaller hybrid

Lessons from the Second Test

The second motor test proved to be a turning point for our test oxidizer flow system. We decided to abandon the unreliable ball valve design in favor of one which could be activated by a pyrotechnic charge. There would be no room for failure in our flight vehicle.

We also decided to stop testing potential flight-capable oxidizer valves while trying to prove that the motor itself worked. For ground tests, therefore, we switched to a sturdier pneumatically-controlled valve which could be closed by command, thus shutting off the oxidizer flow. We also added a second one-way valve which would prevent any thrust from running back into the oxidizer tank. Our last test revealed a fuel-rich condition and a low fuel regression rate; therefore we built a new injector which would allow more mass flow.

We replaced the broken copper tubing with a sturdier flexible steel hose. We also added 'snubbers' to all our pressure sensors, which would filter out big spikes in pressure and thus help to prevent another blowout. Steve assembled a sequencer which would allow us to precisely control the time between ignition and the opening of the valve, and also to control the length of the burn.

The Third Rocket Motor Test

Three weeks after the second test, on Saturday, May 6, we began the third test. Steve, Gene, Ron Lajoie, Ron Creel, new member Peter Ewing, and myself had worked hard the previous week preparing the electronic equipment, the new valves, and the new motors, including three donated by HAL5 member David Dean of McDonnell Douglas.

Each of the foot-long test grains were cut into four 3-inch long cylinders. This way, after a short burn, the center cylinders could be removed and the grain could be measured to plot the fuel regression. (Unlike a solid rocket motor, hybrid rocket motor fuel does not contain any oxidizer; thus these types of cross-cuts do not promote burning between the cylinders.)

While waiting for Larry Larsen to return from Texas (on a trip to get a large milling machine for making even larger motors), we decided to have lunch. Compared to our last event, this was a feast! Hot dogs, beans, chips, cokes, cake, and ice cream brought by HAL5 members, family, friends, and associates, including a McDonnell Douglas colleague of Dr. Dean. Ron Lajoie, designated that day's HALO Safety Officer, passed around a safety statement from McDonnell Douglas and a HALO safety form/waiver for each person to sign. This was the largest turnout to date, with over 20 people in attendance.

The first test of the day was our third asphalt motor. When all was ready, Steve started the sequencer. The now familiar 'snap' of the ignitor squib was heard by all, and 1.5 seconds later (as programmed), the valve was opened. In a repeat of the Test Day 2, the N_2O poured from the nozzle without burning. This time, however, we were able to shut off the flow and stop the test. (We vented the remaining N_2O from the oxidizer for safety reasons.) Steve reprogrammed the sequencer for a 2.5 second delay, while I changed out the ignitor in our asphalt motor.

Too bad we had to vent that N_2O. The supply bottle was clearly getting low, and Steve had a difficult time of coaxing N_2O into the oxidizer tank. The second attempt, however, was a **great** success! The motor fired beautifully, fully achieving the desired 200 lbs of thrust we need to get into space. After three seconds, when the tank pressure dropped too low to sustain thrust, we stopped the test and began the nitrogen purge to cool the rocket motor.

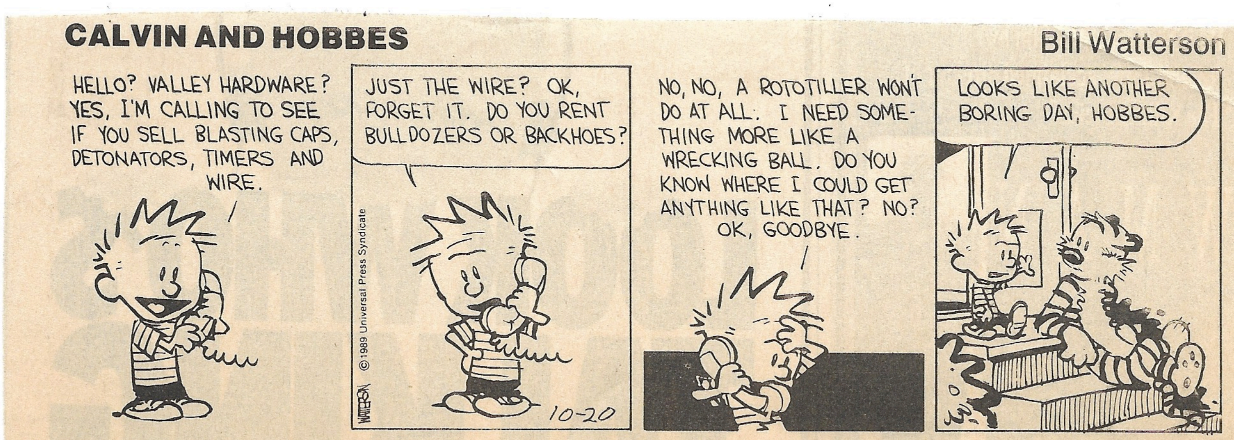
The David Dean Motor Test

After the successful asphalt motor test, we set up the first of Dr. Dean's test motors. By now the N_2O supply bottle was obviously low, and Steve barely managed to get enough N_2O into the oxidizer tank. The test itself, however, went very well. The sequencer worked fine, and the motor burned gaseous N_2O for three seconds. Despite the lack of sufficient thrust, all agreed that this first test was a good data point.

Our systems operated perfectly; we got great data, nothing was damaged, and even our new flame deflector (a simple thick steel plate) survived intact. I am very pleased thus far with all areas of our HALO rocket motor development program, put together in only eight months.

I encourage all interested persons to contact me, Tim Pickens, at 971-1566 (Home) or 772-8885 (Work).

This article courtesy of Southeastern Space Promoter, newsletter of HAL5.



REPORTS ON THE MANCHESTER LAUNCH
APRIL 1-2,1995 at Spears Range Middle Tenneessee Tripoli

KEVIN CORNELIUS' MANIFEST

The first launch on Saturday was a LOC HI-TECH H-45 using an AERO H180-10W Reload in a RMS-29/240 MOTOR. Igniter was wire-wrapped thermalite using single core copper wire-(red). Approx. 20 ft. off the launcher the nozzle blew out the bottom of the casing. Boost pressure dropped, the rocket gained only 300 ft or so of altitude, arced over & impacted the ground about 100 ft. from the pad. Total flight time approx. 10 seconds. Damage to the rocket was extensive, the nose cone burying into the ground 1 ft., the payload sedion was driven down to near the forward centering ring, but the fin section was untouched. Replacement of the main body tube & payload section will be necessary to repair the rocket. All other flights for the weekend went as planned with Kyle's CHEETAH winning the drag race with Jake.

ROCKET	MOTOR	RESULT
LOC HI-TECH H-45	AERO H180-10W	NOZZLE FAILED-DESTROYED
AERO ASTROBEE	AERO G64-4W	NOMINAL
AERO CHEETAH-J	AERO G33-7J	DRAG RACE-NOMINAL
AERO CHEETAH-K	AERO G33-7J	DRAG RACE-NOMINAL-WON
LOC VULCANITE	AERO H128-10W	NOMINAL
AERO ASTROBEE	AERO H128-10W	NOMINAL
AEROARCAS	AERO G40-7W	NOMINAL
AEROASTROBEE	AERO G64-4W	NOMINAL
VAUGHN BoB	AERO H70-10W	NOMINAL

HYPERTECH HYBRIDS

Hypertech had on hand several of its new offerings & flew a total of 5 hybrid launches for the weekend. All boosts were impressive, as the hybrid motor gave a noise much similar to a WWII V-1 or Buzz Bomb. 2 of the flights went out-of-site & 1 of those rockets was never recovered. A few of the hybrid systems were sold that weekend. Many more are sure to be sold to other highpower users as Hypertech has proven the reliabiltiy of their hybrid motor system.

BRIAN DAY'S FLIGHTS

THOY Condor - H120-10, HV Arcas - G64-7, LOC Graduator - G33-7, again - G40-7, Arreaux - F50-6, LOC Oynx - F52-6, again - F25-6, THOY Wasp - F14-6.

The two Estes E15's around the G40 in the HD Beauty all lit up perfectly. Robert and Dorothy Burdine dropped by to see the show. Tim Bennett and Mark Tygielski came and flew. Ed Stluka met up with local radio enthusists for a tracking network.

3/4 SCALE AEROBEE

The launch of Dennis LaMothe's 3/4 scale AEROBEE took place on Saturday at approx.12:00. A few seconds after the flash of the igniter was seen, the N-motor came to life & the rocket slowly lifted off. Just as the rocket cleared the launch tower, fire was seen at the booster/payload section coupling indicating the failure of the forward bulkhead o-ring. The rocket gained only 500 feet of altitude, arced over, came apart at the coupling & fell to the ground in a ball of fire 1/2 way between the launch tower & the spectator line. The remaining propellant burned for several minutes. This was the 3rd failure of this type motor & it is expected to lose Tripoli certification soon. See photos below of the rocket launch and landing.

FLOATING BITS

Gene Hornbuckle certified with an H motor. Tim Pickens brought his steam rocket and all the support equipment for it. The rocket flew Sunday afternoon to only about 300', but all systems worked fine. Vince Huegele took several turns as Firing Officer, but flew all his birds on G motors. His PML Explorer, Aero Strong Arm, and LOC-IV all had super flights.

Spaceweek Rocket Contest

In the second year of the Huntsville Spaceweek middle school rocket contest, eleven students from five schools participated in the city championship. This was twice the size of the attendance of last year.

It was a windy but clear day for Robert Burdine and Vince Huegele from NASA's project LASER (Learning About Science, Engineering, & Research) to go to Chapman school to host the contest. Vince explained the rules, timed the models, and kept score. Robert helped prep and load the models on HARA's launch rack, and supervised the launches. Cathy Kulas, a teacher from the school system on loan to Project LASER, had publicized the event through the schools, and provided the prizes.

The contest was a simplified parachute duration on an "A" motor. Contestants get two flights and the highest combined time wins. Several modelers did well to get their chutes deployed at all. Considering they're beginners, building and launching is how to start. Schools fly the contest themselves to determine who advances to these finals.

The best single flight was eight grader Kristen Moore's of Mountain Gap with 49 seconds. That score got her third place even though she couldn't find the rocket in the neighborhood trees for another shot. Bryan Kelly of Huntsville Middle was back in the crowd until his number two flight of 43 seconds took him to second place. Mark Tolber won it all with two solid times totaling only a second and a half over Bryan

NAME	SCHOOL	G	TIME1	TIME2	TOTAL
Mark Tolber	*Huntsville Middle*	7	20	36.9	56.9
Bryan Kelly	*Huntsville Middle*	7	11.9	43.5	55.4
Kristen Moore	*Mt. Gap*	8	49.2	-	49.2
Sarah Trapp	*Mt. Gap*	8	27.6	18.8	46.4
Denise Brooks	*Butler*	9	17	20.2	37.2
Sandra Neway	*Huntsville Middle*	7	17	19.4	36.4
Mike Messerby	*Mt. Gap*	8	9.2	25.3	34.5
Mike Ryback	*Mt. Gap*	8	15.8	13	28.8
George Baker	*Davis Hills*	8	15.3	5.8	21.1
Hamilton Stevenson	*Davis Hills*	8	DQ: E	13.9	13.9
Joel Banta	*Huntsville Middle*	8	DQ: ND	DQ: ND	-

ND: no parachute
E: engine ejection
DQ: disqualified

SOAR '95

The first HARA launch of 1995 delivered seven student payloads into the air. Project SOAR successfully flew on schedule and up-staged many activities on the Saturday before Spaceweek. March 18 was a beautiful day for rockets and balloons, as evidenced by the attendance of the HAL-5 group and their HALO prototype.

SOAR made four nominal flights on G80-4 motors carrying some experiments individually for size and weight considerations. The SOAR boost vehicles are LOC-IV kits with extended nose sections. The sections separate and are recovered on their own chutes after going up about 600 feet. Two rockets were used, with the first breaking a fin on landing. The second model had the fin joints reinforced with fiberglass cloth and withstood the landings easily.

The experiments were well thought out for fifth graders. The first payload was a fertilized chicken egg, but to keep it incubated, a heat source was needed. The student used a battery powered sock. The next experiment was to measure the actual flight time by launching a stopwatch to compare against the predicted time. Another payload series was lettuce seeds, oil and water, and carbonated soda. Local hams flew a two channel transmitter on all flights. Two girls tried a chromatography test with colored water dispersed by flight loads through a coffee filter. Whitesburg and Ridgecrest elementary schools supported SOAR.

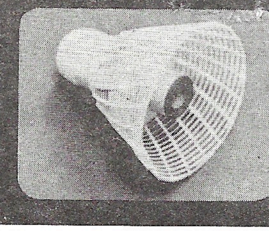
the experiments returned to the students for immediate analysis. Integration of the payloads was simplified by a using a standardized container (Slim-fast!) that is a perfect size to go inside a four inch diameter airframe.

A WHNT-TV 19 reporter spent most of the morning with students and teachers taping the action. They edited an excellent story of the whole exercise for the news that night.

Estes Industries Rocket Plan No. 61

'BIRDIE,'

OCTOBER 1968
DESIGN OF THE MONTH
by DON VAIL



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GENERAL INFORMATION

The Birdie will fly with Series III engines *only*. It will not be stable with other engines. The recommended types to use are the 1/4A3-2S and the 1/2A6-2S.

When preparing your model for flight install an igniter as directed in the instructions which came with the engine. Slide the engine into place in the engine holder tube. It should fit just tightly enough to prevent its sliding out when it is on the launcher and the clips are attached. If it is too loose wrap tape on the rear of the engine until it will not slide out.

The Birdie uses featherweight recovery. At ejection the engine is expelled from the engine holder tube. Since the model has relatively high drag and low weight without its engine, it falls slowly. The expended engine is not stable by itself, so it tumbles back. The tumbling motion results in high drag and a slow return.

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1 Begin construction by gluing the engine block in place. Smear white glue around the inside of the engine holder tube about 1/2 inch from one end. Insert the engine block into the other end and push it forward with a Series III engine until the rear end of the engine is even with the rear end of the tube.

2 Cut a hole for the launch lug in the shuttlecock as shown in the drawing. The hole should be no wider than the space between two of the long plastic ribs.

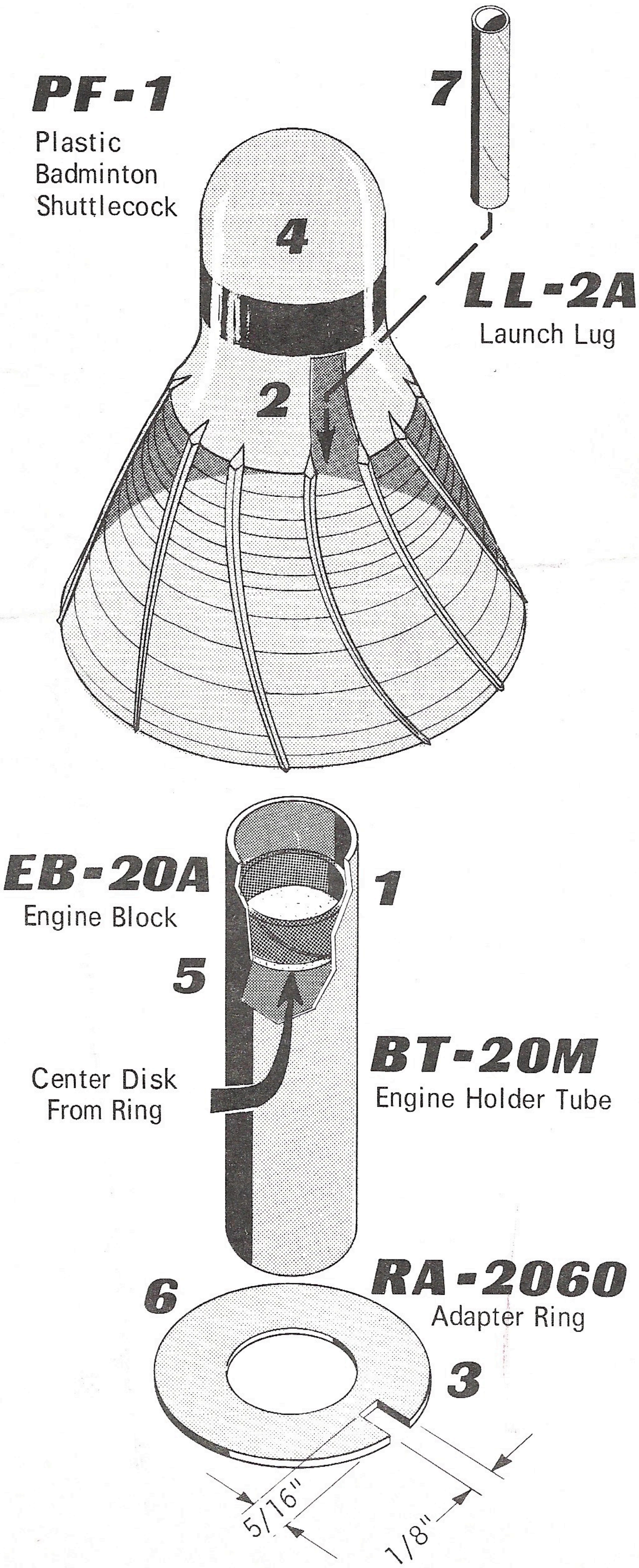
3 Cut a notch in the RA-2060 ring as shown in the illustration. Save the center disk from the ring.

4 Inside the nose of the shuttlecock are a number of molded plastic posts. Smear some glue around the outside of the outermost set of posts and push the engine holder tube into place. It should make a tight fit around the outside of the posts. (If there are no posts in the nose of your shuttlecock, smear glue around the sides of the inside of the nose and insert the tube.)

5 Push the center disk from the RA-2060 ring, edge first, halfway down the inside of the engine holder tube. Turn the disk with a finger or pencil so it touches the inside of the tube all the way around and push it the rest of the way with an engine casing. The disk should rest against the engine block and will need no glue.

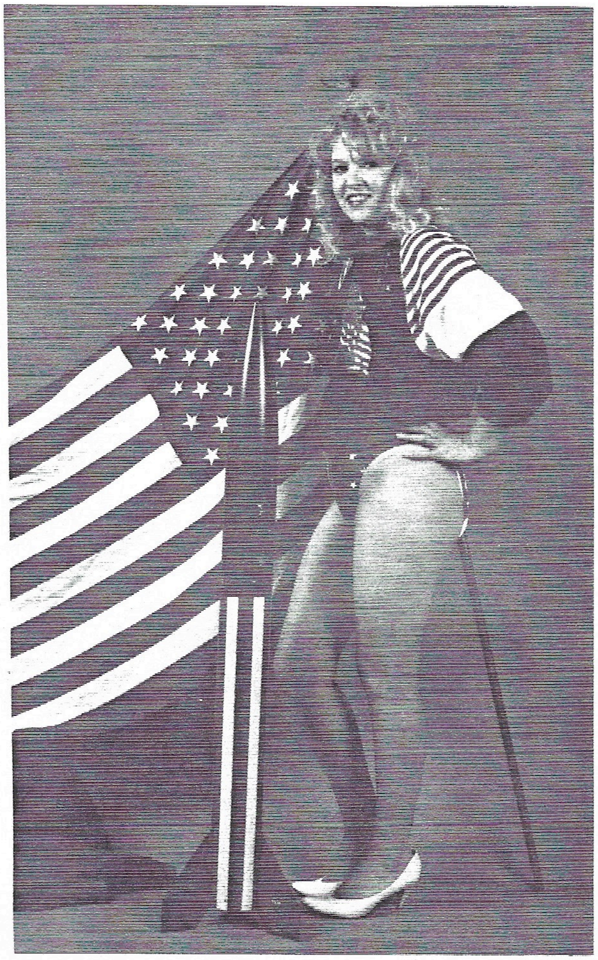
6 Slide the RA-2060 ring into place. The outer edge of the ring should touch the inside of the shuttlecock all the way around and the notch should match the hole in the side. Apply a line of glue to the joint between the ring and the tube.

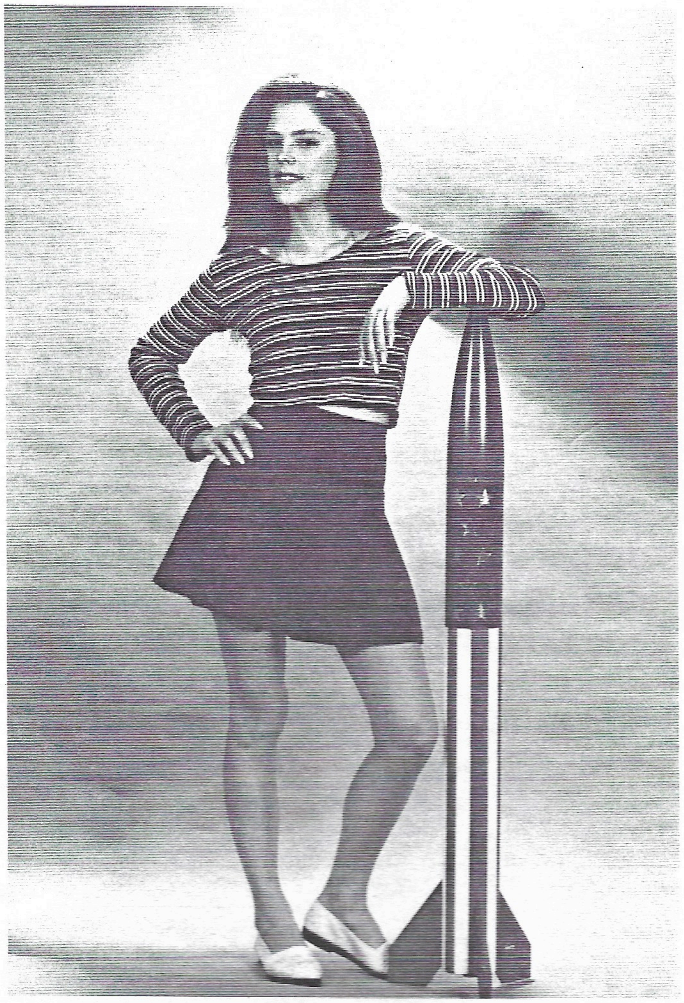
7 Install the launching lug from the front as shown. Secure it by gluing it to the ring at the rear where it passes through the notch.

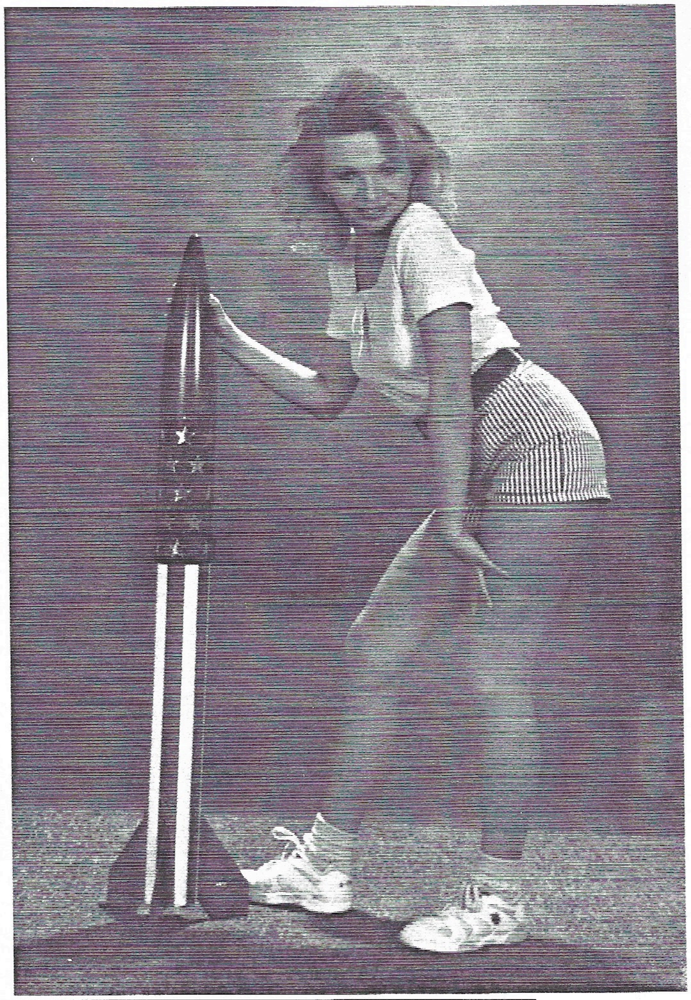


Rocket Modeling

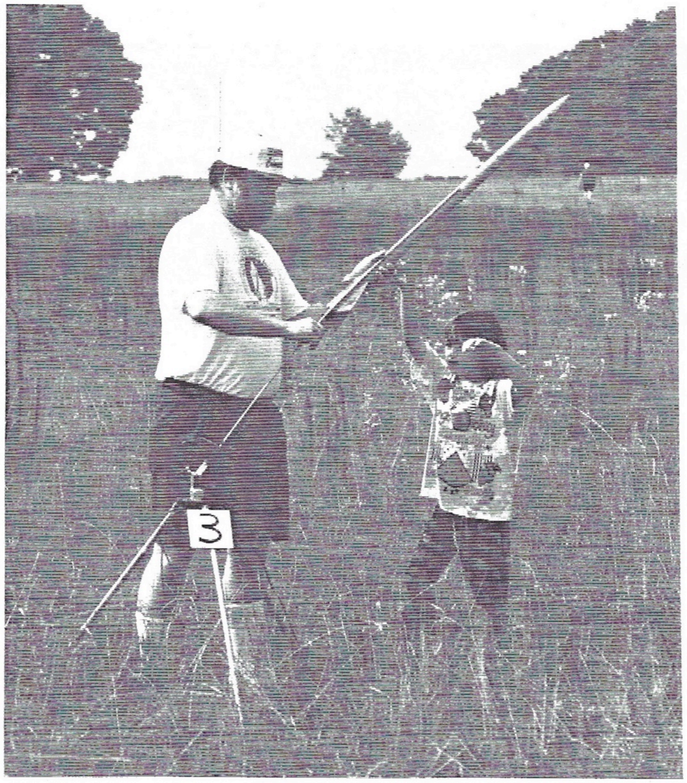
Photos by Jerry Schaefer







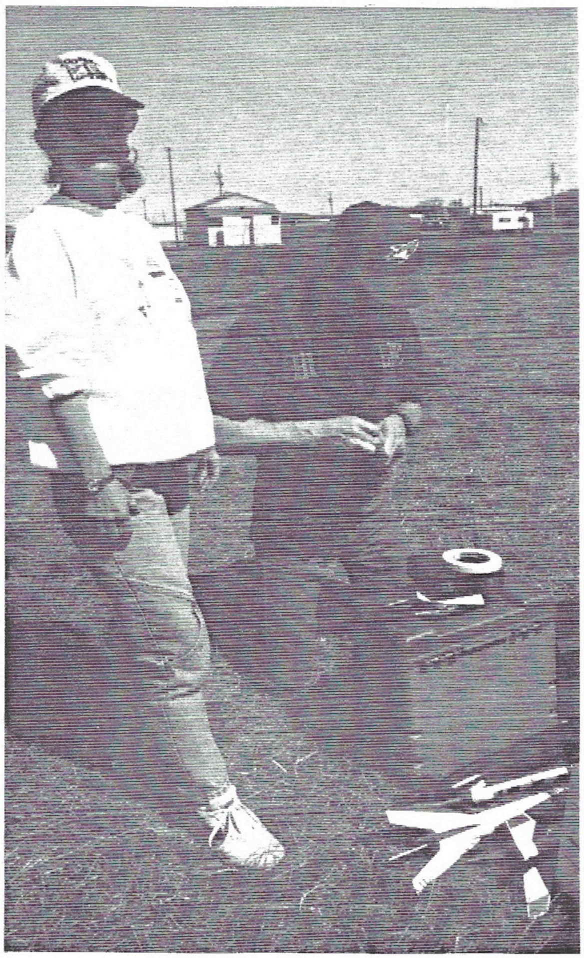
THIS PATRIOTIC TRIBUTE HELPS CELEBRATE THE SUMMER HOLIDAY. ROCKETS ARE NOT FIREWORKS, BUT THEIR RED GLARE CAN BE INSPIRATIONAL!

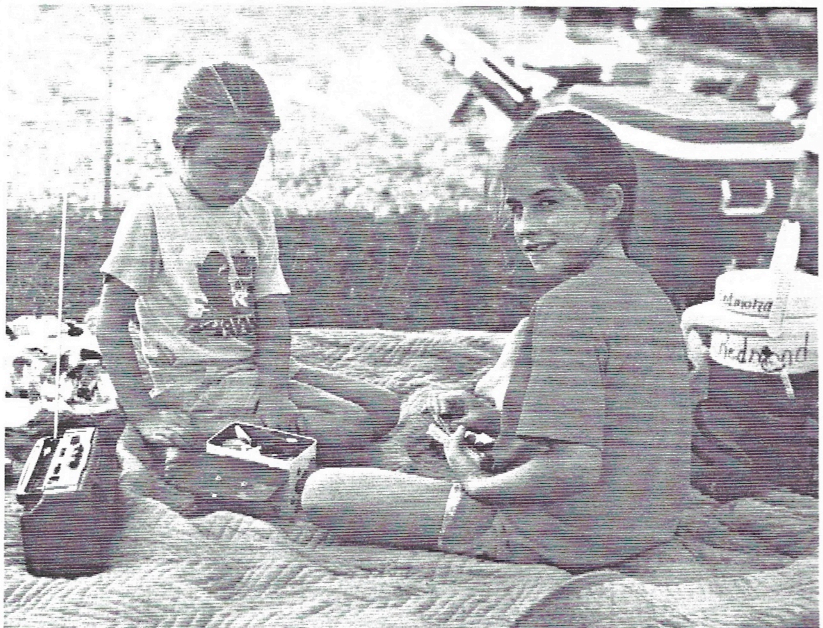


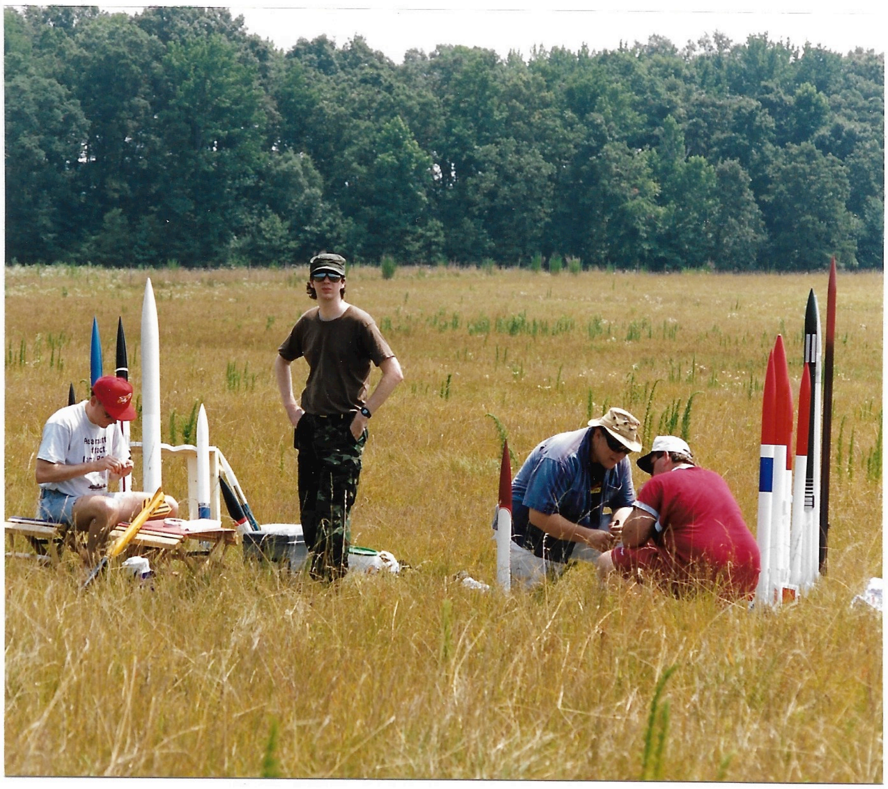
Parting Shots

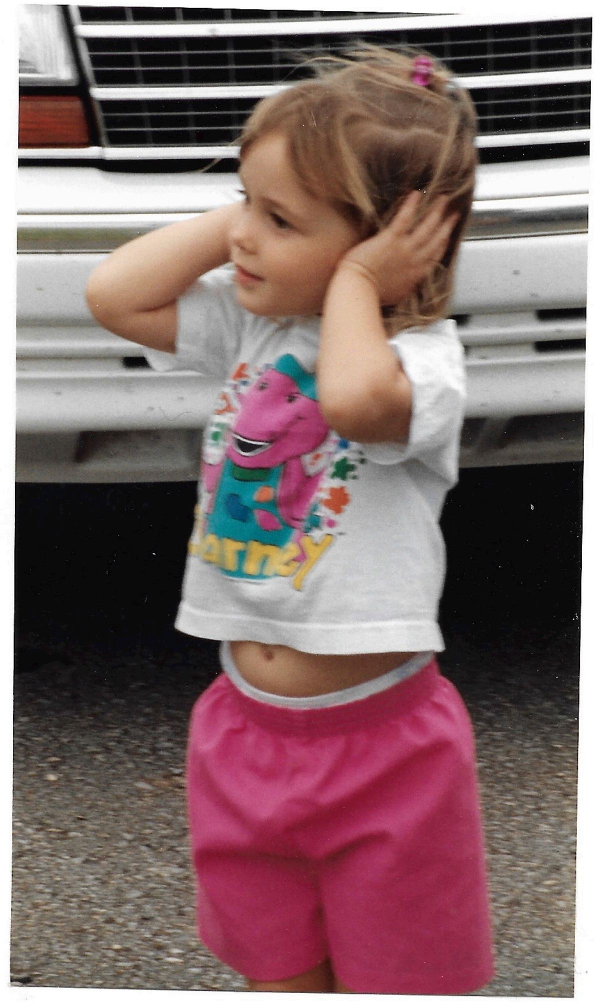
Clockwise from top, this page.

Stephanie and Mac Weathers hook up his Arreaux. Mark Tygielski and daughter prep on pad #3. Melissa and Kristen Redmon keep cool while dad looks for his rocket. Brian Day and Kathy work out of the range box.







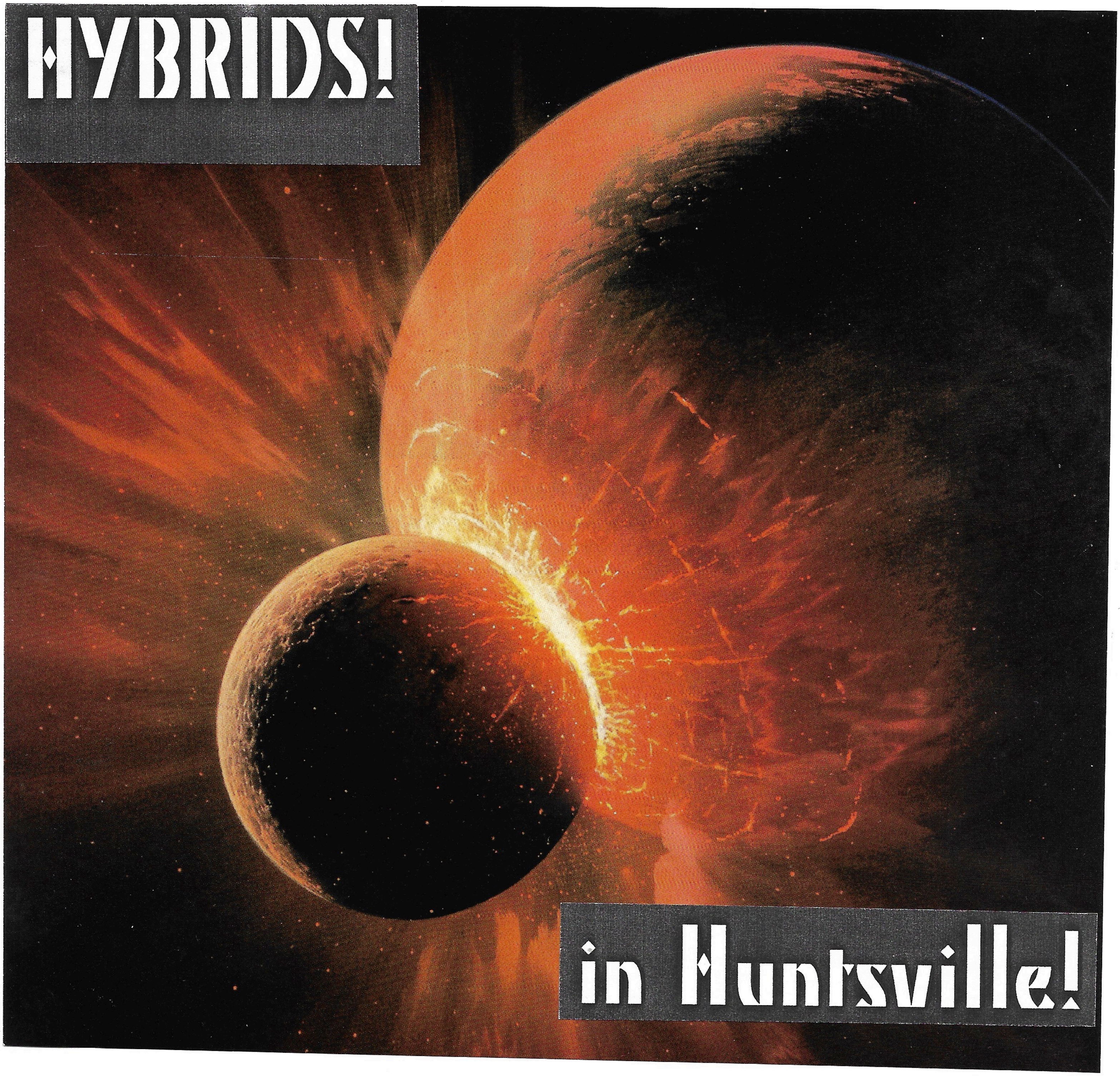


HARA Scenes

Clockwise from top, this page.

Joe Robertson is serious about-safety checks. Jessica Warren knows what daddy's toys sound like. David Gannett and Brian Day inspect Scott Saint's flop wing glider.

M A X - Q



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