NAR Section 578

Volume 5 Issue 1

January, 2002

WASHINGTON AEROSPACE

INSIDE THIS ISSUE:

Washington Aerospace Officers

- President—Kent Newman
- Treasurer—Christopher Scott
- Secretary—Bill Clugston
- Ops Mgr—Andrew MacMillen

For Club Information:

Kent Newman - ohiochase @aol.com or 360 893-1148

Christopher Scott—ChristopherJ@centurytel.net or 253 858-7256

FROM THE PRESIDENT.....

BY KENT NEWMAN

2002 Launch Schedule

In reviewing preliminary launch schedules for 2002, I find myself looking for room in the current newsletter format to be able to include all of the launches that are available to Northwest rocketeers. It' s a problem! The addition of Washington High Power (WHiP) at Touchet, Washington, and Washington Aerospace at Offutt Lake near Olympia, WA, are additional scheduled launch events for the NW that were not here at the beginning of last year. A nice problem to have!

Look for the current schedule in a full page printable format on page 11 and 12.

Meeting Agendas

In 2000, a formal agenda for club meetings was presented to help members target specific areas of interest. Each presentation provided an opportunity to see material that was perhaps new, very likely different and certainly fodder for discussion. In each case, it was an opportunity to learn for all of those attending.

Continuing with that theme, please note the list of presentation topics at the bottom of the page and the months that the presentations are to be made. Do note that there may be some topic presentation changes due to presenters' or members' needs but the list will remain fairly comprehensive.

2002 Officers

Elections for 2002 club officers were held during the December meeting with the following results:

President	Kent Newman
Treasurer	Christopher Scott
Secretary	Bill Clugston
Operations Mgr.	Andrew MacMillen

Month	Meeting Topic	Presenter
February	March NAR Contest Review Motor Building Class (@ All Hobbies)	Jim Pommert Christopher Scott/Bill Clugston
March	Experimental Motors Youth Rocketry Electronics	Greg Deputy Kent Newman
April	Level 1 Rocket Building Avionics Bay May NAR Contest Review	 Jim Pommert
May	Igniters Youth Rocketry Building June NAR Contest Review	Kent Newman Jim Pommert
June	Level 2 Rocket Building Recovery Systems	Chuck Layton Kent Newman
July	Two-Stage HPR Rockets Youth Rocket Building August NAR Contest Review	Kent Newman Jim Pommert
August	Painting	Mike Watkins
September	Level 3 Rocket Building	Kimberly Harms

MONROE SPACE PORT

"on a rain- and wind-shortened January 6th launch day."

BY DAVID DAVIS

Here's the motor distribution for the 16 flights made on a rain- and wind-shortened January 6th launch day:

B - 3	F - 3
C - 7	G - 2
D - 5	H - 1
E - 1	

Note that the motor total exceeds the flight total. Cluster flights are the reason, of course. All flights were under FAR 101 constraints. No certifications took place during this launch.

Chris Scott did a super job Sunday under less than nominal conditions.

"Kompetition Korner"

BY JIM POMMERT

2002 WAC NAR Contest Schedule

(President's Note:) Jim Pommert has done a great deal of investigation and work in putting together a contest schedule for fun and competitive contest flying for the 2002 season. Jim's plans are to follow up each month with details on each of the contests, tips on rocket selection, motors and construction tips. This is perfect for those interested in accumulating NAR contest points or for those just interested in having fun flying in contests with their kids.

Stay tuned for monthly updates!

March 3rd Monroe
Open Contest (2 Contest Factors)

½ A-engine Parachute Duration	(7)
NARAM 44 event	
A-engine Streamer Duration	(8)
Sport Scale	(20)
NARAM 44 event	
E-engine Rocket Glider Duration	(25)
Total =	(60)

April 7th Monroe
Rain Date for March Contest

May 5th Monroe
Open Contest (2 Contest Factors)

B-engine Drag Race (<19 years)	(2)
F-engine Drag Race (>19years)	(2)
G-engine Streamer Duration	(14)
B-engine Boost Glider Duration	(19)
NARAM 44 event	
F-engine Helicopter Duration	(25)
Total =	(60)

June 2nd Monroe
Open Contest (2 Contest Factors)

Open Drag Race	(2)
A-engine Parachute Duration	(7)
C-engine Helicopter Duration	(22)
NARAM 44 event	
G-engine Dual Eggloft Duration	(29)
Total =	(60)

July 7th Monroe
Open Contest (2 Contest Factors)

B-engine Parachute Duration	(8)
B-engine Superroc Duration	(14)
C-engine Eggloft Duration	(16)
C-engine Rocket Glider Duration	(22)
NARAM 44 event	
Total =	(60)

August 17TH & 18TH Offutt Regional Contest
(3 Contest Factors)

C-engine Parachute Duration	(9)
E-engine Streamer Duration	(12)
F-engine Superroc Duration	(19)
C-engine Boost Glider Duration	(20)
A-engine Rocket Glider Duration	(20)
Total =	(80)

September 7th Offutt
Open Contest (2 Contest Factors)

C-engine Superroc Duration	(15)
F engine Eggloft Duration	(20)
F-engine Flex Glider Duration	(25)
Total =	(60)

October 6th Monroe
Rain Date for a contest

The NAR "Pink Book" will be the reference for all contest details.

HISTORY OF MONROE SPACEPORT

BY STEVE THATCHER

The year was 1991 and a fledging company called Impulse Aerospace was working on their first product which was a launch controller system called Veri-Fire. The company's goal was simple – try to make a living out of rocketry. The company consisted of just two people - myself and Bill Maness. Bill was the businessman and I was the technical guy. Bill introduced me to HPR in the spring of 91 and we became business partners that summer.

We actually launched rockets down at a place called Sixty Acres Park in Redmond, Washington and even Marymoor Park, We flew E, F, and G motors and kept things under the sixteen ounce weight restriction that was in place at the time. We even pursued a 3600' waiver from the FAA for larger motors at Sixty Acres. That was our first waiver, so we knew how to get them, but we still needed a better place to launch from (one of the large trees near the park is probably still the home of my Aerotech Arreaux rocket). The site was simply not big enough to support the 3600' waiver we had (besides we wanted to go higher and use more propellant...).

Bill and I attended LDRS that year and became even more set on finding a site that would support larger motors and rockets. With Newton fever raging, 1992 rolled in and we spent time looking at maps and decided that our best bet was somewhere in the valley between Monroe and Duvall. I can't remember how many farmers we talked to, but the answer was basically the same – "that'll scare our cows!"

We talked with park rangers and they told us of a spot close to Duvall that unfortunately had high grass. After launching there once and losing a 29/100 motor from my LOC Aura and probably a few other things, we decided to keep looking. On one of our drives, we spotted a guy out on a mower in a pretty good open space of land near a wild life area. We found out from him that the land was a work farm and was used by the Monroe Reformatory. That answer led us to the reformatory and Bill, being the businessman, handled the negotiations. The work farm turned out to be public land which actually meant we could use it as long as we could work out the details with the work farm people - they didn't have a problem with the idea and they didn't have any cows close by... With permission in place, the FAA waiver was the next issue. After researching the location, we approached the FAA contact that I had and found out we could get a 5000' waiver due to its location in relationship to SeaTac. 1400' better than Sixty Acres Park and a larger place to fly (the only drawback was the swamp, of course).

The summer of 1992 saw the first flyers at the Monroe Spaceport. Of course, Bill and I were just having fun. We had picked up the ISP (Industrial Solid Propulsion – Aerotech's commercial side) reload and rocket line. We had our own version of a launch store there and were selling Veri-Fires, motor casings, reloads, and rockets. We also traveled to other sites to sell and on one of those trips we ended up in Sheridan, Oregon, where we met Dave Davis. We all became friends and Dave started coming out to Monroe to fly. The word was getting out through the Boeing Employees Model Rocket Club that there was a high power site where launches were being held every first Sunday of the month in Monroe. The number of people attending was growing and the site was working out pretty well. From cows stepping on parachutes in the next field to the swamp on the other side, we had our little bit of rocket heaven.

I hope you enjoyed reading a little bit of the history of Monroe Spaceport and I would expect some of you to wonder where in the heck I was all these years if I was one of the people that started the site. All I can say is that life took a drastic turn in 1993 that caused me to leave the hobby (I kept most of my rockets, a 29/100 motor, and reloads, though...). A combination of life turning back the other way in 2000 and a movie called "October Sky" sparked that old feeling I had when I was launching rockets in Monroe. To top it off, a TV channel surfing activity found me stopping at a public channel show that the Boeing Rocket club had put on. I can't remember what the topic was, but the show ended with www.northwestrocketry.com... Imagine my surprise to find out that the Monroe Spaceport was alive and well after all these years. I had never dreamed that what was started back then, was still going on.

I went out to Monroe for the first time since 1992 just this last spring after getting back into HPR. I must say I was very happy to be back again and almost blown away by the number of people attending the launches. I have to give a big thanks to Bill Maness and Dave Davis for keeping it alive after I dropped out. Of course, thanks also go to the people at Washington Aerospace and Tripoli Puget Sound for their involvement.

"From cows stepping on parachutes in the next field to the swamp on the other side, we had our little bit of rocket heaven."

Building the LANCE MGM-52

BY CHUCK LAYTON

Maybe it's the current political/military situation or maybe it's just my strange fascination with relatively small Army missiles designed to launch nuclear warheads short distances that caused me to purchase the LANCE MGM-52 from The Launch Pad.

This scale kit is based on the LANCE mobile field artillery system. It was the replacement missile for the Honest John and the Sergeant systems. The LANCE was unique in that it used prepackaged liquid fuel propellants that could be swapped in and out quickly in the field. In the early 1970's the LANCE achieved minor notoriety as the launch system for the "Neutron Bomb." Fortunately, President Jimmy Carter killed this insane weapon in 1978.

" the LANCE achieved minor notoriety as the launch system for the "Neutron Bomb."

The Launch Pad LANCE is 28.75" long and 2.6" in diameter and is designed to fly on a range of 24mm motors from D12's to F24's. Even though the kit is rated at skill level 2 it should not be treated as an Estes level 2. There are several challenges including rolling paper shrouds for the nose cone tip extension and the tail cone.

The 5-page instructions are fairly detailed and together with the line sketches they are relatively easy to follow.

Smoothing the paper extension on the nosecone requires some extra care.

Construction:

The parts included with the kit are all "Estes quality" meaning thin Kraft paper body tubes and balsa fins that must be cut from stock. I rarely build a kit exactly to the instructions and this kit was no exception. I chose to upgrade some of the components to produce a more durable rocket.

I replaced the balsa fins with basswood and covered them with a layer of 3 oz. glass. The body tube was then rolled with 2 wraps of 3 oz. glass.

The tailcone detail. As with the nosecone, the tailcone is fabricated from paper.

The most challenging elements in the construction of this kit are the paper nose cone extension and the tail cone. Patience is key here. After cutting the pattern out of card stock I found it helpful to drag a pencil over the inside surface to induce a curl. Then heat a cup of water in the microwave and hold the paper shrouds over the water. This will cause the shrouds to curl even further. Simply glue them together and paint them with CA. I also filled the space between the very tip of the extension and the round top of the plastic nose cone with epoxy. (I know this adds weight, but with these military styled kits and their close CP/CG relationships that is a good thing.) The extension is glued to the nose tip. Body filler and sanding will produce a smooth joint.

I replaced the paper centering rings with thin LOC rings so that I could use 2 tee-nuts for motor retention instead of the engine hook. The last modification I made was to replace the thin mylar parachute with a Top Flite nylon chute and the elastic cord with 3/8" nylon tape.

Finishing:

After a filler coat of Kilz and sanding I used

All finished and ready for primer and finish coats.

Building the LANCE MGM-52—Cont.

Krylon primer and their camo flat green paint (which I only ever see in the stores during hunting season.) The kit does not come with any decals. White vinyl trim can be used for the straight lines but you'll have to have someone cut the 3/4" U.S. ARMY decals.

Overall I am very pleased with the realistic field look of this model. If it lands in deep grass though, finding it could be a problem. It really blends in!

On the last page of the directions there are drawings and instructions for making the LANCE an incredibly detailed missile. I chose to do some of the black and white stripe detailing but stopped short of cutting pinheads to use for scale rivets! After all, I've got 6 other piles of rocket projects scattered all over the basement and garage including my L3.

Launch Pad kits are a nice challenge to build and finish. They usually have options for construction and detailing. I would recommend the LANCE (or any Launch Pad kit) as a nice alternative to the basic formula build mid-power kits. It is definitely for the experienced modeler.

The Lance in final dress coat ready for the skies!

I had planned on flying the LANCE by now but so far (as we all know) the weather recently in the Northwest has been less than stellar for flying. So instead I've had to be satisfy the need to fly by chasing my 7 yr. old around the house pretending to nuke him if he doesn't hide well enough. He thinks the LANCE looks v-e-r-y realistic!

Chuck Layton
WAC and WHiP

"It is definitely for the experienced modeler."

Introductory HyperTEK Hybrid Special from Now Hybrids

(*ROL Newswire*) -- Now Hybrids is offering a starter hybrid motor special through February 15th. You can get the HyperTEK 300cc motor system for $99.95 delivered to your door! The 300cc motor system includes one standard grain, the .098 and .125 orifices to change the thrust profile, o-rings, tie wraps and lube--everything you need to fly it from your club's HyperTEK Ground Support Equipment. The motor can be flown twice with the standard grain, producing about 130N or 220N average thrust depending on orifice, with a total impulse of about 500NS. Additional reloads can be purchased for $26, giving you a cost per flight of about $13 plus a dollar or two for nitrous oxide. It can also fly on the Special Effects (EFX) reload.

The HyperTEK 54mm systems are modular. The 300cc tank can be unscrewed from the injector bell, and replaced with a 440cc tank, converting the motor to a small J. If the 835cc tank is added, you can even fly it as the K-240.

Most airframes with 54mm motor mounts can accept the 20.5 inch long motor assembly and only require the drilling of a small vent hole.

This offer applies to shipments to US addresses only, and California orders must add sales tax.

Club Meetings

7:00 p.m. Saturday night before every Monroe launch!
Where: Peace Lutheran Church
214 East Pioneer
Puyallup, WA 98372

COMPOSITE MATERIALS-PART DEUX

BY KENT NEWMAN

Last month' s newsletter contained information regarding the attributes of composite materials. In this month' s issue, the discussion will be carried forward to discuss rocketry applications.

As a quick review, it was discovered that composite reinforcement could be varied depending upon the qualities desired:

- Stiffness
- Tension
- Impact Strength
- Resin (matrix system) Influence, i.e.,
  Resistance to heat
  Resistance to weather
  Resistance to ultraviolet light
  Resistance to chemicals

Although all of the above qualities are not necessary for hobby rocketry, the physical construction of a rocket can be greatly enhanced depending upon the size, intended use and core construction materials of the project. And, of course, cost constraints should be included in the list.

"the reasons first offered may not be the best reasons to laminate any rocket project"

Applications:

To provide a guideline in selecting composite cloth for a project, consider the table at the bottom of the page:

There is an obvious recurring theme on the number of wraps recommended to be used. However, there is a great deal of flexibility available. Consider a 6 inch project. One could apply two wraps of 6 oz. E-glass or two wraps of 3.7 oz. S-glass (30% stronger than E-glass) and have a similar result in each case. One could also apply two wraps of 6 oz. E-glass or four wraps of 3 oz. E-glass and have the same laminar result.

In any case, however, always consider multiple layers of lighter cloth versus single or fewer layers of heavier cloth to attain a given laminate construction.

Multiple layers:

- Improve strength by increasing the thread count per inch.
- Reduce the number of pinholes by reducing the number of interstitial spaces in the laminate.
- Lessen the chance of bubbles
- Increase directional strength (especially when layers are applied at 45 degrees to one another).
- Conform to shapes (when thinner or lighter cloth is selected).

Cutting cloth:

- Consider a cutting wheel and mat when cutting composite cloth. The local sewing store will have these items and you will be glad that you got them.
- Use ceramic scissors for Kevlar. Kevlar will ruin the household pair.
- Always straighten the cloth to make sure that the warp and fill threads are perpendicular to one another and the cloth is evenly tensioned before cutting.

Composite Applications:

I won' t go into detail on the actual steps required to apply composite materials or to build up components from composites directly. There are a number of good references in existence already. Several of those references are listed at the end of the article.

Generally, there are three application techniques used to apply composite material in hobby rocketry:

1. Hand lay-up – the process involves preparing the surface of the core material, applying epoxy or epoxy-coated cloth and smoothing. This is the easiest method but

Rocket Class	Size	Composite Mat' l	Cloth Weight	Wraps
Model	< 2" dia	E-glass	1.5 to 2.0 oz.	2 to 3
Mid-Power	< 3" dia	E-glass	2.0 to 4.0 oz.	2 to 3
Sport	<4" dia	E-glass; S-glass	4.0 to 6.0 oz.	2 to 3
Heavy	> 5.38" dia	E-glass; S-glass; Kevlar	4.0 to 6.0 oz.	2 to 3
High-Perf	Any size	Carbon; S-glass	1.5 to 6.0 oz.	2 to 3
Fins		E-glass; Carbon; S-glass	2.0 to 6.0 oz.	2 to 3

COMPOSITE MATERIALS-CONT.

the least efficient with regard to attaining the desirable 50/50% ratio of epoxy to cloth by weight.

2. Vacuum bagging – this method involves wrapping the composite project in a number of materials designed to soak up excess epoxy when the project is place under a vacuum. The resulting project provides an excellent ratio of epoxy to cloth weight but is more expensive and time-consuming.
3. Heat tape – Shadow Aerospace is a big proponent of this method where heat tape is wrapped around a project with the composite material just applied. The heat tape shrinks thereby squeezing excess epoxy from the project. I haven' t used this method and haven' t heard from many people that have experienced complete success but it may be a more economic means of pulling excess epoxy off than vacuum bagging.

Most projects will require room temperature for the epoxy/composite matrix to cure. The heat tolerance of most epoxies and some specific compounds in particular can be greatly improved when the epoxy is cured under heat for specified periods of time. For example, heat tolerant epoxy might be desirable on a minimum diameter project where the fin can/ fin attachment points are exposed to the hot motor casing or on a design where the fins are exposed to the motor temperature for extended periods of time. Epoxy manufacturers can provide information regarding heat curing and the benefits that can result .

Hygiene:

- Use a dust mask or, better yet, a respirator when working with composite materials. Cutting fiberglass will cause a lot of fiberglass dust (bad for the lungs) to be released into the air. Sanding epoxy/fiberglass will certainly release a lot of dangerous irritant into the atmosphere. And some epoxies still contain chemicals that are potentially hazardous. Why take a chance over a hobby?
- Use goggles and gloves (for the reasons listed above) when cutting, epoxying, sanding, etc.
- Use a skin protection cream before putting on the gloves. It is a second layer of protection and it will expedite cleanup when you are through.

Misperceptions:

One hears a number of a comments about the application of composite material, the benefits, the pitfalls, etc. Let me throw out some responses to those comments to consider.

- "This is going to be my L2 project. I want to fiberglass it to take the stress of a 54mm motor".

  That project will likely fly very well with a raw phenolic or cardboard airframe, thank you very much. However, laminating the project with an aerospace composite material to increase the durability of the rocket will do some real good for your project. Want to fly that rocket 8 or 10 times? Or 25 or 30 times?

- "I used a roller to get a finish that was as good as vacuum bagging".

  I think this comment misses the point. One applies a vacuum to uncured composite layers to reduce the amount of epoxy in the matrix. The final product finish is not the primary consideration.

  A roller does do a good job of evenly distributing the epoxy along the surface of material. The resulting "good" finish is likely excess epoxy filling the weave of the cloth adding only weight to the project and no additional strength.

- "I like to coat the cured fiberglass with epoxy to fill the weave marks of the cloth and any pinholes. It' s recommended in the epoxy manufacturers' literature".

  This step is absolutely true....if one is building a boat. And, honestly, if weight isn' t a concern at all or weakening the composite surface is of minor importance, painting the cured or semi-cured cloth will indeed help provide a smooth surface. Just realize that what is being done only negates the purpose of composite construction rather than supports it (A composite structure results in the lightest and strongest construction possible.)

- "I just sand the cured fiberglass until I get a really smooth surface".

  95+% of composite lay-ups will not have a smooth surface ready for final finishing. And if one sands into the fiberglass cloth of the matrix, all of that work intended to provide a lightweight strong structure will be compromised. The strength of composite structures comes from the cloth fibers. The epoxy holds the cloth in the proper configuration to demonstrate its strength. Don' t sand it away!

"This step is absolutely true….if one is building a boat."

COMPOSITE MATERIALS-CONT.

Now, what some people do (myself included) is put a final "sanding veil" on the project before it is cured. This is typically a 2 oz layer of E-glass that is intended to help cover pinholes and weave marks and can be "sacrificed" to a degree when "lightly sanding" the finished and cured project. The light sanding is meant to take down dust particles, loose threads or other similar irregularities. Do not sand into the main structural support of the primary cloth. Use an epoxy-based filler for the final finish of your project.

- "I don't use Kevlar. It' s just too hard to sand!"

  I suspect that this is the plaintive cry of someone who subscribes to the school of "sand it 'til it's smooth!" mentioned above. Kevlar is horrible to sand into; it "fuzzes" and frays and is extremely difficult to get to lie down again. But sanding the surface of the cloth should never be an issue. Without sanding the surface of the cloth, trimming the ends of an airframe tube after the application cures, drilling holes for venting or rail guides and trimming hatchway openings cause enough problems. But with care, the fuzzing can be kept to a minimum. Use CA on the "fuzzies"? And sand lightly.

"sanding the surface of the cloth should never be an issue"

- "I like to coat my couplers for extra strength".

  Maintaining as much objectivity as possible, I suppose that there is truth to this statement. A layer of epoxy applied to phenolic or cardboard does have some strength. But, how much? Try painting a coat of epoxy on a piece of waxed paper and let it cure. Carefully peel the waxed paper off of the epoxy and see how strong that thin, brittle little sheet of epoxy actually is. Now, take another sheet of waxed paper. Lay down 2 or 3 pieces of 4" X 4" of 3 oz. E-glass and sandwich them with epoxy and let it cure. Again, carefully peel the waxed paper off of the glass/epoxy and try to bend or break it.

  Which material do you want to use to strengthen that your rockets?

- "I just made my own 36" motor mount tubes out of carbon fiber! They're the lightest I' ve ever seen"

  Could very well be, but there might be a couple of things to consider here. Most importantly, what is the purpose of a motor mount tube? I would suggest that there are two purposes: one is to align the motor with the vertical axis of the rocket. And to do this generally does not require 36" of tube. Something on the order of 1/2 to 2/3 of the length of the longest motor to be used should be more than sufficient. Two, the MMT is an excellent way to mount the fins. Does one really need a composite tube to perform these functions?

  More critically, consider the fact that most marine epoxies begin losing their matrix ability at around 120 to 130 degrees. Motors can heat up to 200 degrees pretty easily. Not a real good thing for most epoxies.

There are a number of good references to be used for further composite construction investigation. Please look at these sites and try your hand at reinforcing building with composite materials:

Hand Laying fiberglass:
www.infocentral.org/index.cgi?construction
Vacuum bagging:
www.info-central.org/index.cgi?construction
Heat Tape:
www.info-central.org/index.cgi?construction
Vendors:
Aerospace Composite Products -
www.acp-composites.com/
Composite Structures Technology -
www.cstsales.com/
Fiberglast -
www.fibreglast.com
Fiberlay -
www.fiberlay.com

Best ← → Worst

Cost	E Glass	S Glass	Kevlar	Graphite
Weight (Density)	Kevlar	Graphite	S Glass	E Glass
Stiffness	Graphite	Kevlar	S Glass	E Glass
Heat	S Glass	E Glass	Kevlar	Graphite
Toughness	Kevlar	S Glass	E Glass	Graphite
Impact Resistance	Kevlar	S Glass	E Glass	Graphite

A HYBRID PRIMER—PART 2.

BY ANDREW MACMILLEN

===== History =====

Pioneers, 1933-1950:

The first hybrid rocket was launched was launched August 18, 1933. The Russian GIRD-09, developed by Sergei Korolev and Mikhail Tikhonravov, used jellied gasoline suspended on a metal mesh and LOX under its own pressure. The semisolid fuel both eliminated the need for a cooling system and protected the combustion chamber walls, while the pressurized LOX eliminated any pumps. The 7 inch

GIRD-09 (Retro Rockets—Peter Always)

by 8 foot rocket generated a thrust of 500N for 15 sec. (M514) and reached 1500m.

In Germany from 1937-1939, I.G. Farben ran tests using coal and gaseous NOX, which developed 10,000N for 120 sec. Hans Oberth also tested a LOX and tar-wood-saltpetre mixture. The first US tests were conducted from 1938 to 1941 by the Californian Rocket Society using coal and GOX. In 1947, the Pacific Rocket Society tested wood and LOX motors.

Research, 1951-1971:

GE conducted the first US commercial tests between 1951 and 1956 using polyethylene and 90% hydrogen peroxide.

The French National Aerospace Research Establishment (ONERA) started researching hybrids in 1956. ONERA's first flight was April 25, 1964, with a thrust of 10,000N. Other flights through 1967 reached 100km.

In the US, Rocketdyne started testing Plexiglas and oxygen motors in 1960, and United Technologies Corp. (UTC) started research in 1961, with a 18.4 ton test on April 25, 1967, and a 50,000N test in 1970.

Tests were conducted in Germany from 1965 to 1970, and further testing occurred between 1974 and 1987.

Sweden also ran tests from 1965 to 1971, with a first flight in 1971 launching a 20kg payload to 80 km.

Development, 1979-2001:

Teledyne Ryan began design work for the AQM-81A "Firebolt" target drone in late 1979 and the vehicle, powered by an UTC hybrid motor, entered USAF service in 1983.

James C. Bennett, a principal in US hybrid rocket research and development, co-founded Space Enterprise Consultants in 1980, and Arc Technologies, Inc., later known as Starstruck, Inc. Starstruck successfully conducted a sea launch of its Dolphin rocket on August 3, 1984 with a thrust of 175,000N using HTPB and LOX. This Dolphin launch produced two notable firsts: the first flight of a privately developed large launch vehicle in the US, and the first flight of a large hybrid rocket. In 1985, Mr. Bennett co-founded American Rocket Company (AMROC), which tested engines upto 324,000N, and unsuccessfully launched the SET-1 sounding rocket on October 5, 1989, which failed for reasons unrelated to the hybrid motor. AMROC folded in 1995, but SpaceDev acquired rights to AMROC's hybrid technology in 1999, and continues to develop hybrid technology.

Starstruck, Inc. launches the Dolphin. On August

In 1995, NASA and DARPA started the Hybrid Propulsion Demonstration Program (HPDP). Under this program, the world's largest hybrid engine was tested at NASA's Stennis Space Center August 13, 1999. It was 70 inches by 45 feet, and developed 250,000 pounds of thrust for 15 seconds.

Also under HPDP, in 1996 and 1997 Environmental Aeroscience Corporation (EAC). launched the 6" diameter Hyperion 1A four times from NASA Wallops Flight

"The 7 inch by 8 foot rocket generated a thrust of 500N for 15 sec. (M514) and reached 1500m."

A HYBRID PRIMER—CONT.

A hybrid engine is tested 8/13/99 at NASA' s Stennis Space Center.

Facility, reaching an altitude of 120,000 feet burning N2O and HTPB. These were the first hybrid flights for NASA. In affiliation with Cesaroni Technology Incorporated (CTI), their 112,500N Hyperion 1C motor was successfully tested in February 2001. The Hyperion 1C is anticipated to reach an altitude in excess of 250,000 feet, while the proposed 12" diameter 890,000N Hyperion 2 will exceed 500,000 feet and Mach 5.

The Hyperion

"The Hyperion 1C is anticipated to reach an altitude in excess of 250,000 feet"

Model Rocketry:

In the early 1990's, Korey Kline started development of HPR hybrid motors after a discussion with Bill Wood. Korey Kline and the group which founded eAc launched the first HPR hybrid August 16, 1994, and made them available in 1995 under the Hypertek brand. Hypertek is now manufactured by CTI in affiliation with eAc.

In December 1994, Aerotech launched their first "RMS/Hybrid" test, and in 1995, introduced its line of hybrid rocket motors to the market.

Also in 1994, Bob Fortune, John Urbanski & Bill Colburn were experimenting with nitrous motors. In 1995, John & Bill independently came up with the idea of substituting a plastic hose for the metal stem used in the Hypertek launch system. The hose acted both as a burst safety valve and the nitrous release valve when melted by a preheater grain.

R.A.T.T. Works combined this idea with a monocoque/floating bulkhead design and certified their motors with Tripoli in 2000. Propulsion Polymers is currently working with Tripoli to certify motors with a similar design.

===== Myths =====

Myth #1: "Nitrous motors are cheaper." From the comparison above, lower impulse motors are only a little less expensive than solids, without electronics costs. In the high power range, cost savings are quite significant.

Myth #2: "HPR nitrous flights were first." Yes, HPR nitrous motors were available before any US government nitrous rockets. However, Russia, Germany, France, and Sweden all had successful flights prior to 1970. The USAF used a nitrous motor in the Firebolt in 1983, and Starstruck flew the Dolphin in 1984, ten years before HPR flights started.

Myth #3: "Nitrous is a drug." Hybrid motors use auto grade nitrous, which is used to enhance engine performance. Racing nitrous is mixed with hydrogen sulfide, which will make you very ill.

Construction Tip—Epoxy Syringes

Using medicine syringes to apply epoxy has been discussed previously. It' s a great way to put an even bead of epoxy along fin fillets, dab epoxy onto bulkheads and to apply the adhesive through a straw to create internal fin fillets. Finding surplus syringes can be the problem, however!

I' ve found a new source at my friendly veterinarian. Syringes, sized anywhere from 10cc to 60cc are commonly used to give animals medicine, nourishment, etc. After being used, the syringes are sterilized for future use but do pile up after a time. Ask a neighborhood vet if they might be able to spare some syringes. Be sure to explain it' s to be used for applying epoxy!

2002 Region Launch Schedule

Month	Date	Days	Location	Waiver	Host	Event
January	6th	Sun	Monroe,WA	5,000'	WA/TRAPS	
February	3rd	Sun	Monroe, WA	5,000'	WA/TRAPS	
March	3rd	Sun	Monroe, WA	5,000'	WA/TRAPS	Open flying contest
	9th	Sat	Kent, WA	Model	BEMRC	
	23rd-24th	Sat-Sun	Touchet, WA	10,000'	WHiP	
April	7th	Sun	Monroe, WA	5,000'	WA/TRAPS	
	13th	Sat	Dayton, WA	4,500'	BMR	
	13th	Sat	Kent, WA	Model	BEMRC	
	14th	Sun	Spokane, WA	11,000'	SPARC	
	20th	Sat	Offutt Lake, WA	FAR 101	WA	
	20th-21st	Sat-Sun	Sheridan, OR	FAR 101	OREO	
	27th-28th	Sat-Sun	Touchet, WA	10,000'	WHiP	
May	4th-5th	Sat-Sun	Swan Falls, ID	16,700'	Tripoli Idaho	SPUDROC 7
	5th	Sun	Monroe, WA	5,000'	WA/TRAPS	Open flying contest
	11th	Sat	Kent, WA	Model	BEMRC	
	11th	Sat	Dayton, WA	4,500'	BMR	
	12th	Sun	Spokane, WA	11,000'	SPARC	
	18th	Sat	Offutt Lake, WA	FAR 101	WA	
	18th-19th	Sat-Sun	Brothers, OR	16,000'	OREO	
	25th-27th	Sat-Sun	Touchet, WA	10,000'	WHiP	
June	2nd	Sun	Monroe, WA	5,000'	WA/TRAPS	Open flying contest
	7th-9th	Fri-Mon	Dayton, WA	4,500'	BMR	
	8th	Sat	Kent, WA	Model	BEMRC	
	8th	Sat	Spokane, WA	11,000'	SPARC	
	8th	Sat	Offutt Lake, WA	FAR 101	WA	
	15th-16th	Sat-Sun	Brothers, OR	16,000'	AeroPac	MudRoc 6.0
	21st-23rd	Fri-Sun	Black Rock, NV	90,000'	OREO	
	22nd-23rd	Sat-Sun	Touchet, WA	10,000'	WHiP	
July	7th	Sun	Monroe,WA	5,000'	WA/TRAPS	Open flying contest
	11th-16th	Thu-Tues	Amarillo, TX	21,500+'	POTROCS	LDRS XI
	13th	Sat	Kent, WA	Model	BEMRC	
	13th	Sat	Dayton,WA	4,500'	BMR	
	14th	Sun	Spokane,WA	11,000'	SPARC	
	20th-21st	Sat-Sun	Offutt Lake, WA	FAR 101	WA	
	27th-28th	Sat-sun	Brothers, OR	16,000'	OREO	

Month	Date	Days	Location	Waiver	Host	Event
August	2nd-4th	Fri-Sat	Black Rock, NV	90,000'	AeroPac	Aeronaut 2002
	4th	Sun	Monroe, WA	5,000'	WA/TRAPS	
	10th	Sat	Kent, WA	Model	BEMRC	
	10th	Sat	Dayton, WA	4,500'	BMR	
	16th-18th	Fri-Sun	Bonneville, UT	25,000'	UROC	"HELLFIRE"
	17th-18th	Sat-Sun	Offutt Lake, WA	FAR 101	WA	
	24th-25th	Sat-Sun	Touchet, WA	10,000'	WHiP	
September	1st	Sun	Monroe, WA	5,000'	WA/TRAPS	
	7th	Sat	Offutt Lake, WA	FAR 101	WA	
	14th	Sat	Kent, WA	Model	BEMRC	
	14th-15th	Sat-Sun	Touchet, WA	10,000'	WHiP	
	15th	Sun	Spokane, WA	11,000'	SPARC	
	21st	Sat	Dayton, WA	4,000'	BMR	
	21st-22nd	Sat-Sun	Sheridan OR	FAR 101	OREO	
	27th-29th	Fri-Sun	Black Rock, NV	90,000'	AeroPac	"XPRS"
October	6th	Sun	Monroe, WA	5,000'	WA/TRAPS	
	12th	Sat	Kent, WA	Model	BEMRC	
	12th	Sat	Dayton, WA	4,500'	BMR	
	13th	Sun	Spokane, WA	11,000'	SPARC	
	19th-20th	Sat-Sun	Brothers, OR	16,000'	OREO	
	26th-27th	Sat-Sun	Touchet, WA	10,000'	WHiP	
November	2nd-3rd	Sat-Sun	Idaho			
	3rd	Sun	Monroe, WA	5,000'	WA/TRAPS	
December	1st	Sun	Monroe, WA	5,000'		

Launch Contacts:

Washington Aerospace	(WA - NAR 578)	Kent Newman	360-893-1148	ohiochase@aol.com
Tripoli-Puget Sound	(TRAPS #41)	Christopher Scott	253-858-7256	ChristopherJ@centurytel.net
Monroe Launches	(WA-TRAPS)	Christopher Scott	253-858-7256	ChristopherJ@centurytel.net
Washington High Power	(WHiP NAR - 633)	Scott Binder	509-525-4461	info@bsdrocketry.com
Blue Mountain Rocketeers	(BMR NAR - 615)	Tim Quigg	509-382-4176	tquigg@hcis.net
Boeing Emp Mod Rocket Club	(BEMRC NAR #627)	Bruce Johnson	425-742-2252	abrucej@aol.com
Seattle NAR	(SEANAR - NAR 568)	Don Qualls	206-784-1667	silent1@ix.netcom.com
Spokane Area Rocket Club	(SPARC - NAR 626)	Kirk Mohror	509-230-7761	fvracr@aol.com
Oregon Rocketry Enthusiast' s Org	(OREO - NAR 555)	John Lyngdal	503-649-7371	john.lyngdal@tek.com
Tripoli-Oregon	(TRA #44)	Gary Fillible	503-843-3137	
Tripoli-Portland	(TRA #49)	Dennis Winningstad	503-297-3685	winningstad@attbi.com
Tripoli Idaho	(TRA #43)	Vern Knowles	208-939-1076	vern_knowles@worldnet.att.net
Tripoli Utah	(TRA #6)	Ron Weigel	801-566-2965	ronweigel@quest.net
AeroPac	(TRA #23)	Tom Rouse	408-997-0210	tomr@aeropac.org

Club Meetings

The first Saturday of every month!

Where: Peace Lutheran Church
214 East Pioneer
Puyallup, WA 98372

Time: 7:00 p.m.

We' re on the Web!
www.hawkfeather.com/wa-aero/

NAR Section 578
Super
Discounts

All club members get the following discounts at the All Hobbies store

20%

Special Discount on single item purchases of over $300.

10%

On all of the following:

LOC(except as noted)
AEROTECH KITS
IMPULSE AEROSPACE
DR. ROCKET
AEROTECH MOTORS
AEROTECH RMS
CUSTOM
QUEST
TOP FLIGHT
PARACHUTES
PUBLIC MISSILES, LTD.
THE LAUNCH PAD
ESTES

5%
AEROTECH &
DR. ROCKET MOTORS
& PARTS

NO DISCOUNT

All Red Sticker Items

ALL HOBBIES STORE
1430 E. Main
Puyallup, WA 98372
253-841-0089

Regional Launch Schedule

Notes:
1) BEMRC launches (Boeing) are model rockets only. "C" impulse maximum.
2) "EX" motors are not allowed at certified motor launches; and certified motors are not allowed at "EX" launches except when flown with an "EX" motor.

January 5th (Sat)	Puyallup, WA **(WA Aerospace Meeting)**
January 6th (Sun)	Monroe, WA (TRAPS/WA)
February 2nd (Sat)	Puyallup, WA **(Washington Aerospace Meeting)**
February 3rd (Sun)	Monroe, WA (TRAPS/WA)
March 2nd (Sat)	Puyallup, WA **(WA Aerospace Meeting)**
March 3rd (Sun)	Monroe, WA (TRAPS/WA) - Flight Contest
March 9th (Sat)	Kent, WA (BEMRC)
March 23rd-24th (Sat-Sun)	Touchet, WA (WHiP)
April 6th (Sat)	Puyallup, WA **(WA Aerospace Meeting)**
April 7th (Sun)	Monroe, WA (TRAPS/WA)
April 13th (Sat)	Dayton, WA (BMR)
April 13th (Sat)	Kent, WA (BEMRC)
April 14th (Sun)	Spokane, WA (SPARC)
April 20th (Sat)	Offutt Lake, WA (WA)
April 20th-21st (Sat-Sun)	Sheridan, OR (OREO)
April 27th-28th (Sat-Sun)	Touchet, WA (WHiP)
May 4th (Sat)	Puyallup, WA **(WA Aerospace Meeting)**
May 4th-5th (Sat-Sun)	Swan Falls, ID Tripoli Idaho—SPUDROC 7
May 5th (Sun)	Monroe, WA (TRAPS/WA)
May 11th (Sat)	Kent, WA (BEMRC)
May 11th (Sat)	Dayton, WA (BMR)
May 18th (Sun)	Spokane, WA (SPARC)
May 18th (Sat)	Offutt Lake, WA (WA)
May 18th –19th (Sat-Sun)	Brothers, OR (OREO)
May 25th-27th (Sat-Mon)	Touchet, WA (WHiP)
June 1st (Sat)	Puyallup, WA **(WA Aerospace Meeting)**
June 2nd (Sun)	Monroe, WA (TRAPS/WA)
June 7th-9th (Fri-Mon)	Dayton WA (BMR)
June 8th (Sat)	Kent, WA (BEMRC)
June 8th (Sat)	Spokane, WA (SPARC)
June 15th (Sat)	Offutt Lake, WA (WA)
June 15th-16th (Sat-Sun)	Brothers, OR (OREO)
June 22nd-23rd (Sat-Sun)	Touchet, WA (WHiP)

Launch Contacts:

Washington Aerospace (WA)	Kent Newman	360-893-1148
Tripoli Puget Sound (TRAPS)	Christopher Scott	253-858-7256
Monroe Launches (TRAPS-WA)	Christopher Scott	253-858-7256
Wahington High Power (WHiP)	Scott Binder	509-525-4461
Blue Mountain Rocketeers (BMR)	Tim Quigg	509-382-4176
Boeing Emp Model Rocket Club (BEMRC)	Bruce Johnson	425-742-2252
Seattle NAR (SEANAR)	Don Qualls	206-784-1667
Spokane Area Rocket Club (SPARC)	Bret Conant	509-299-7122
Oregon Rocketry Enthusiast' s Org (OREO)	John Lyngdal	503-649-7371
Tripoli – Oregon	Gary Fillible	503-843-3137
Tripoli – Portland	Dennis Winningstad	503-297-3685