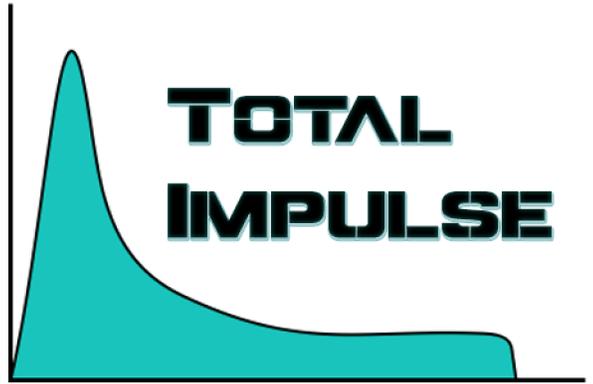




JACKSON MODEL ROCKET CLUB



### NASA'S LIFTING BODY PROGRAM PART 3

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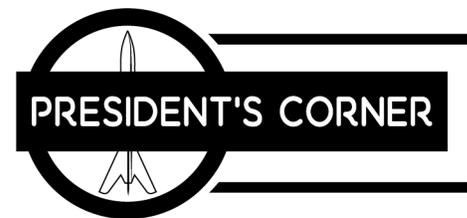
### STARLINER

### HUGHES AIM-54 PHOENIX



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**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](mailto: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 Rob Dickinson  
 6237 Arroyo Vista Dr.  
 Rockford MI 49341

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

**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/zc5IC1](https://groupme.com/join_group/28013422/zc5IC1)

Welcome to the March – April 2019 issue of *Total Impulse*. The weather in Michigan is finally starting to warm up for the upcoming flying season. This is a big year for model rocketry and space exploration in general. Once again, one of the main NAR events of the year is practically in our back yard with NARAM 61 taking place at Muncie, IN. In addition to NARAM there will be Sport Flying the entire 8 days as well as the FAI USA Team fly-offs. Before NARAM we also have the two-day CrapShoot VI in Muskegon on May 25, 26. See below for the entire launch calendar for the year.

A big thank you to all who contributed to this issue. Your volunteerism is just another example of why JMRC is an incredible club. That said, we're always looking for more submissions. Please consider contributing a piece whether it's a multipage article or short product review. All submissions are greatly appreciated. Shoot me an email if you have any questions about contributing to the newsletter.

Finally, don't forget the shirt logo contest (page XX). We have some submissions already that will be online soon. There's plenty of time to submit your design, so take a shot.

**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.

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

Send correspondence to:  
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**Launch/Event Calendar - 2019**

- April 13th (MIS)
- May 4th (TBD)
- CrapShoot VI - May 25,26 (Muskegon)
- June 15th (MIS)
- July 13th (MIS)
- NARAM 61 - July 27 - August 3 (Muncie, IN)
- August 17th (MIS)
- September 14th (MIS)
- October 12th (TBD)
- November 9th (TBD)

**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.

The flying season has finally arrived, and we are ready to take advantage of all the good weather that is heading our way {just trying to set the tone for the year }. Just a reminder that we are introducing a new structure to our membership and launch fees. If you are planning to fly high power and attend 2 or more launches within a year it is **actually cheaper** to make your membership current. It only costs \$30 a year for an adult membership to join our club and you will not have to pay any launch fees. If there are two or more members in your family wanting to fly high power rocketry then a single Family Membership of \$40 makes it an instance savings on the first launch. This is of course coupled with our original policy that kids and students always fly free.

I have not been directly asked why we are taking this dramatic shift in club financial dynamics, but I'm guessing the thought has popped into some people's head. In case you were wondering I'll just give out a few of the reasons that pushed us in this direction. We are an official 501(c)3 Non-Profit organization and we heavily focus on education, this is the primary reason students fly free. We also believe that people that have a membership to the club have a sense of ownership, which is exactly the concept we were trying to attain. Roger and I started this club over two decades ago and I truly believe that our success was driven by the membership each year grew and felt an ownership to the club and actively participated/donated their skills to make us a better group. Everyone has a unique skill to add and we welcome it all to continue to grow. Another major reason we are removing all launch fees for our active members is to encourage everyone to come out to the launches even if the forecast is questionable for optimal flying. I completely understand the hesitation of driving out to a field, paying \$15 for the day and watch the clouds, wind, etc. roll in that prevents you from flying a single thing.... These days are always frustrating. I still remember some of our amazing flying days that started with a storm that rolled through for an hour, or a field that was so snow-covered preventing access was followed by members with 4 wheel drive making several passes to allow us to access. The dedication and attendance are what makes us do what we do, and we want everyone to show up if it fits their schedule.

Will this new model work for us as a club? I wish I could answer that, but alas time will tell all. I have very high hopes for a successful flying season with a reduced fee structure from our business model. If everyone can attend every launch that fits your schedule even if it is only for part of the day we would love to see you on the field!

**On the Cover:**

(top) *The Martin X-24B Lifting Body over Edwards AFB - NASA photo (bottom left) Dave Glover's "Starliner" scratch-build from a 1956 ad (bottom right) The Hughes XAIM-54A Phoenix air-to-air missile located at the Air Zoo Museum in Kalamazoo, MI - Chris Timm photo*

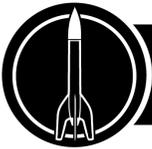
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- |                    |                            |
|--------------------|----------------------------|
| Concept Mini \$119 | Concept X-treme \$325      |
| Concept \$285      | Ground Pounder \$345       |
| TARC Pad \$285     | Ground Pounder Heavy \$425 |
| +Shipping          |                            |





# TRACKIMO 3G: A ROCKET-FINDING SOLUTION THAT WORKS

HERB CRITES

As the last line of defense against losing a prized, expensive rocket, for just over a year I've used the [Trackimo 3G](#), a cell phone-based GPS tracker. It works by regularly sending its GPS location to Trackimo's central server over the 3G GSM mobile phone network. In turn, Trackimo's server relays the 3G Tracker's data to your Internet-connected PC or tablet by way of their web page, or to your smart phone via the Trackimo Apple or Android app and your mobile carrier. For rocketry, the "go anywhere" smart phone capability is quite literally the Trackimo's *killer app*.

walking forward, making any course corrections needed to avoid obstacles. When the two symbols coincide, you're there!

If you still can't see the rocket due to thick foliage, for example, then remotely activating the tracker's Blue Tooth radio via the app's top-right "radar screen" button (older app)--or selecting "Nearby Devices" from the top-right *Account Settings* menu (newer app)--and okaying the Trackimo prompt to enable BT on the phone, will enlist your phone *directly* into the search for your Trackimo 3G as a *Blue Tooth device*.



Figure 1--The Trackimo 3G is a small, lightweight GPS tracker that leverages the GSM communications network and a smart phone app to report its position anywhere on the mobile-connected parts of our planet you—or your rocket—might send it.

The Trackimo device's location-update interval is user-adjustable from 1 minute to 2 hours, depending on how much tracking longevity the user requires before the battery depletes. I've found that full charges yield about 2-1/2 to 3 days of location reporting on the most frequent, once-a-minute update setting.

On a GSM-covered rocket range, the live Trackimo smart phone/tablet app for iOS or Android allows you to very easily orienter directly to your rocket's touch-down location. Superimposed on the Google Maps-provided, user's choice of either a map or satellite view of the local terrain, a blue dot represents your GPS-enabled smart phone's real-time location. If you and your mobile phone are moving, the blue dot sports a direction-of-movement arrowhead, too. The Trackimo-carrying rocket shows its last-reported location as the tip of an orange pointer symbol filled with one of many available, user-selected icons.

It's easy to manipulate the Trackimo app's terrain/map view, even on a compact smart phone. Here are a few of the basic moves that work on both my Apple and Android devices...

### Sizing and Orienting the Trackimo Smart Phone App's Touch Screen Map

Fingertip Gesture	Movement
One-Finger Touch and Move	Drags the view in any direction, maintaining same orientation
Two-Finger Touch and Rotate	Reorients the view's default top is north compass direction
Single-Finger 2-Tap	Zooms IN by increment at point tapped
Two-Finger 1-Tap	Zooms OUT by increment at point tapped
Two-Finger Spread	Zooms IN proportionally
Two-Finger Pinch	Zooms OUT proportionally

To recover a lost rocket, first locate its orange Trackimo symbol on the Trackimo app. Orient your phone's video screen (or rotate the map) to north by using terrain association, the sun, or (probably best) a separate compass app in your mobile phone (if so-equipped). Determine the correct heading from your own location (blue dot) to your rocket (Trackimo symbol). In Figure 2's case, this would be about 2 o'clock. Face that same direction, keeping the map image on the phone aligned with north. Start

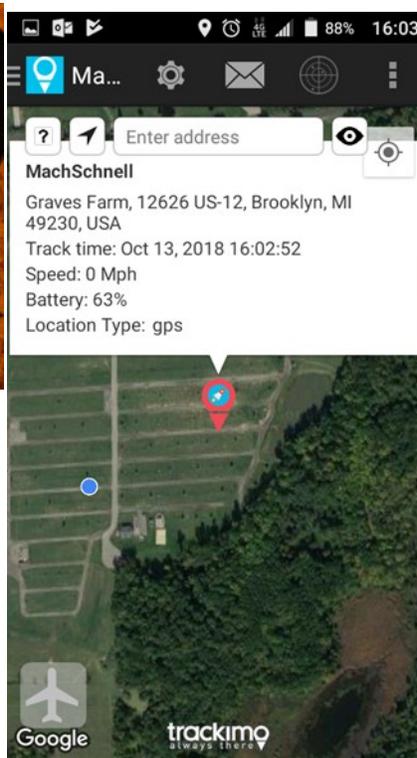


Figure 2--User's location (shown here at JMRC's Graves Farm rocket range) is depicted on the Trackimo app as a blue dot, adding a direction pointer to the dot if the phone and user are moving. An orange Trackimo symbol represents the Trackimo 3G's (and rocket's) last reported location. Tapping on the orange symbol invokes the bubble above it, revealing a wealth of tracking data. (Note--Previous Trackimo app for Android shown.)

Upon detection, the Trackimo app will display the *Nearby Devices* window (Figure 3), estimating the distance in meters (but *not* direction) to that device, based on its signal strength. Just walk slowly in various trial directions or a widening spiral until the indicated, estimated distance begins to decrease or increase. (Sort of like you'd respond to the "cold, warmer, warmer" clues in a game of blind man's bluff.)

If your rocket *STILL* eludes you, the Trackimo's got one last trick up its sleeve to help you reveal its hidden host. Tapping the speaker button found on the Trackimo app or web site orders the tracker to emit four soft beeps, usually after about 10 seconds of issuing the command. Listen carefully for them, and repeat the process as often as needed until it's found. The beeps are faint though, and probably inaudible when the Trackimo is properly packaged in the payload bay for a flight. A loud, external speaker is what's

really needed to make this feature a viable one for rocketry. Until Trackimo builds one, adding a separate screamer to your missile is a good fallback for the close-in search.

Trackimo's central server retains each tracker's history for one year in a secure, user-searchable database, a nice feature that adds considerable value to the \$5 per month/\$60 annual fee. Figure 4 shows a screen shot of the history function. This example shows my Trackimo account as accessed through a PC and web browser, providing a more spacious and easier way to adjust the tracker's settings, operation, and data searches than through the smart phone app. Figure 4 shows each of the the one-per-minute locations my Trackimo recently logged at the very first Michigan Team 1 Birch Run launch, including the Trackimo's sole rocket ride of the day. (An on-board video clip of its flight is

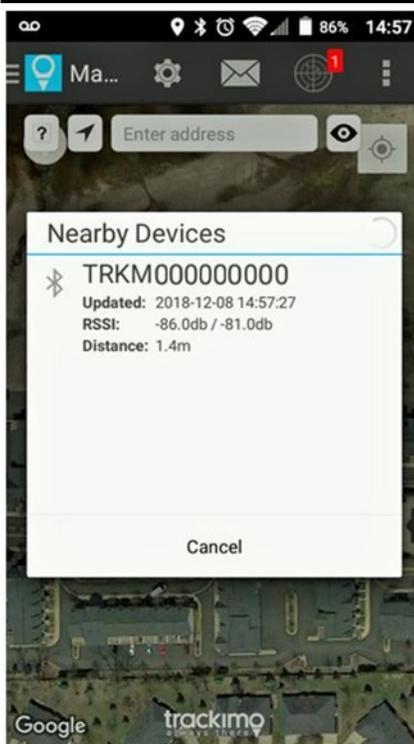


Figure 3--To home in on a lost rocket in the last 10 to 60 feet, the Trackimo tracker can be remotely ordered to turn on its Blue Tooth receiver/transmitter to allow the user's phone to directly search for and locate it, like as when one pairs a new BT device to a mobile phone. Once the two connect over Blue Tooth, the Trackimo app estimates and reports the approximate distance that still separates rocket from phone. (Note--Previous Trackimo app for Android shown.)

available [here](#).)

The red "S" dots show where the device was stopped for some period of time (there's a bunch at my parking spot/rocket prep table at the top; one at the high-power launch pad just below and left of the upper bunch; and the lowest one is where the rocket landed upon its return to Earth). Yellow dots mark locations that were logged while moving. You can see on the southern-most S-dot, described in the panel to its left, that my rocket laid in the grass for some five minutes (3:08 to 3:13 pm) before I walked it back north (the three yellow way points) to my parking spot.

For comparison, look at two of these same Trackimo-reported spots—my parking spot and the high-power launch pad—against their actual locations on the ground that the rocket's video camera recorded, shown in Figure 5. **Dead-on accurate**, I'd say.

Fortunately, where my rocket touched



Figure 5--Compare this same-day (18 August 2018) overhead photo of the rural Birch Run rocket range to the tracking history provided by the Trackimo app in Figure 4. The accuracy of the day's reported locations--spot on.

down, it was easily visible. But only a few meters to the east was a lush field of knee-deep soybeans, and just across the road to the north, was a notorious, 6-foot corn field. It was reassuring to know this precise, reliable, no-guesswork-required tracker was on board for that flight.

Now no tracker solution is perfect, and Trackimo, particularly the older, weaker, 2G version, is no exception. At one JMRC launch at Michigan International Speedway, one of my Trackimo 2G-equipped rockets landed in a nearby field's low spot apparently lacking line of sight to a 2G cell tower. The Trackimo 2G correctly sensed its GPS location, but was incommunicado with the GSM cell phone network...until I found my rocket the old-fashioned way and lifted it from the shallow depression it had landed in, immediately restoring its mobile device comms.

But down in Texas at an earlier launch with an Austin club (whose rocket range had much better 2G GSM coverage), I successfully located a lost, Trackimo 2G-carrying rocket that had landed deep into a dried-out corn field. Guided by the Trackimo app on the wife's iPhone, I arrived at the designated corn row—but the bird was still not to be found. But walking an additional short, outward spiral for two revolutions from that spot quickly brought me to the place where my rocket had landed, invisibly, in the thick maze of maize. **Everything**—rocket, rigging, and chute—was hugging the ground, and none of it was draping any of the man-tall corn stalks. I would have never have located that bird, but for the Trackimo tracker and its app that we had installed earlier on my very understanding and reasonably patient wife's iPhone.

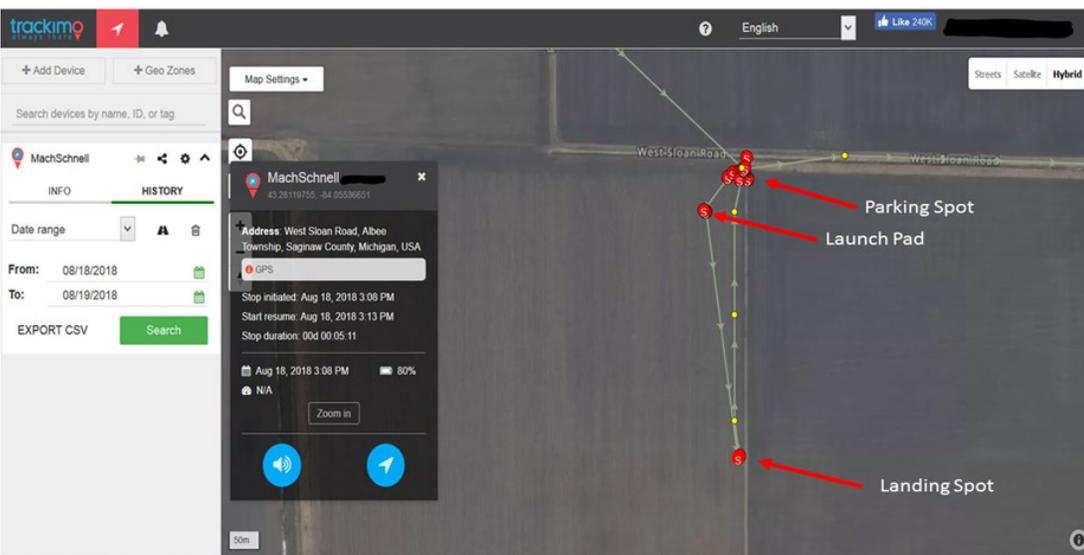


Figure 4--The searchable history function, shown here as it's more spaciouly rendered by a PC and monitor logged in to the user's account on the Trackimo web site, adds quite a bit of value to the Trackimo's \$5 per month subscription fee. Red "S" spots show where stationary locations were logged, while the yellow dots indicate a position that was logged while moving. Clicking on any of the way points reveals its date, stop and start times, ground speed, Lat/Long location, battery charge reading, and stop duration data, depending on the type of way point. History searching is also available using the Trackimo app for iOS and Android on a Wi-Fi or GSM-connected mobile phone or tablet.

Since then, I've replaced my 2G Trackimo (which was unfortunately consumed in a K-motor cato) with the latest 3G model, and the performance of the newer device has been nothing short

of stellar. I've tested the Trackimo 3G's performance in several launches where it wasn't actually visually lost, but I imagined it was. In every test, the Trackimo 3G quickly and accurately led me to the rocket's exact landing spot. And the issue I had (only once) with the 2G's GSM connectivity has never been repeated by the Trackimo 3G. *This* model really is ready for prime time.

The Trackimo 3G's size is small, about 1-3/4" x 1-1/2" x 3/4", and it weighs about 42 grams. It fits easily into a 54mm airframe, like the one below. I load mine, sealed in a Ziploc bag for moisture protection (it's NOT waterproof), into a well-forward payload bay that's cushioned with foam fore and aft. (The placing of the Trackimo's GSM transmitter some distance away from the Stratologger altimeter and a Mobius camera is intentional, just in case the Trackimo's radio signals might interfere with the other components' functions.)

The Trackimo 3G's cost is about \$200 (\$160 during Trackimo's occasional sales), including 1 year of cell service. Subsequent years are \$60 for 12 months of service. And it has other handy uses between launches. I use it while cycling to trace and record the routes I've gone, and I plug it into DC power when I'm traveling by car between here and Texas, so that my loved ones can track my journey.

If you decide to purchase a Trackimo 3G, be certain what you're buying is 3G. And if it is a 3G, that it's the *current* Trackimo 3G model. A few sellers on e-bay appear to selling the soon-to-be-obsolete 2G version, often for under \$100. Summit Racing and Crutchfield are offering a \$124 and \$149, respectively, Trackimo 3G—but it's the now-discontinued, circa 2015, first-generation 3G.



Figure 6--The compact and lightweight Trackimo 3G fits easily into a 54mm diameter payload bay (like this one), or larger. Because the Trackimo 3G isn't waterproof, seal it inside a water-tight Ziploc bag before mounting it in your well-padded payload bay.

The 2G model is the one that gave me fits at MIS when it lost its mobile phone link at the critical moment. Those 2G towers are getting very few and far between these days—especially way out in the boondocks we rocketeers frequent. And reportedly, only T-Mobile continues to support 2G in the US. So, steer clear of the 2G "bargains." When 2G expires, so will the Trackimo 2G .

And while those 2015-vintage Trackimo 3G trackers probably won't suffer the 2G's mission-critical connection problem, nor face 2G's imminent demise, they won't have the Bluetooth-driven, close-in navigation feature, limited though it is, that the current 3G version does. Nor do early 3G Trackimo trackers provide Wi-Fi geolocation as a GPS backup, only the much less accurate cell tower triangulation scheme. Bluetooth and Wi-Fi are features that are *only* available in the *current* Trackimo 3G model...and it's only available for purchase on the [Trackimo web site](#) as of this writing.

So how to know you're buying a 3G and not a 2G? And how can you tell that the 3G you may have found is an *up-to-date* Trackimo 3G, with all the killer features? Simple. According to the Trackimo technician with whom I spoke, in both cases, it *must* say "3G" on the face plate just below Trackimo. *No "3G", no sale, is my advice.*

In short, the contemporary Trackimo 3G's got a lot of advantages.

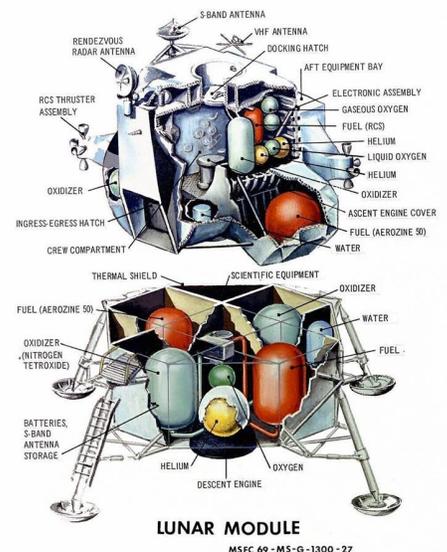
- Extremely easy to use.
- Well-supported by a very elegant, intuitive-to-operate family of Google Maps-based apps for smart phones, tablets, and PCs.
- Has an impressive list of features, and boasts leading-edge GPS, Bluetooth, Wi-Fi, and GSM electronic components.
- The Trackimo server maintains a secure, searchable, historical record of every location a Trackimo tracker has logged for the last 12 months.
- Though not waterproof, it is very solidly constructed for its low mass, and with proper payload bay cushioning should withstand the G-forces and hard knocks that rocketry typically dishes out.
- It has the practical size, weight, form, and security-related features that suit it for many non-rocketry pursuits, like cycling, hiking, travel, loss- or theft-recovery measures, and wandering pet, child, or elder safety.
- Reliably connects to the 3G GSM network on par with the best and latest 3G and 4G mobile devices. *And this technology continues to improve its coverage and expand its service footprint all over the world.*
- And at just under \$200, Trackimo 3G is still fairly inexpensive as tracking solutions go. The potential loss of the airborne component of any tracking solution must be part of the risk/cost/benefit analysis...especially considering all the towering, 100-year-old oak trees and deep lakes our rockets occasionally retire to here in Michigan.



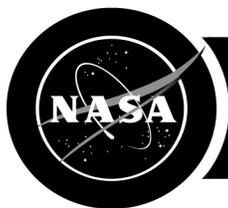
Figure 7--Be sure the Trackimo you're thinking about buying displays the "3G" designation, indicating it's the latest model.

But, in my view, the attribute that stands above every other consideration is also the simplest one...the Trackimo 3G has proven itself a tracking solution that **works** in quickly locating a lost, prized rocket.

Good skies,  
Herb Crites  
NAR, TRA Level 2



LUNAR MODULE  
MSFC 69-MS-G-1300-27



# NASA'S LIFTING BODY PROGRAM

PART 3

Buzz Nau

## X-24A

At the dawn of the space race, the US Air Force, seeing earth orbit as an extension of their domain, began developing manned space orbiting programs. Having Sputnik orbit the earth every 90 minutes was a constant reminder that the potential arena of war had just increased exponentially.

Hypersonic and Lifting Body wind tunnel research by Alfred Eggers at the Ames Research Center in the 1950's influenced the direction that the US Air Force would take in entering this new theater of operations. Ballistic capsule type re-entry vehicles were discarded early on. The key advantage of capsules was their simplicity, but they had several drawbacks that winged and lifting body vehicles addressed, mainly pilot-controlled recovery and vehicle reusability. Most of the early USAF development programs were winged projects like the X-20 Dyna-Soar and ASSET (Aerothermodynamic/elastic Structural Systems Environmental Tests). Winged configurations were at the middle ground of complexity between lifting bodies and ballistic capsules.

In August of 1960 the USAF initiated a development program for an unmanned, maneuverable recovery vehicle for the SAMOS reconnaissance satellite. In November 1960 the Martin Aircraft Company (becoming Martin Marietta Corporation in 1961) was selected to design a lifting body for the program. By the end of 1963 Martin Marietta's designer Hans Multhopp had developed the SV-5, a "blunt" lifting body design that resembled a potato with fins. Multhopp had been an aerodynamist at Focke-Wulf during WWII and was the chief designer of the sweptwing Ta-183. At this time the Air Force established another program, START (Spacecraft Technology and Advanced Reentry Tests) that was divided into separate manned and unmanned sub-programs. PRIME (Precision Recovery Including Maneuvering Entry) was an unmanned project to investigate the re-entry hypersonic envelope and PILOT (Piloted Low-Speed Tests) was the manned atmospheric transonic to landing project. The Martin Marietta SV-5 design was selected for both projects, the SV-5D/X-23A for the unmanned PRIME vehicle and the SV-5P/X-24A for the PILOT pro-



X-24A on the ramp at Dryden Flight Research Center - NASA photo

ject. About this same time the M2-F1 was undergoing flight tests and the USAF had cancelled the X-20 Dyna-Soar.

Four X-23A vehicles were built and three were flown between December 1966 and April 1967 aboard Convair Atlas boosters. The first flight attempted only pitch maneuvers once it reentered the atmosphere. The vehicle was lost when the attempt to recover it by aircraft failed. The second flight in March 1967 performed bank maneuvers at hypersonic speed successfully, but again, the vehicle was lost this time from a failure of the floatation gear. The third flight was a complete success and at sea recovery of the vehicle. Because of the excellent data gathered from the third flight, the fourth was cancelled as a cost saving measure.

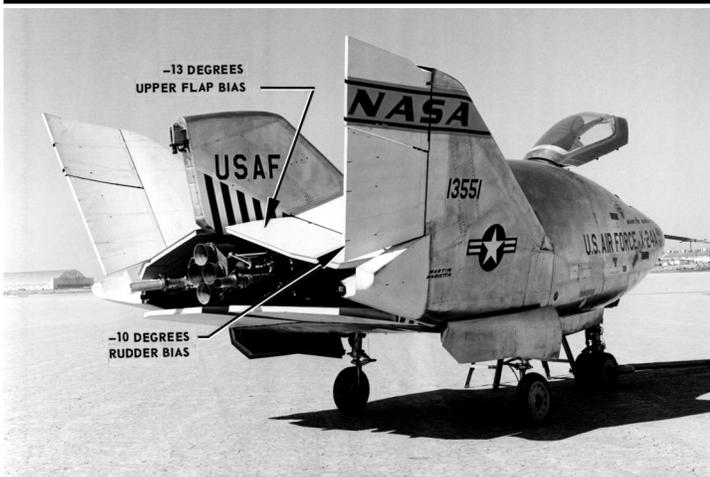
The manned SV-5P design went through several refinements during which modifications to the outer fins were made to improve airflow over the control surfaces and a central fin was added. The first mod was later added to the HL-10 and second one to the M2-F2 during its transition to the M2-F3. The final SV-5P/X-24A design would have several advantages over the M2-F2 and HL-10 including better hypersonic and subsonic lift to drag ratios. It also flew at a lower angle of attack when landing which would improve pilot visibility significantly over other lifting body vehicles.

The SV-5P construction was ordered on 2 March 1966 and on 11 July 1967 the aircraft was designated the X-24A. On 24 August 1967 it was delivered to Edwards AFB where the M2-F2 and HL-10 were still active programs. Like previous lifting bodies, the X-24A would be a joint NASA / US Air Force flight research operation. After delivery it went through the usual instrument installation and trip to Ames for wind tunnel tests. This preparation work was complete by March 1968 and the X-24A was cleared for glide testing. After low and high-speed taxi tests with the peroxide and XLR-11 rockets as well as captive flight tests attached to the B-52 Mothership, the finned potato was ready for flight.

During the design of the SV-5D and SV-5P a third version was also introduced in response to a request from Chuck Yeager for a jet powered lifting body vehicle for test pilot training.



X-23 PRIME mounted atop an Atlas booster - NASA photo



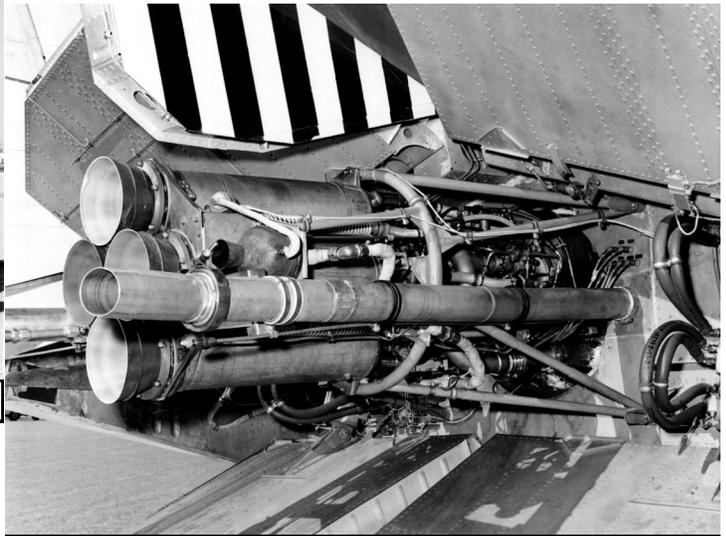
X-24A control surfaces - NASA photo

Northrup had spent a short amount of time looking into the request and dropped the idea after discovering the amount of thrust required to safely fly the M2-F2 or HL-10 under jet power. The SV-5J was Martin's proposal for Yeager's request and they were prepared to build and test fly one. Martin reached out to NASA test pilot Milt Thompson to see if he was interested in test flying the SV-5J. Thompson was a veteran test pilot in the lifting body program having flown the M2-F1 and M2-F2. Thompson's boss, Dryden Flight Research Center Director Paul Bikle was prepared to give Milt a leave of absence to make the flight, but Thompson wasn't convinced the vehicle would be safe, especially since Northrup was so quick to drop out. He was invited to Martin's home office in Baltimore, MD to discuss the proposal and try the SV-5J simulator. In the simulator he found the aircraft terribly underpowered and difficult to get off the ground with the gear retracted before it settled back down on partially retracted gear. He warned the Vice President of the project before leaving that the aircraft was too underpowered and would damage Martin's reputation. He had a favorable impression of the X-24A, but not the jet powered version.

After returning to Edwards, hoping the project would be forgotten, he received several calls asking him to quote a price to make the flight. Not interested in flying it, he finally gave them the ridiculous amount of \$25,000 which was a year's pay for Thompson at the time. Worried that Martin would take him up on it, he told Bikle that he would put a 2x4 across the runway about a mile and a half from the end of the runway and aim for it causing the SV-5J to bounce in the air. If it continued flying, he'd raise the gear and continue going, but if it settled then he'd land it and ask for his \$25,000 since he hadn't mentioned anything about a duration of the flight. Fortunately, there was no reply on his offer and the SV-5J was forgotten.

Jerry Gentry made the first glide flight of the X-24A on 17 April 1969. A successful practice landing flare was made at altitude, but later in the flight lateral (pitch) sensitivity was discovered at high speeds reminiscent of the M2-F2 control problems. Gentry reduced his landing speed and used the peroxide (instant lift/drag) rockets during the flare for a successful landing. Postflight analysis indicated the problem was due to an error in the aileron-to-rudder interconnect electronics. This was resolved and a second flight was made by Gentry on 8 May 1969. The interconnect worked correctly, but he still sensed lateral and rolling motions on final approach. The peroxide rockets were used again to assist in the landing flare. Like the previous M2-F2 and HL-10 programs, there appeared to be stability issues right at the forefront of X-24A flight tests. A joint investigation involving USAF and NASA engineers investigated the problem. The main cause of lateral sensitivity was faulty wind tunnel data due to airflow interference over

control surfaces from the support struts. This resulted in several control settings being incorrectly programed. Light turbulence was the suspected culprit for the rolling motions during landing.



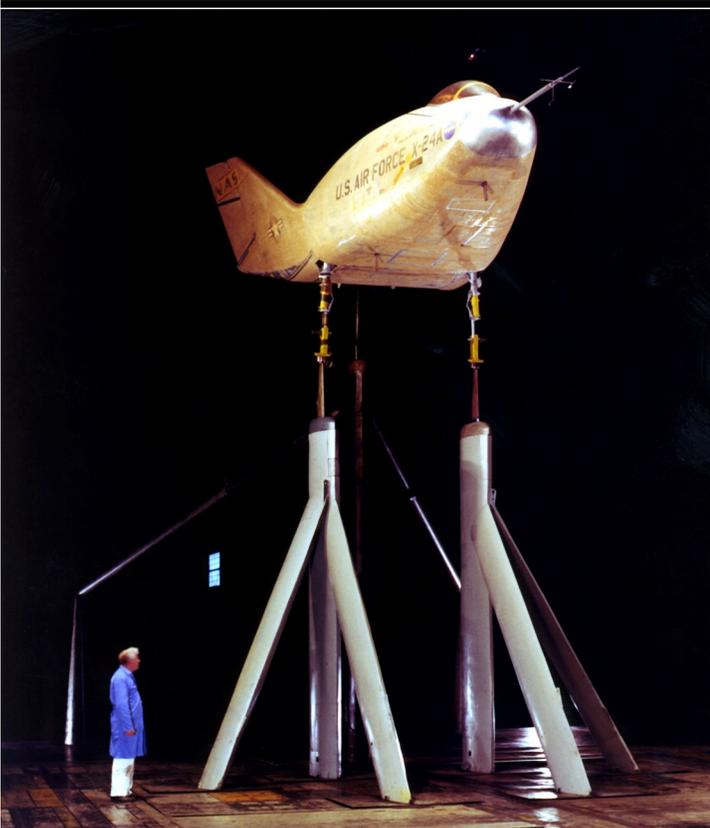
XLR-11 Rocket Engine - NASA photo

The third glide flight was made on 21 August 1969 where Gentry was inadvertently launched when a new B-52 pilot engaged the wrong switch for arming the launch but triggered the launch instead 45 seconds early. Despite the early drop and lack of flight film (the cameras weren't turned on until 30 seconds before launch) the flight was a success as Gentry did not experience the same control sensitivity that he did on the first two flights. Six more glide flights were made, all but one by Gentry. Flight six was flown by John Manke and the last glide flight was made on 24 February 1970.



X-24A on the dry lake bed - NASA photo

Jerry Gentry made the first powered flight on 19 March 1970 using two of the four XLR-11 chambers to reach 44,383 feet and Mach 0.865. The second powered flight was made by John Manke on 2 April 1970. This time three of four chambers were used pushing him to Mach 0.866. After these shakedown flights the next goal was transonic testing. The third powered flight on 22 April 1970 used all four chambers and Gentry flew the X-24A to Mach 0.925. The following flight by Manke on 14 May 1970



X-24A mounted in the Ames Research wind tunnel. Simulated ablative covering is coated on the airframe - NASA photo

suffered the first problems with the XLR-11 engine in the X-24A program. Only two chambers lit forcing him to fly an alternate test profile. Manke followed that flight up with a successful one on 17 June 1970 hitting Mach 0.99. The only significant stability concerns during the powered flights was a pitch trim issue in the transonic region. After eliminating engine misalignment as a possible cause, it was concluded that the rocket plume was causing flow

separation issues with the tail control surfaces. Nothing could be done with the vehicle to solve this issue, so it was remediated by flying at a higher angle of attack. This resulted in lowering the X-24A's top speed from a predicted Mach 1.8 to 1.7.

Jerry Gentry was to make the first supersonic flight attempt on 26 August 1970, but XLR-11 engine problems and a fire in the tail from jettisoned fuel thwarted the mission speed goal. Repairing the fire damage set the test flight schedule back six weeks and the next supersonic attempt was made on 14 October 1970 with John Manke as the pilot. It was also the 23<sup>rd</sup> anniversary of Chuck Yeager's first supersonic flight. This time everything worked correctly and Manke flew the X-24A to 67,900 feet and Mach 1.186. Manke followed that flight up with an equally successful supersonic flight on 27 October 1970 with a top speed of Mach 1.357 and altitude of 71,407 feet. His descent profile simulated the Space Shuttle where he made a precision landing, supporting the validity of unpowered landings for the orbiter.

Subsequent flights researched the vehicles limits in various speed, control setting, and angle of attack configurations. Jerry Gentry made his last X-24A flight on 20 November 1970 before transferring to a Vietnam combat assignment. He was replaced by Air Force Major Cecil Powell.

Like the M2-F2 and HL-10, the X-24A was plagued with XLR-11 problems that impacted several flights. These problems eventually ended the X-24A flight program early. The vehicle made a total of 28 flights, 10 glide and 18 powered. The maximum speed reached was Mach 1.6 and max altitude was 71,400 feet, both reached by John Manke. In terms of handling, the X-24A was considered as good as the HL-10 by the pilots. The story of the X-24 does not end here. On 15 December 1970 the vehicle was airlifted to Martin Marietta's Denver facility for a make-over.

### X-24B

Dryden, Ames, Langley, and Martin Marietta were not alone in lifting body research. The Air Force Flight Dynamics Laboratory was also investigating hypersonic vehicles and had developed several lifting body shapes with a hypersonic lift to drag ratio of 2.5 to 1 or better (typical lifting body L/D ratios were in the 1.4-1.2 to 1 range at hypersonic speeds). This would allow for a reentry recovery area size in the range of Alaska to



X-24B lands while shadowed by a F-104N chase plane - NASA photo



Test Pilot John Manke and the X-24B - NASA photo

Greenland..... huge. The laboratory needed to test the design in the transonic to subsonic region and originally looked at creating an airframe "glove" to fit on one of the Martin SV-5J trainers but withdrew that idea. Instead, the Flight Dynamics Laboratory issued a development plan for a similar aircraft to be launched by NASA's B-52 rather than go with the ground launched option. Further investigation revealed it was easier (and cheaper) to convert the existing X-24A instead of a jet powered trainer since the X-24A was already fitted with the XLR-11 rocket engine. Paul Bikle endorsed the program in August 1969 and NASA program manager John McTigue injected \$550,000 to the Air Force Flight Dynamics Lab to compete the proposal. After the X-24A made its final flight on 4 June 1971 the program began preparing for the vehicle's transition to the X-24B by removing test equipment and the XLR-11 before shipping the airframe back to Martin Marietta.



X-24B on Rogers Dry Lake Bed - NASA photo

-52 in preparation for glide flights.

After an aborted attempt on 24 July 1973, the X-24B made its first glide flight on 1 August 1973 with John Manke at the controls. The drop altitude was at 40,000 feet and Manke made a successful practice landing maneuver at 30,000 feet. The entire test flight was nominal and lasted 4 minutes and 11 seconds. The second glide flight was made on 17 August 1973 where various control configurations and trim settings were checked successfully.

Prior to the first powered flight a test was required on the new fuel dump location. Flight Dynamics Laboratory engineers were aware of the fire issues during the M2-F2 and X-24A flight programs and investigated a new fuel dump location based on wind tunnel data. This was to prevent jettisoned fuel from being redirected into the base of the vehicle and starting an after-engine fire. The new location was at the side of the right fin above the aileron. On the third glide flight a small amount of alcohol-water fuel would be loaded and jettisoned during flight. John Manke was at the controls on 31 August for this flight. When he opened the fuel jettison the aircraft rolled right requiring 70% aileron throw to compensate until the fuel was jettisoned and then the vehicle returned to normal flight control. The dump was then relocated to the back of the right fin, so it dumped the fuel directly aft. A fourth glide flight confirmed the new location performed well and did not induce any control issues. Major Mike Love had replaced Cecil Powell in the program and made the fifth glide flight and his first in a lifting body.

After two aborted attempts, the first powered flight took place on 15 November 1973. John Manke used three XLR-11 rocket chambers to reach Mach 0.917 and followed that up on 12 December 1973 maxing out at Mach 0.993. Both flights also acquired stability and control data. There were no further flights in 1973 and the next flight was Mike Love's second glide flight on 15 February 1974. On 5 March 1974 the first supersonic flight was made by Manke, reaching Mach 1.086.



X-24B Instrument Panel - NASA photo

The ten-month metamorphosis was completed at Martin's Denver facility and the vehicle was returned to Edwards on 24 October 1972. The X-24 no longer looked like a potato with fins. Instead, the X-24B had the appearance of hypersonic speed just sitting on the ramp at Dryden. It still had a rounded upper body, but a long wedge nose replaced the blunt body of the X-24A. The wedge shape also replaced the rounded lower body with a flat shape that extended out to winglets. Test equipment and the XLR-11 rocket engine were reinstalled, ground taxi runs were performed as well as a couple of captive flights aboard the B



*Bill Dana after the last X-24B powered flight sporting his renowned pink boots (23 September 1975) - NASA photo*

After Manke's supersonic flight an "overdrive" switch was installed to boost the XLR-11 chamber pressure to increase thrust from 8,600 pounds to 9,800 pounds. Manke tried it first on his 24 May 1974 flight, but one chamber failed to light degrading the expected performance. Love followed up on 8 August 1974 reaching Mach 1.54 and Manke again on 29 August 1974 where a split fuel tank caused the engine to shut down early. The aircraft was grounded for two months for repairs.

When the X-24B returned to flight on 25 October 1974, Mike Love hit Mach 1.752 which would be the fastest speed at-

tained by the vehicle and second only to the HL-10 for all lifting body vehicles. The remaining flights of 1974 and 1975 had similar goals of testing stability and control envelopes for the vehicle. However, between 25 October 1974 and 6 June 1975, Manke and Love also attempted landing on a marker on the dry lake bed to see how precise they could touchdown the X-24B. The nine flights during this period showed they could land within 500 feet of the mark. This data was used to convince leaders at the Flight Dynamics Laboratory, Dryden Flight Research Center, and the US Air Force Flight Test Center Commander that the X-24B was capable of landing on Edwards 15,000-foot concrete main runway. This was a test that had never been done with a rocket powered research aircraft and would be valuable data for the Space Shuttle program.

Approval was given and planning ensued including Manke and Love making simulated X-24B landings on Edwards main runway using T-38 and F-104 aircraft. Manke alone flew over 100 simulated approaches. On 5 August 1975, John Manke made the first runway landing. After dropping from the B-52, only three of the four XLR-11 chambers lit forcing a three-chamber flight profile where he reached Mach 1.19 and 57,050 feet. His touch down target was a stripe painted on the runway 5,000 feet from the approach end. One of the main gears touched down 5 feet before the stripe and the other main touched down just after it. Love made the next runway landing touching down 400 feet past the stripe. In general, the pilots felt the runway landings were easier due in part to the additional field of view queues you get from objects surrounding the runway. These queues assist pilots in gauging their altitude during the flare for landing.

The runway landings also used a different flare procedure than that used on the dry lake bed. A pre-flare would be initiated at 1,000 setting the glide slope to 3 degrees. Just before landing another small flare would be made before touchdown. This two-step flare was a procedure adopted by the Space Shuttle for landings.

Bill Dana made the final two X-24B powered flights reaching Mach 1.48 on the first flight. His second flight on 23 September 1975 only three XLR-11 chambers lit. This officially ended the X-24B and Lifting Body test program. Three pilots, Einar Enevoldson, Tom McMurtry, and Francis Scobee made familiarization glide flights afterwards with the last one occurring on 26 November 1975.

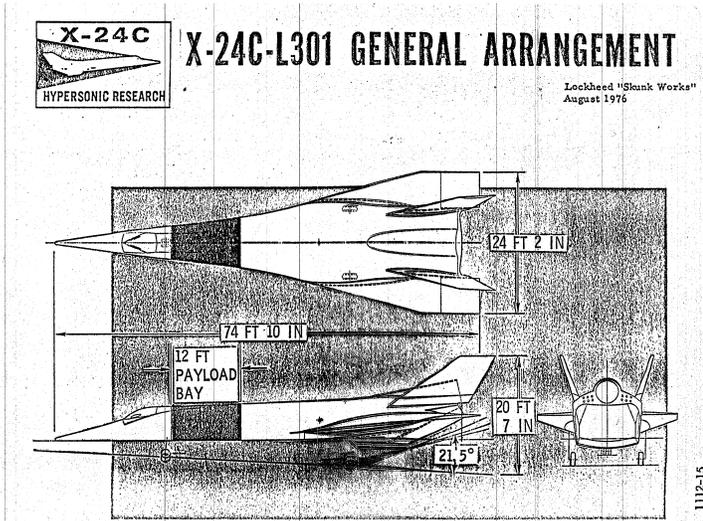
The X-24B made thirty-six research flights and benefited greatly from the lifting body vehicles that preceded it. Pilots



*X-24B Pilots (l-r) Einar Enevoldson, John Manke, Richard Scobee, Tom McMurtry, Bill Dana, and Mike Love - NASA photo*

commented that the handling was superb and that it was an easy aircraft to fly. It suffered, as did all the other powered lifting bodies from the finicky XLR-11 rocket engines which were the cause of most in-flight issues throughout the program. The X-24B now resides at the Wright Patterson Air Force Museum in Dayton, OH

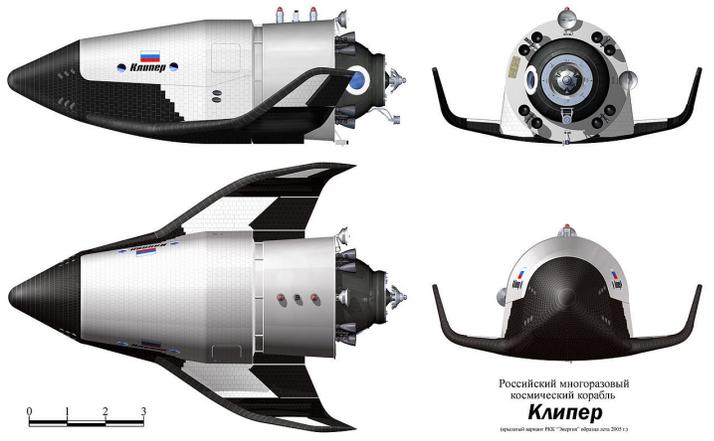
The Lockheed L-301, aka X-24C was considered as a continuation of the lifting body program. The design was based on the same Flight Dynamics Laboratory research as the X-24B but would be powered by a new rocket motor and scramjet engine allowing it to operate in the hypersonic range. The L-301 was to reach Mach 8, but development was cancelled due to funding.



**Beyond the X-24**

Lifting Bodies did not end with the conclusion of the NASA program. The Scale Composites X-38 was an experimental lifting body, similar in shape to the X-24A and developed as a crew rescue vehicle for the International Space Station (ISS). The program ran from 1995 to 2002 which included the design and construction of three prototypes. The ISS crew was limited to the available reentry vehicle capacity, which at the time was three due to the limits of the Russian Soyuz TMA capsule. The X-38 program was co-sponsored with the European Space Agency (ESA) and the German Space Agency (DLR) and would have allowed the automatic return of up to six ISS crewmembers. In the case of an emergency, the crew would egress the station via the X-38 which would de-orbit and glide back to earth. The landing would be performed by deploying a steerable parafoil. The program was cancelled in 2002 due to ISS cost overruns even though the first space deployed prototype was nearly complete. Another lifting

body program aimed at supplementing the Soyuz TMA capsule was the RSC Energia Kliner. Proposed sometime in the early 2000's it was a cancelled in 2006 also due to a lack of funding.



RSC Energia Kliner - Unknown source

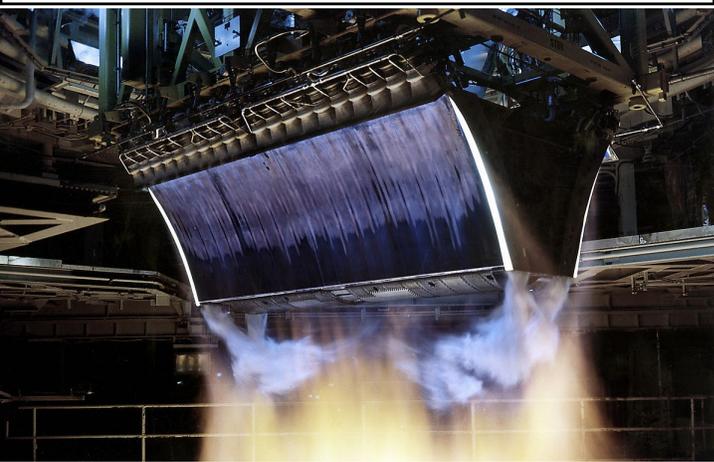
In 1996 NASA awarded Lockheed Martin with a contract to develop a space vehicle capable of reducing payload costs from \$10,000 per pound to \$1,000. The X-33 was the half-scale demonstrator vehicle for the program's planned technologies. Named VentureStar TM by Lockheed Martin, the prototype was a single-stage-to-orbit (SSTO) lifting body design powered by aerospike engines. The program was cancelled in 2001 because of development problems with construction of the composite fuel tanks.



(top) X-33 Reusable Launch Vehicle artist conception - Lockheed Martin (bottom) X-33 Aerospike engine test - Lockheed Martin



X-38 drop from NASA's B-52 Mothership - NASA photo





BAC MUSTARD - Source unknown

Lifting body programs outside the United States include the BAC Mustard (Multi-Unit Space Transport and Recovery Device). The development project occurred in the mid-1960's and involved three identical blended wing body vehicles combined to perform different functions during launch (booster or orbital vehicle). The design was based on the Douglas Astro, a USAF proposal that was similar to the Mustard in flight profile but would only include a pair of vehicles combined into a single launch to orbit system instead of three. Neither program progressed past the drawing board.



SNC Dream Chaser landing after first glide flight - NASA photo

The most recent lifting body program is Dream Chaser by Sierra Nevada Corp. It is currently a development program for a manned resupply vehicle to the ISS that will be launched to orbit by an Atlas V or Ariane 5 booster. The program began in 2010 and loosely resembles the Northrup HL-10. The Dream Chaser was dropped from NASA's Commercial Crew Development program which currently includes the Boeing Starliner and Space-X Crew Dragon. However, SNC received funding from NASA within the Commercial Resupply Services program and is guaranteed a minimum of six launches. Dream Chaser made its first glide flight successfully on 11 November 2017. In December 2018, SNC received NASA approval to begin full scale production of the Dream Chaser with an expected first flight sometime in 2021.

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X-24B in flight over Roger's Dry Lake Bed - NASA photo

# X-24A/B Photos



X-24A powered flight - NASA photo



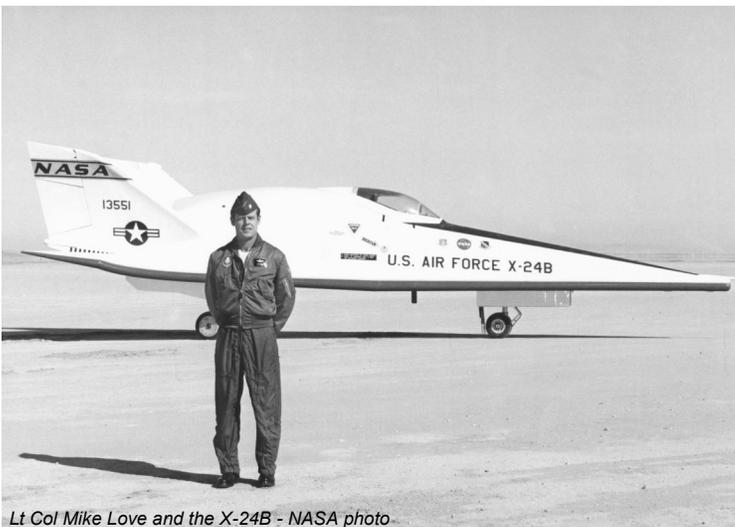
X-24B on dry lake bed - NASA photo



X-24B landing on dry lake bed with F-104N chase plane- NASA photo



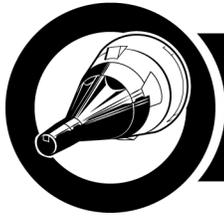
Maj Cecil Powell and X-24A on dry lake bed - NASA photo



Lt Col Mike Love and the X-24B - NASA photo



X-24B landing gear stress test - NASA photo



## HUGHES AIM-54 PHOENIX MISSILE

Chris Timm & Buzz Nau

The origin of the Hughes AIM-54 Phoenix as a long range, over-the-horizon extension of a standoff missile platform began in the late 1950's with the Douglas F6D-1 Missileer. Acting on an internal assessment of the perceived Soviet threat at the time, the US Navy announced a development contract for an air-to-air missile platform aircraft capable of standoff intercepts of multiple targets and ability to loiter on station for long periods of time. The contract was awarded to the Douglas Aircraft Company in mid-1960 based on their F6D-1 Missileer design which was a sub-sonic three-seat aircraft that resembled a larger version of the Douglas F3D Skyknight. It was to employ the Westinghouse APQ-81 pulse-doppler radar paired with six Bendix XAAM-10 Eagle two-stage air-to-air missiles.

Several factors doomed the concept. It was a low performance aircraft at a time when production military aircraft stats were going in the other direction. It would have also required escort fighter coverage since it would be defenseless against close in threats after expending its complement of Eagles. Secretary of Defense Thomas Gates cancelled the program in late 1960 due to the limited mission capability of the Missileer though Eagle development continued for a little while longer.

At roughly the same time the US Navy was developing its Fleet Air Defense requirements that led to the F6D Missileer, the US Air Force was evolving requirements for a new high speed, low altitude attack aircraft to replace the F-105 Thunderchief, but with longer range. After the Missileer was cancelled the Navy began re-evaluating the Fleet Air Defense requirements. Meanwhile, the Air Force Tactical Air Command (TAC) continued developing the requirements for their low level, high speed attack aircraft.

This also coincided with the appointment of Robert McNamara as the recently selected Secretary of Defense under President John F Kennedy. McNamara assembled a Washington think tank to evaluate the two programs with an emphasis on commonality that would infect military programs throughout his tenure in the Kennedy and Johnson administrations. Unsurprisingly McNamara recommended that the US Air Force's demand for a mach speed low level bomber and the US Navy's need for a fleet



Bendix Eagle—US Navy photo



Douglas F6D-1 Missileer - RG Smith print Douglas Aircraft Company



TA-3B Skywarrior launches an XAIM-54 Phoenix—US Navy photo

air defense superiority interceptor be fulfilled by one aircraft with emphasis on the USAF requirements. The sole Navy requirement was that the aircraft be capable of carrier operations. Thus began the TFX (Tactical Fighter Experimental) program.

To give an idea of how poorly the program would evolve, there was a run off competition between Boeing and General Dynamics for the TFX contract selection. The selection committee didn't feel either proposal capable of meeting the project requirements and had them refine their entries. Again, the committee wasn't overly convinced in either design, but unanimously favored Boeing's 818 design. However McNamara overrode the committee and picked the General Dynamic TFX entry (designated F-111) based on the higher commonality between the USAF and USN versions and not on the ability to meet any of the program requirements. Grumman was sub-contracted to build the F-111B which somewhat placated the Navy as they were a long time manufacturer of naval aircraft, but that wasn't nearly enough for this square peg to fit in a round hole.

Predictably the program started out badly between the two services and only got worse over time. With neither side budging on their mission requirements, it eventually became an impossible task to combine the missions into one aircraft. The Air Force managed to keep the FB-111A somewhat on track while the Navy's F-111B aircraft suffered from continual overweight problems for carrier operations and the visibility over the nose was unsatisfactory for carrier landings. There were a series of weight reduction programs in an attempt to get the aircraft within the requirements for carrier operations. The tradeoffs were a never ending struggle and only added to the Navy's disgust with the aircraft.

During the initial TXF development, the Bendix Eagle missile was cancelled leaving the F-111B in need of a new radar and long range air-to-air missile. Hughes was tasked with both solutions and utilized their AN/AWG-9 integrated weapons system and newly developed XAIM-54 Phoenix air-to-air missile. The AN/AWG-9 radar had originally been developed for the cancelled

USAF XF-108 Rapier and F-12 programs and was modified for use in the F-111B.

The Phoenix was a new missile based on their previous AIM-4 Falcon. Each had two sets of cruciform fins, the aft ones being used for control and guidance, but the similarities ended there. The Phoenix was much larger, heavier, and capable. It was roughly twice as large as the Falcon with diameter of 15 inches, length of 13 feet, and weighed about 1,000 pounds. It accelerated to mach 5 during boost and utilized semi-active homing from the AN/AWG-9 system then switched to active radar homing during the terminal phase of intercept.

While the F-111B development was painfully underway, the AWG-9/AIM-54 proceeded rather well. Initial tests of the missile system were conducted using a modified TA-3B Skywarrior and eventually moved to the F-111B before the program was can-



F-111B with an XAIM-54 - US Navy photo

radar intercept officer) interceptor with variable sweep wings and twin vertical stabilizers.

The AN/AWG-9 installed in the F-14 was significantly improved over the one initially built for the F-111B. It was 700 pounds lighter and went from tracking 18 individual target aircraft at once to 24. The AN/AWG-9 was a multi-mode pulsed doppler radar capable of TWS or track-while-scan which enabled it to engage multiple diverse targets at once. It could also track targets over 100 nautical miles away from sea level to 100,000 feet.

On 21 November 1973 a "six on six" test was performed at the Pacific Missile Test Center, Pt Mugu Naval Air Station (NAS). Armed with six AIM-54 Phoenix's a F-14 engaged six separate target simultaneously. Four missiles were direct hits, while one missed due to a control failure on the drone and the other miss was because of a faulty AIM-54 antenna. The test was considered a huge success as all missiles were launched with 38 seconds and were guided/controlled by the launching aircraft.

The F-14 Tomcat and AIM-54 Phoenix missile entered service in 1974. The Tomcat was capable of carrying up to six AIM-54's which was known as the "John Wayne" loadout, but rarely did since the aircraft could not recover aboard a carrier with that much weight. Typical loadouts were 0-4 Phoenix missiles in addition to AIM-7 Sparrows and AIM-9 Sidewinders as well as a full load of 20mm ammunition for the MA-61 Vulcan cannon.



F-111B with an XAIM-54 Phoenix—US Navy photo

celled. Throughout early testing the Phoenix lethality was nearly 80% which was quite high for air-to-air missiles in the 1960's.

As years continued to pass by with no quality resolutions for the F-111B in sight, the relations with the US Navy soured to the point that even if the Fleet Air Defense requirements could be met, the Navy would have refused to order the aircraft. Meanwhile, the threats that defined the need for a Fleet Air Defense remained and now included addressing long range cruise missiles. Additionally, the Navy's F-4 Phantom II continued to age and it needed a replacement on deck.

In October 1967 Grumman sent the US Navy an unsolicited design proposal to meet the needs for fleet defense. This would become their VFX (Navy Fighter Experimental) design which centered on maneuverability, air superiority and standoff missile capability. Finally convinced of the inevitable, McNamara conceded that the F-111B was a dead end and allowed a request for proposal (RFP) for the Navy's VFX contract in 1968. The finalist were McDonnell Douglas which had a strong entry in addition to Grumman with the Grumman 303F design, designated the F-14 Tomcat, being selected. The F-14 utilized the TF-30 afterburner turbofans from the F6D Missileer (and F-111B) as well as the AN/AWG-9 radar and AIM-54 Phoenix. It was a two seat (pilot and



F-14 Tomcat with a "John Wayne" loadout of six AIM-54's - US Navy photo



F-14 from the Pacific Missile Test Center is loaded with YAIM-54 Phoenix's for the "six on six" test - US Navy photo

Iran was the only other country to purchase and fly the F-14 / Phoenix combination having ordered 80 Tomcats and over 600 Phoenix missiles. Prior to the overthrow of the Shah, 79 of 80 F-14's ordered had been delivered along with some replacement parts, but less than 300 Phoenix missiles.

Operational success for the Phoenix was mixed. The US Navy fired three AIM-54's in two confirmed engagements with zero hits. However, Iran is reported to have been much more successful with the missile. Effective use of the F-14 / AIM-54 by the Islamic Republic of Iran Air Force (IRIAF) has been inconsistent due to shortages of parts and adequately trained crews as most of the US trained crews fled the country after the 1979 revolution. That said, the IRIAF claim 159 kills with their fleet of 79 F-14 Tomcats and just over 60 of those with the AIM-54 Phoenix out of 70 to 90 fired. In several cases multiple kills are claimed from a single Phoenix due to the close formation of the target aircraft. Though the IRIAF continue to claim they have F-14's still in service, they do not appear to have any operational AWG-9 radars or Phoenix missiles. Iran recently announced their internally developed Fakour 90 as the replacement for the Phoenix. The Fakour is also radar guided and resembles the Phoenix, but with a significantly shorter range. It reportedly entered production in 2018.

The US Navy retired the AIM-54 Phoenix in 2004 and the F-14 Tomcat two years later. Though it's (US Navy) combat performance was demonstrably low, just the mere proximity of F-14's with the long range Phoenix was enough to discourage aggressor aircraft into abandoning their flight plans. As such, the combina-

tion proved to be a successful deterrent throughout the cold war even though US rules of engagement pretty much handcuffed the pair's use especially during middle east conflicts. Since then the threat of long range bombers has waned with the AIM-120 AM-RAAM filling the medium range (30-40nm) environment. As cold war warriors go, there was no other combination of aircraft and weapon system that dominated the skies like the F-14 Tomcat and AIM-54 Phoenix.

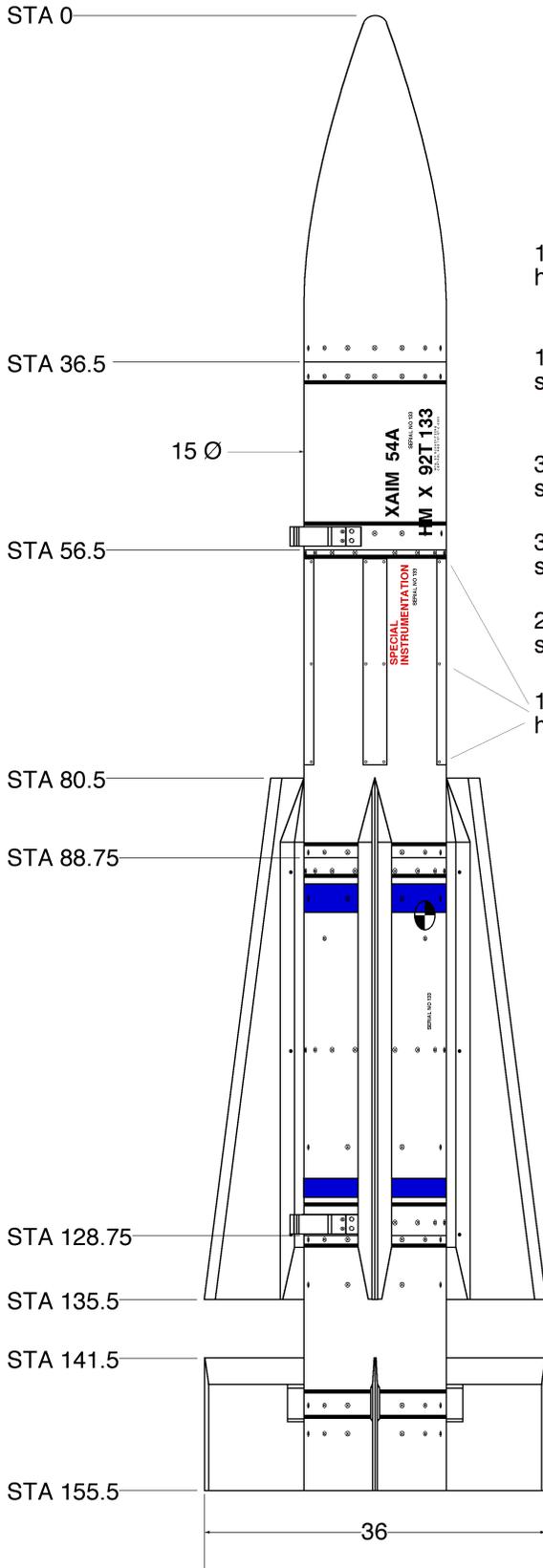
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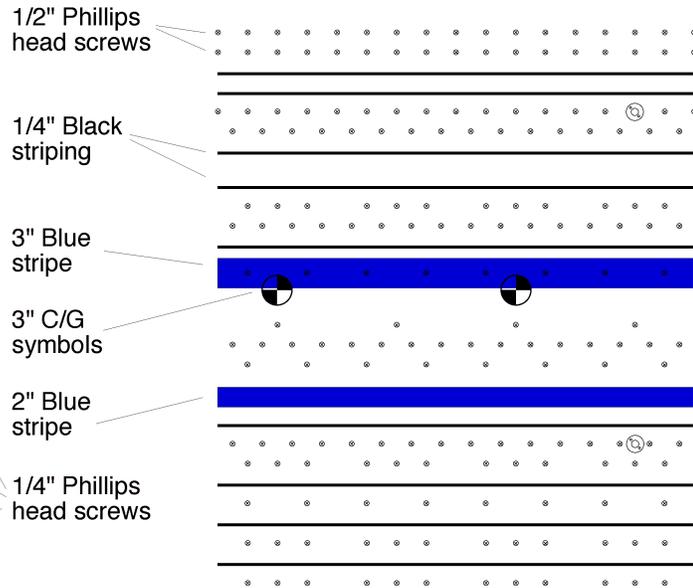
**PHOENIX  
XAIM-54A**

1/20 scale  
Dimensions in inches  
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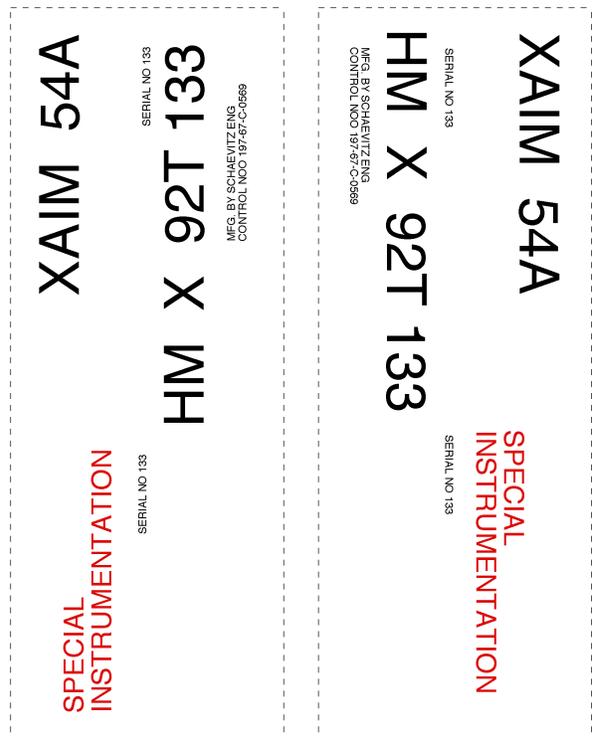
Sources:  
Measurements and photographs of XAIM-54A  
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History Museum, Kalamazoo, Michigan.



Striping and screws @ 1/20 scale



Stenciling @ 1/10 scale

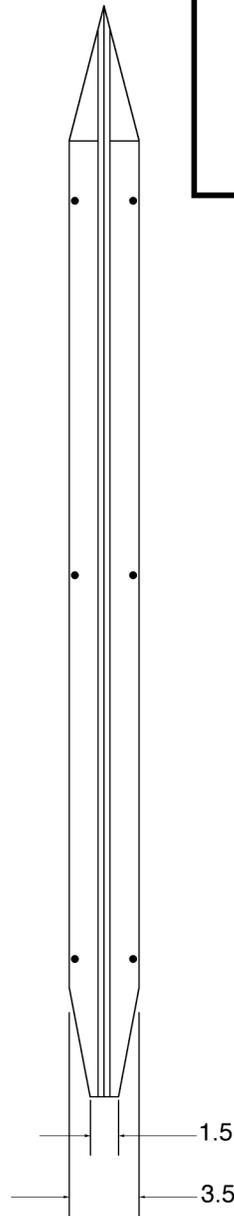
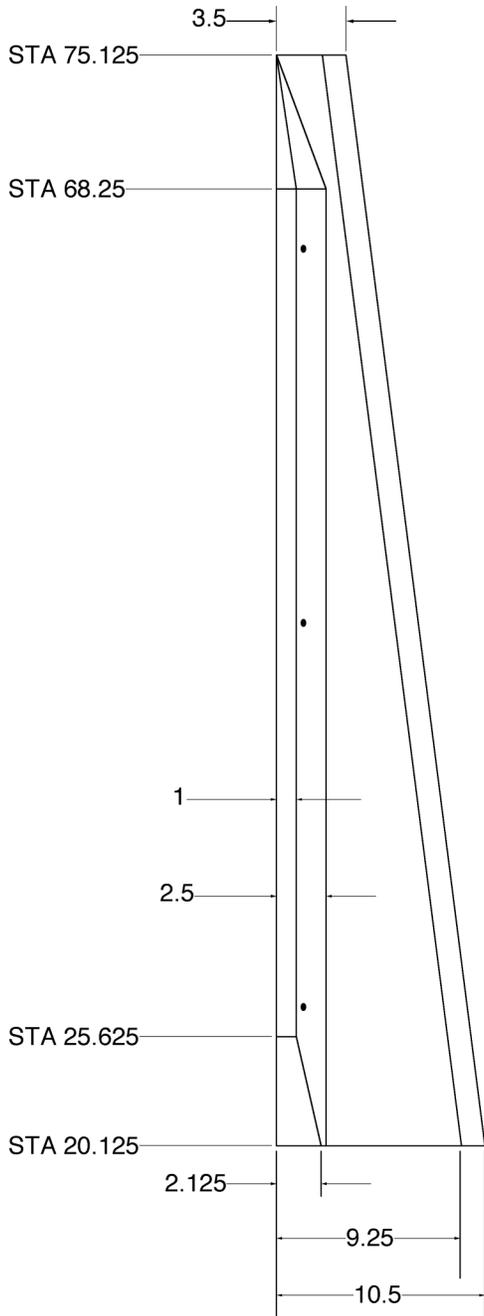


Font heights 2", 1", 1/2".

# PHOENIX XAIM-54A

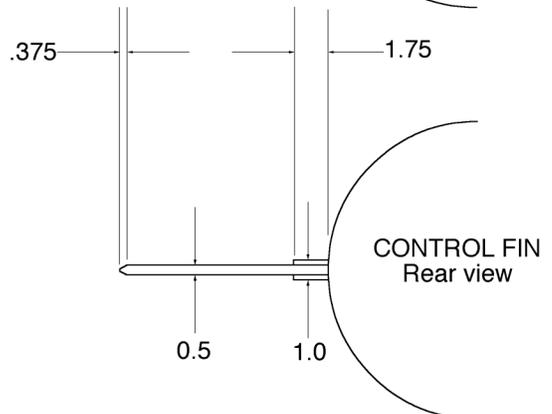
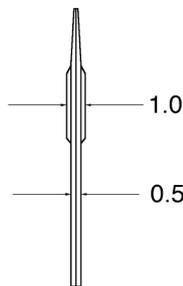
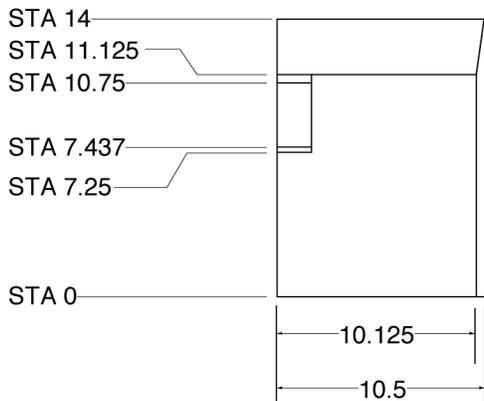
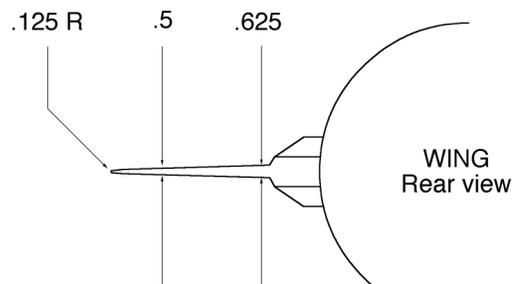
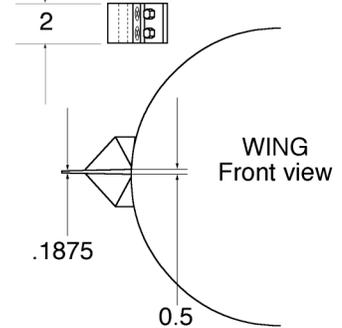
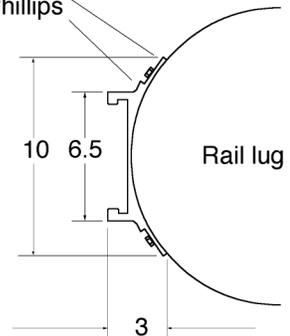
1/20 scale  
Dimensions in inches  
© 2019 Chris Timm

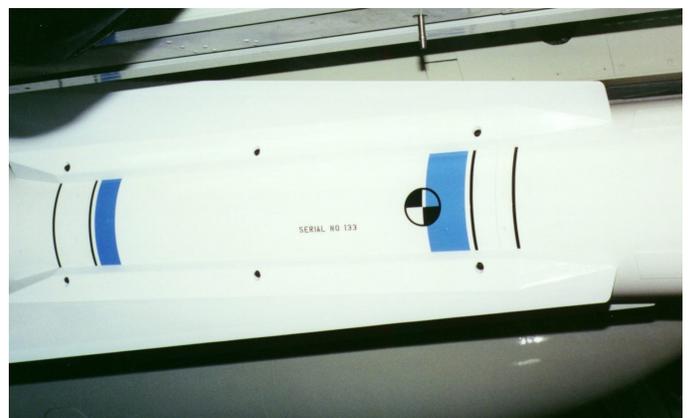
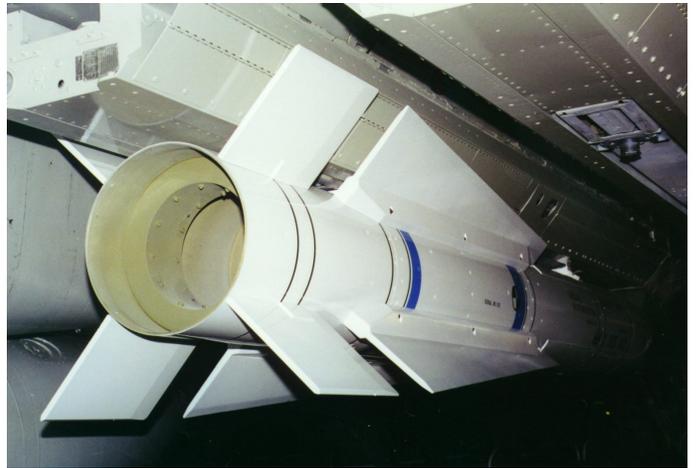
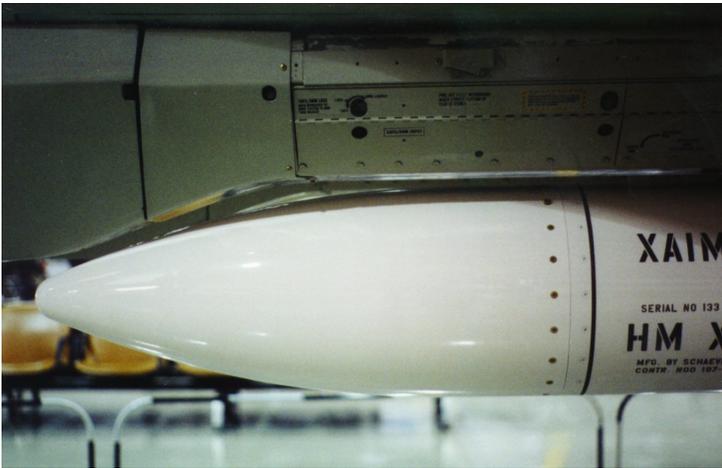
Sources:  
Measurements and photographs of XAIM-54A  
Phoenix on display at the Kalamazoo Aviation  
History Museum, Kalamazoo, Michigan.

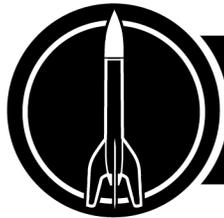


(2) 1/2" Hex

(2) 11/16" Phillips







# STARLINER

SCRATCH-BUILD BY  
DAVE GLOVER

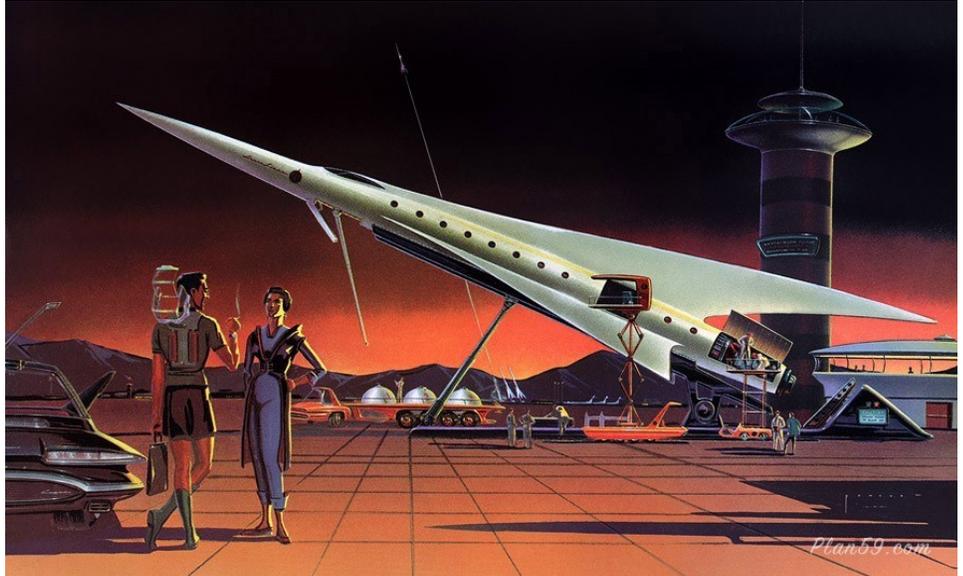
I find one of the more enjoyable aspects of model rocketry is building rockets from scratch. They can be of your own design or making scale versions of "real" or "fantasy" rockets. My daughter Sarah brought home a picture of a 50's passenger rocket from [Plan59.com](http://Plan59.com) knowing I would enjoy it and possibly take it on as a project. After a short discussion, we decided to move forward with the design process and develop a version that would fly on 29mm or 24mm composite motors.

Our first step was taking measurements off the image and entering them into RockSim 9. A 29mm motor mount was planned with 3/16<sup>th</sup> inch aircraft plywood centering rings and a boat-tail added to match the photo. Once all the components were entered, the scale feature was used to increase the size to match a common diameter body tube. The fin drawings were scaled up in the process and traced onto plain paper for transfer onto whatever material was chosen.

Next was locating the components and entering the actual weights into RockSim. The body tube is a Public Missile, Inc. (PMI) 3" X 36" Quantum airframe cut down to 34" and three fin slots, also cut by PMI, a service worth the additional cost. An 11" polystyrene nosecone, a 12" x 29mm motor mount, centering rings, and motor retainer were also available from PMI. I had originally thought of using custom cut G-10 fins, but the cost was more than I anticipated. The large fins required material 10" x 36" and after asking for club member input, I decided to use 3/16" balsa with fiberglass applied to both sides to keep them straight and give them the strength needed to stay together during flight. Large sheets were not available at local hobby shops, so they were found at Balsa Machining Service in Nevada, a company I had previously used at a reasonable price. The boat tail is a solid lightweight plastic material from Chris' Rocket Supply.

Would it actually fly? Using RockSim, with the correct range of motors being used, the rocket would be stable despite its large dorsal fin and remaining two fins being smaller and set at 110 degrees off the dorsal fin instead of a standard 120 degrees for three finned models. The decision was made to go ahead with the build and components located.

Fin Construction: The fin pattern was transferred to the balsa sheets and cut with X-Acto knives and then covered on

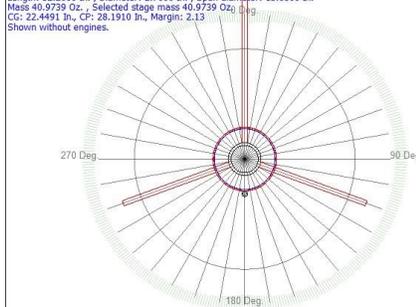


Starliner (1956) ad - Courtesy of Plan59.com

both sides with fiberglass cloth, which just happened to show up on the auction table at the JMRC Christmas party. Two 12" x 40" x 1/4" glass sheets were obtained from a local glass company, left over from another project and grinded the edges down for their cost of labor. On one glass sheet, wax paper was taped on top of the glass; a layer of the fiberglass cloth laid out on the wax paper; epoxy was brushed on the fins,

which were laid out on the fiberglass (photo#1). Epoxy was brushed on the exposed fins and a layer of fiberglass cloth

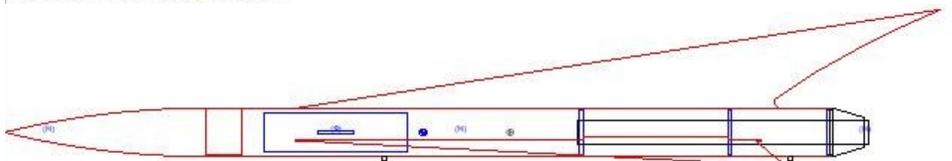
Starliner  
Length: 52.2000 In. , Diameter: 2.7000 In. , Span diameter: 13.6800 In.  
Mass 40.9739 Oz. , Selected stage mass 40.9739 Oz.  
CG: 22.4491 In., CP: 28.1910 In., Margin: 2.13  
Shown without engines.



laid over the fins. West System's epoxy 105 resin and 206 hardener was used in saturating the fiberglass over the fins and worked into the cloth using a plastic squeegee; wax paper was placed over the fins (photo#2) and the 2<sup>nd</sup> sheet of glass placed on top. The whole assembly was flipped over, the glass and wax paper were re-

### Starliner

Length: 52.2000 In. , Diameter: 2.7000 In. , Span diameter: 13.6800 In.  
Mass 44.1839 Oz. , Selected stage mass 44.1839 Oz.  
CG: 23.3410 In., CP: 28.1850 In., Margin: 1.79  
Shown without engines.





moved, the cloth saturated with epoxy and squeegeed, and the wax paper and glass replaced. A number of books were placed atop the glass to compress the fins and glass until dry, which was left in place for 24 hours. The glass & wax paper were easily removed and a rough cut of the fiberglass was made (photo #3). The re-



maining material was removed on a belt sander connected to vacuum while wearing a hepa-filter mask and safety goggles and a single vent to avoid fiberglass dust getting into the eyes. I was amazed at the finished fins, so strong, yet lightweight

**Motor Mount:** The MM is secured with two plywood centering rings placed just fore & aft of the fin tab openings and the aft end secured by the boat tail. After the fins were secure in place and prior to securing the boat tail, the aft rail button was installed as it would be inaccessible afterwards.

Fins were then secured to the body tube (BT) and motor mount system using 15 minute epoxy after lightly sanding the quantum tube for better adhesion (photo #4). After the fins were all secure,



fillets were made using the 15 minute epoxy after the body tube was masked with painters tape along a line made by rubbing



a black permanent marker on the end of a dowel and pulling the dowel along the fin/BT, leaving straight lines. (photo #5) A tongue depressor was dragged along the fillet to achieve an even finish along the entire length of the fins. Rough fillets were placed where the fins butted up to the motor mount inside the rocket before the tail cone was put in place (photo #6).



**Cockpit:** This was made from scrap balsa carved to match the curvature of the BT and connect to the dorsal fin and epoxied onto the BT and dorsal fin. A bit of Elmer's wood filler was used to fill in the gaps over the entire model before sanding



and applying the white primer.

**Painting:** Because the color was a silver metallic, one of the colors that shows up ANY imperfections in the surface, a lot of time was spent priming, inspecting, sanding and repriming before I had a finished surface I would let out of the house. I chose a lacquer primer & silver metallic paint simply because I could not find the silver metallic in an enamel spray. I fash-



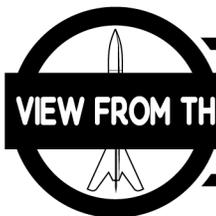
ioned a broom handle attached to two four foot objects in the garage and with the broom stick through the rocket body tube, it was easily rotated as I painted end to end. The vapors from lacquer paint is more flammable & toxic compared to enamels, so the garage doors were open, a fan gently blowing, and I wore a mask with a vapor cartridge. The paint was then covered with several coats of gloss clear coat. Decals were made from scratch on the computer using "Shapes" in Microsoft Word and printing them onto clear water-seal decal paper by Hayes Paper Company. Once printed, the decals were sprayed with clear acrylic paint and allowed to dry overnight. The decals were then cut out, soaked in warm water with a drop of dishwashing soap added, and then transferred to the rocket. I found this decal paper to curl quickly and tightly, which made unrolling and having it lie down a bit difficult. When I left one decal in the water an extended period of time, it unrolled itself and went on



just fine. The following day another coat of the clear acrylic paint to protect them from rubbing off.

**First Flight:** Due to the size of the fins and my expectation that the dorsal fin will take a hit on landing, I am using a 60" diameter parachute with a Chute Release in the hopes of a lower deployment altitude to avoid excessive drift and slower landing speed to avoid damage. An Aerotech G79-6 White Lightning 29mm motor is planned with an expected altitude of 750'.

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VIEW FROM THE FLIGHT LINE

Frankenstein Never Scared Me.....

DALE HODGSON

Well, it's been a long, long winter for me. As far as the rocket thing goes, I've been building some stuff and finally cleaning up my bench just a little. Trouble is though, the more I'm building the more stuff I think of that I want to try. And if I do that of course it means more parts which will cause my bench to fill up again (I've solved that problem with multiple benches - Ed). There are tougher things in life than having too many rocket parts lying around so we'll let that one go for now.

At this point I'm sure that some of you are questioning the title of this month's offering. You Bob and Tom fans out there know exactly where this title came from. It's from a bit where Kevin Pollak does a great impression of the always "a bit off center" Christopher Walken giving an interview. It's great stuff and always strikes me as very funny. I chose the title because I've been Frankensteining a few rockets this winter. It's a term I came up with because I am essentially building rockets from spare parts that I have lying around. I've taken it to a whole new level though, building a rocket around just one part. Truth be told this all started a few years ago at one of our Winter Banquets. Fred Ziegler (yes, THAT Fred Ziegler, Debauchery Brother to the bitter end) and I both won a balsa tail-cone. Nothing to write home about, just a 54mm to 29mm tail-cone. As Fred and I were talking about it I said something like, "hey, let's build a rocket around this just for grins". Wasn't too long when Fred sent me a design for one. I did a little tweaking as well and we came up with something cool. So, we built them, and I named mine "Samantha's Revenge" after my grand daughter who said that I wouldn't paint a rocket hot pink and fluorescent green. Really? Of course, I did! The rocket is still in my fleet and it flies great on CTI F-240's when we can get them.

It was so much fun building something around one part that I've kept the tradition alive and tried to do the same thing periodically ever since. So far I've done a 38mm minimum diameter built around a partially glassed fin can and motor tube I got from Gabe Osborn. Then a 5.5" Warlock (scaled down from 7.5") based on a nose cone and spare fins. I built another 38mm dart built around a 3D fin can. There was a 54mm project built around an Acme Fin can and a Public Missiles Intelli-Cone. And finally, a 29mm dart built around a Slimline retainer. Most of these I have flown, but a couple are still waiting for a good launch day. Believe it or not, what this little exercise did for me was stretch my designing abilities a little bit. In order to pull off some of the things I did required the fabrication of some parts. I actually came up with a recovery harness slider that so far has worked great. I will go more into detail on those in a future article. Suffice it to say I've built everything from 29mm to a 98mm and flown them all, so they are a proven designs. What materials I used to build them varied but again, that will wait till next time.

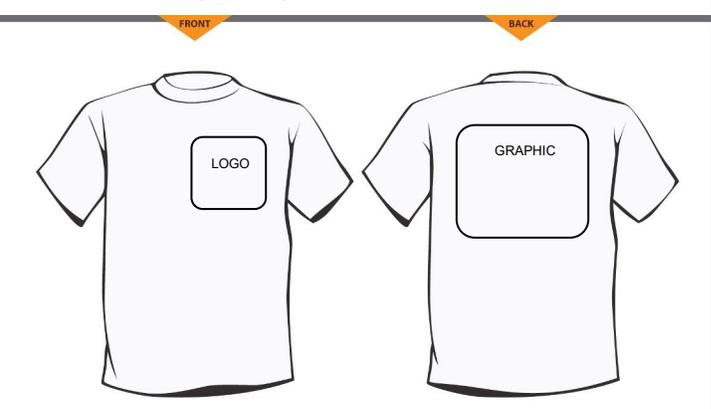
Since we're always looking for something to do as far as contests go maybe Frankensteining might be fun...give everyone the same basic part and build something around it, no holds barred. Judging would be fairly easy I suppose. We could base it on something like sheer imagination of the project but with one caveat...the thing has to survive a flight.

So, all of this came from two guys playing around with a 50-cent part in the beginning and look where it's gone from there at least for me? Maybe my next article will cover being scared of fast marsupials....you'll get the reference in a minute or two. Looking forward to the 2019 season!



Shirt Logo Contest!!!

JMRC is holding a shirt logo contest. We are looking for designs that express what JMRC is all about and can be printed or embroidered on shirts. It can be a small logo for the front or large one for the back, or a combination of the two. There are really no restrictions on your ideas and imagination. Enter as often as you like. A poll will be created for the membership to vote on their favorite. Entry deadline is June 15, 2019. The winner will get a shirt with their logo in addition to a free, one year JMRC/HUVARS membership. Email Buzz if you have any questions. We're looking forward to seeing what you can do!





# COMPETITION CORNER

## Eggloft

Buzz Nau (T-34 Escape Velocity)

One of the more challenging competition events is eggloft. In addition to achieving the highest altitude or longest duration, the model must also carry a large egg and return it intact. There are several compromises the competitor needs to consider.

Let's start with the egg capsule. There are several commercial capsules available or that can be scratch made. Also, with the popular rise of 3D Printing you can also print a capsule. Typically, the more protective the capsule the heavier it will weigh. Weight is the enemy of altitude. Some competitors, including the highly successful *Flying I-Beam Kids* utilize a balloon to hold the egg. It weighs next to nothing but offers little to no protection. I would not recommend this technique for someone just getting started in competition, but seasoned flyers may want to give this one a try.

Now let's discuss airframes. For eggloft duration the most common airframe is a cone shroud. This shape offers the most internal volume for a large parachute. The shrouds are often just printed out on card stock but may also be lightweight fiberglass or other exotic materials. They are also capable of being produced from a 3D printer. On the other hand, eggloft altitude models are often just a section of body tube otherwise known as an "egg on a stick". Some competitors will use shroud airframes for duration and altitude, reducing the numbers they need to build and keep on hand. The compromise to consider with airframes besides shape is length. A longer airframe will contribute to better stability and a straighter flight, but also adds weight and surface drag.

Next we'll look at fins. Shape is easy. They are either trapezoidal or elliptical. Material is usually thin balsawood or G10 fiberglass. The compromise here is span. A longer span will help keep the egglofter pointing in the right direction but will add drag. A shorter span will be less effective at dampening out flight deviations.

Eggloft altitude uses electronic altimeters these days to record the flight's altitude. There are several, small size, NAR approved altimeters in use. Most will fit in an 18mm tube and can be attached to the shockcord, but if a Altus Metrum Micro Peak is used it is advised to fit a light shroud over the sensor to prevent anomalous recordings.

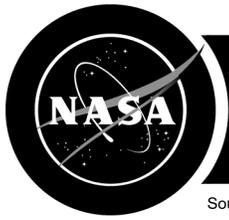
One of the most important consideration in eggloft is the launcher. A typical launch lug cannot be used because of the large egg in the nose. You can use loops formed from music wire and attach one at the nose and another outboard on a fin. You would want to use a 3/16" rod in this case to avoid rod whip as much as possible. Most often, egglofters are flown out of a tower. Veteran competitors will also add a piston launcher for improved boost performance.

Finally, we need to bring it back safely. Eggloft altitude can safely be recovered with a 16-18" parachute, but you should use more than eight shroud lines and attach them securely. This can be done easily with a double knot at the end of each line, then attach them to the parachute with a small strip of mylar tape, but leave the knot exposed. Finally, add a drop of fast cyanocrylic to the knot which will wick through the line under the tape. Use approximately 18" of 150# Kevlar long shock cord from the airframe to the egg. Use a shorter section to attach the chute to the egg. It helps to reduce the chance of shredding the chute by adding a 4" section of braided elastic cord.

[Aerospace Specialty Products](#) sells the [Eggstravaganza](#) kit in 18mm and 24mm versions. These include a pre-printed cardstock shroud, vacu-formed egg capsule and mylar chute. These are very competitive designs. [Apogee Components](#) also produces an 18mm [Eggtosser](#) kit as well as egg capsules for scratchbuilding your own model. There are also plans available for download from the [NAR's website](#).



Egglofter flown by T-34 at NARAM 60 used a semi-shroud to allow room for the altimeter.



# THIS MONTH IN AEROSPACE HISTORY

Source—NASA Archives

## 95 Years Ago – 1924

March 1: Donald K. (Deke) Slayton born, Sparta, WI.



## 85 Years Ago - 1934

March 9: Yuri Gagarin born, Gzhast, Rayon, Smolensk Oblast, USSR.



## 60 Years Ago - 1959

March 3: Pioneer 4 (Juno II AM-14) launched from Cape Canaveral, Fla. First U.S. sun-orbiter, a US-IGY space probe. First successful flyby of the Moon.

March 10: First captive flight of X-15, Dryden Flight Research Center

(DFRF), CA.



April 13: Discoverer 2 launched by Thor Agena from Vandenberg AFB.

## 55 Years Ago - 1964

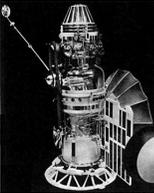
April 2: Zond 1 launched by Modified SS-6 (Sapwood) or Molniya from Baikonur, USSR.

April 8: GT-1 Gemini 1 Launch (Unmanned). First Project Gemini flight which tested the Titan II launch vehicle. It made four orbits and was successfully recovered.

April 17: First X-24 glide flight, Jerauld R. Gentry pilot, DFRF, CA.

## 50 Years Ago - 1969

March 3-13: Apollo 9 launched by Saturn V (SA-504) from KSC, astronauts James A. McDivitt, David R. Scott, and Russell L. Schweickart, into earth orbit. First launch of complete Apollo configuration [Saturn V vehicle, CSM, and LM]. First firing of LM ascent and descent engines in space with astronauts aboard. First separation, rendezvous & redocking of two astronaut occupied spacecraft. First EVA by an astronaut completely free of spaceship life support equipment (Schweickart, LM Pilot).



March 27: Mariner 7 launched by Atlas-Centaur from Cape Canaveral, Fla.

April 14: Nimbus 3 launched by Thor Agena from Vandenberg AFB.

April 17: First X-24 glide flight, Jerauld R. Gentry pilot, DFRF, CA.



April 2: Seven astronauts selected for Project Mercury, Washington, D.C.

April 9: Mercury 7 announced at press conference.



## 45 Years Ago - 1974

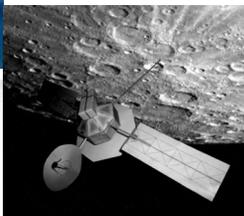
March 5: First X-24B supersonic flight, John A. Manke pilot, Dryden Flight Research Facility (DFRF), CA.



March 8: Miranda (UK X-4) launched by Scout from Vandenberg AFB.



March 26: Meteor 1 launched by Vostok rocket from Plesetsk, USSR.



March 29: Mariner 10, First Mercury Flyby.

**45 Years Ago - 1974—Continued**

April 13: Westar 1 launched by Delta from Cape Canaveral. First satellite for domestic communications.



**40 Years Ago - 1979**

March 5: Voyager 1 passes Jupiter, at 278,000 km, returns photos and data.

March 8: Space Shuttle Columbia delivered to NASA, Edwards AFB, CA from Palmdale, CA.



April 10: Soyuz 33 launched on a Soyuz rocket from Baikonur. Ferry flight to Salyut-6 space station. Crew: Nikolai N. Rukavishnikov and Georgi I. Ivanov (Bulgaria).



**35 Years Ago - 1984**

March 1: Landsat 5 launched by Delta from Vandenberg AFB Western Space and Missile Center (WSMC). UOSAT-2 secondary payload.



March 5: Intelsat 5 F8 launched by Ariane 1 rocket from Kourou, French Guiana.



April 3: Soyuz T-11 launched on Soyuz rocket from Baikonur.

Ferry flight to Salyut-7 space station. Crew: Yuri V. Malyshev, Gennadi M. Strelakov, and Rakesh Sharma (India).



April 6: STS-41C (Space Shuttle Challenger) launched from KSC. Crew: Robert L. Crippen, Francis R. Scobee, Terry J. Hart, George D. Nelson, and James Van Hoften. LDEF-1 launched from shuttle. First in-orbit spacecraft repair was performed on the Solar Maximum Mission. First direct ascent trajectory for Space Shuttle launch. Landed April 13, EAFB, CA. Mission duration: 6 days, 23 hours



**30 Years Ago - 1989**

March 13: STS-29 (Space Shuttle Discovery) launched from KSC. Crew: Michael L. Coats, John E. Blaha, James P. Bagian, James F. Buchli, and Robert C. Springer. Launched TDRS-4 same day. Landed Edwards Air Force Base (EAFB), CA. Mission duration: 4 days, 23 hours. The deployment of TDRS-4 marked completion of the TDRS (Tracking and Data Relay Satellite) system.



**25 Years Ago - 1994**

March 4: STS-62 (Space Shuttle Columbia) launched from KSC. Crew: John H. Casper, Andrew M. Allen, Pierre J. Thuot,



Charles D. Gemar, and Marsha S. Ivins. Carried United States Microgravity Payload (USMP-2) and Office of Aeronautics and Space Technology (OAST-2). Landed KSC, March 18 at 8:10 a.m. EST. Mission time: 13 days, 23 hours.

April 9: STS-59 (Space Shuttle Endeavour) launched from KSC. Crew: Sidney M. Gutierrez, Kevin P. Chilton, Linda M. Godwin, Jerome "Jay" Apt, Michael R. Clifford, and Thomas D. Jones. Carried Space Radar Laboratory (SRL-1). First flight of Toughened Uni-Piece Fibrous Insulation, known as TUF1, an improved thermal protection tile. First Hispanic Shuttle Commander (Gutierrez). Mission duration: 11 days, 5 hours.

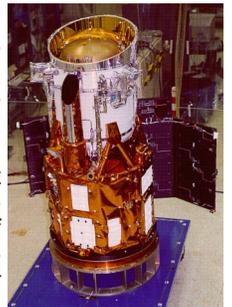


April 13: GOES-8 launched on Atlas-Centaur rocket from Cape Canaveral.



**20 Years Ago - 1999**

March 5: WIRE (Wide-field InfraRed Explorer), designed to measure infrared sources, was launched by a Pegasus-XL rocket released from a L-1011 cargo plane off the coast of Vandenberg AFB. Soon after launch the payload deployed prematurely and become inoperable.



April 15: Landsat 7, a remote sensing spacecraft, launched by a Delta 2 rocket from Vandenberg AFB.

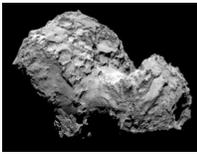


**20 Years Ago - 1999- Continued**

April 16: Sputnik Jr. 3 was a microsatellite that was carried by Progress M-41 to Mir and then pushed out by the crew on April 2. It carried tape recorded voices of the school children in Russia and France who built the satellite.

**15 Years Ago - 2004**

March 2: Rosetta, a European (ESA) cometary probe launched by an Ariane 5 rocket from Kourou in French Guiana. In 2014, it orbited around a comet named 67P/Churyumov-Gerasimenko and released a lander named Philae.



April 19: Soyuz TMA-4 launched on a Soyuz FG rocket from Baikonur. Ferry flight to the International Space Station, bringing Expedition 9 (Padalka/Fincke). Crew: Gennady I. Padalka, E. Michael "Mike" Fincke, and André Kuipers (The Netherlands).



April 20: Gravity Probe-B, was launched by a Delta 2 rocket from Vandenberg AFB to verify a derivative consequence of the General Relativistic Gravitation (GRG) theory, according to which a spinning body such as the



Earth makes the space-time around it to rotate around, though extremely slowly.

**10 Years Ago - 2009**

March 7: Kepler astronomy probe launched by a Delta 2 rocket from Cape Canaveral. Kepler's mission is to search for Earth-sized planets around other stars by looking for



brightness variations in over 100,000 stars in the Cygnus-Lyra region.

March 15: STS-119 (Space Shuttle Discovery) launched from KSC. Crew: Lee



Archambault, Tony Antonelli, Joseph Acaba, John Phillips, Steve Swanson, Richard Arnold and Koichi Wakata. Discovery carried the final set of solar arrays also known as the starboard 6 or S6 truss segment to the ISS. Landed March 28 at KSC. Mission time: 12 days, 19 hours.

March 26: Soyuz-TMA 14 launched from Baikonur cosmodrome by a Soyuz-FG rocket. Crew: It carried a Russian cosmonaut (Gennady I. Padalka), an American astronaut (Michael R. Barratt) and a space tourist (Charles Simonyi) to the International Space Station. It docked with the Zvezda module of the ISS on 28



March 2009. The two astronauts formed part of the ISS Expedition 19 crew.

**5 Years Ago - 2014**

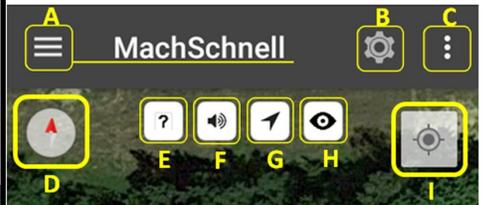
March 1: Dryden Flight Research Center renamed NASA Armstrong Center in honor of Neil Armstrong.



March 25; Soyuz TMA-12M (Expedition 39). Launched from Tyuratam (Baikonur Cosmodrome), Kazakhstan to the ISS. During Expedition 39 CRS-3 Dragon became the first flight to use the Falcon 9 v1.1 rocket. The High-Definition Earth Viewing (HDEV) investigation installed four commercially available high-definition cameras on the exterior of the space station to stream live video of Earth online. ISS used the new Pre-Determined Debris Avoidance Maneuver capability to move away from space debris. Crew members: Alexander Skvortsov (Russian Federal Space Agency), Oleg Artemyev (Russian Federal Space Agency), Steve Swanson (NASA).



**Tackimo Button Functions**



**Control Button Functions (Trackimo Android App released circa March 2019)**

Button	Function
A—3-Bar Stack (Tracker Menu)	Selects among multiple account-registered Trackimo trackers by device name/ID number, shares current tracker data, adds additional trackers to account. (Currently-selected Trackimo device's name is displayed right of A)
B—Gear (Device Settings)	Turns On/Off, sets, and selects various Trackimo device functions
C—3-Dot Stack (Account Settings)	Invokes Account Settings, Notifications, Nearby Trackimo Device Discovery (via Bluetooth), History, Fence, Add New Tracker, Tag, and Logout Functions
D—Compass Needle	Red pointer indicates direction of north of Map/Satellite View on screen. Tap symbol to restore Map/Satellite view on screen to default Top-North orientation (Does NOT sense actual magnetic north)
E—Question Mark (Help)	Launches the Trackimo's Help web site on phone's Internet browser
F—Speaker (Beep Activation)	Orders Trackimo to emit four soft beeps
G—Arrowhead (Location Update)	Forces Tracker to report its current location
H—Eye (Toggle View)	Toggles the view between Google's road map and satellite rendering of the terrain
I—Gunsight (Center on Own-Location)	Pans and Centers the Map/Satellite View on Own-Location symbol (Blue dot)



**WIN AN ESTES SATURN V!!!**

JMRC is raffling off a brand new Estes limited edition Apollo 11 Saturn V. This version has tons of new upgrades over previous versions that increase the scale accuracy and making it simpler to build as well. List price is \$89.99. Tickets will cost \$5 each and will be available at all JMRC launches this summer. The drawing will be announced in the near future.

# APOLLO 50th ANNIVERSARY RESOURCES



## APOLLO PRESS KITS THE DAVID MEERMAN SCOTT COLLECTION



### Apollo 11 Press Kits

Press kits prepared by the public relations staff at the major contractors for the Apollo 11 mission provided valuable additional information not found in NASA issued news releases. Reporters and editors from media outlets including television and newspapers had access to such documents from dozens of manufacturers while working on stories about the first lunar landing.

These press kits are beautifully prepared, with stunning artwork and fascinating period photographs.

With most of my time being spent as a **marketing speaker**, it has taken me fifteen years of collecting to amass what I believe to be the most complete collection of **Apollo 11 press kits** in the world. I'm always on the hunt for more, so please **contact me** if you have any.

Now, in honor of the 50th anniversary of the Apollo 11 mission, I've digitized my collection to make it available to scholars, marketers, Apollo buffs, and fans of graphic design.

FULL ACCESS TO PRESS KITS



FULL ACCESS TO PRESS KITS

[Apollo 11 Press Kits](#). Press kits prepared by the public relations staff at the major contractors for the Apollo 11 mission provided valuable additional information not found in NASA issued news releases.



- Table of Contents
- Apollo Image Gallery
- Apollo Multimedia
- Mission Chronology
- Critics
- Spacecraft
- Diagrams and Maps
- Memorabilia and More
- Lunar Lander Simulator
- "Contact Light"
- Books, DVD and more
- Links
- Mailing Lists / Groups

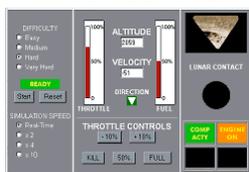


The Project Apollo Archive serves as an online reference source and repository of digital images pertaining to the historic manned lunar landing program. The Archive was created by Kipp Teague in February 1999 as a companion web site to his "Contact Light" personal retrospective on Project Apollo. The Archive is also a companion to Eric Jones' comprehensive [Apollo Lunar Surface Journal](#).

(pictured right: Neil Armstrong on the Moon, July 20, 1969)



The [Project Apollo Archive](#) serves as an online reference source and repository of digital images pertaining to the historic manned lunar landing program. The Archive was created by Kipp Teague in February 1999 as a companion web site to his "Contact Light" Apollo Lunar Surface Journal. Contact Light contains personal reflections as well as many other Apollo resources including the Lunar Lander Simulator.



The [Project Apollo Archive's](#) companion photo collection available on flickr. The collection contains over 15,000 photos!



Amy Shira Teitel, spaceflight historian, author, and all-around space history nerd. Her "[Vintage Space](#)" YouTube channel hosts regular space history videos, many of which are on Apollo.



Amy also hosts a "[Vintage Space](#)" Wordpress Blog.



[Dan Beaumont's Space Museum](#) YouTube Channel is an incredible repository of NASA video reports and documentaries.

### Other Useful Links:

- [NASA's official "Apollo 50th" Website](#)
- [NASA Goddard Space Flight Center—The Apollo Program](#)
- [NASA Apollo Mission Pages](#)
- [NASA Apollo Program Mission Patches](#)
- [National Air and Space Museum - The Apollo Program](#)
- [Apollo 11 Complete Raw footage in 4K](#)
- [Encyclopedia Britannica Apollo Space Program](#)



## CURRENT EVENTS IN SPACE EXPLORATION

Feb. 13, 2019 - [NASA Release 19-004](#)

### NASA's Record-Setting Opportunity Rover Mission on Mars Comes to End

One of the most successful and enduring feats of interplanetary exploration, NASA's Opportunity rover mission is at an end after almost 15 years exploring the surface of Mars and helping lay the groundwork for NASA's return to the Red Planet.

The Opportunity rover stopped communicating with Earth when a severe [Mars-wide dust storm](#) blanketed its location in June 2018. After more than a thousand commands to restore contact, engineers in the Space Flight Operations Facility at NASA's Jet Propulsion Laboratory (JPL) made their last attempt to revive Opportunity Tuesday, to no avail. The solar-powered <https://www.nasa.gov/sites/default/files/thumbnails/image/19-004.jpg> rover's final communication was received June 10.

"It is because of trailblazing missions such as Opportunity that there will come a day when our brave astronauts walk on the surface of Mars," said NASA Administrator Jim Bridenstine. "And when that day arrives, some portion of that first footprint will be owned by the men and women of Opportunity, and a little rover that defied the odds and did so much in the name of exploration."

Designed to last just 90 Martian days and travel 1,100 yards (1,000 meters), Opportunity vastly surpassed all expectations in its endurance, scientific value and longevity. In addition to exceeding its life expectancy by 60 times, the rover traveled more than 28 miles (45 kilometers) by the time it reached its most appropriate final resting spot on Mars – Perseverance Valley.

The final transmission, sent via the 70-meter Mars Station antenna at NASA's Goldstone Deep Space Complex in California, ended a multifaceted, [eight-month recovery strategy](#) in an attempt to compel the rover to communicate.

"We have made every reasonable engineering effort to try to recover Opportunity and have determined that the likelihood of receiving a signal is far too low to continue recovery efforts," said John Callas, manager of the Mars Exploration Rover (MER) project at JPL.

"I cannot think of a more appropriate place for Opportunity to endure on the surface of Mars than one called Perseverance Valley," said Michael Watkins, director of JPL. "The records, discoveries and sheer tenacity of this intrepid little rover is testament to the ingenuity, dedication, and perseverance of the people who built and guided her."

March 8, 2019 - [NASA Release 19-016](#)

### SpaceX Crew Dragon Splashdown Marks Success of First NASA Commercial Crew Flight Test

NASA passed a major milestone Friday in its goal to restore America's human spaceflight capability when SpaceX's Crew Dragon returned to Earth after a five-day mission docked to the [International Space Station](#).

About 6 hours after departing the space station, Crew Dragon splashed down at 8:45 a.m. EST approximately 230 miles off the coast of Cape Canaveral, Florida. SpaceX retrieved the spacecraft from the Atlantic Ocean and is transporting it back to port on the company's recovery ship.

"Today's successful re-entry and recovery of the Crew Dragon capsule after its first mission to the International Space Station marked another important milestone in the future of human spaceflight," said NASA Administrator Jim Bridenstine. "I want to once again congratulate the NASA and SpaceX teams on an incredible week. Our Commercial Crew Program is one step closer to launching American astronauts on American rockets from American soil. I am proud of the great work that has been done to get us to this point."

Demonstration

Mission-1 (Demo-1) was an uncrewed flight test designed to demonstrate a new commercial capability developed under NASA's [Commercial Crew Program](#). The mission began March 2, when the Crew Dragon [launched](#) from NASA's Kennedy Space Center in Florida, and racked up a number of "firsts" in less than a week.



- First commercially-built and operated American crew spacecraft and rocket to launch from American soil on a mission to the space station.
- First commercially-built and operated American crew spacecraft to dock with the space station.
- First autonomous docking of a U.S. spacecraft to the International Space Station.
- First use of a new, global design standard for the [adapters](#) that connect the space station and Crew Dragon, and also will be used for the Orion spacecraft for NASA's future mission to the Moon.

NASA and SpaceX teams gathered in the early morning hours at the company's headquarters in Hawthorne, California, to follow the spacecraft's return journey and ocean splashdown.

"We were all very excited to see re-entry, parachute and drogue deploy, main deploy, splashdown – everything happened just perfectly. It was right on time, the way that we expected it to be. It was beautiful," said Benji Reed, director of crew mission management at SpaceX.

A critical step in validating the performance of SpaceX's systems, Demo-1 brings the nation a significant step closer to the return of human launches to the space station from U.S. soil for the first time since 2011, when NASA flew its last space shuttle mission. However, NASA and SpaceX still have work to do to validate the spacecraft's performance and prepare it to fly astronauts.

"If you just think about the enormity of this flight and all of the prep that went into it – getting the pad refurbished, getting the flight control room set up, getting the vehicle built, getting the Falcon 9 ready, all of the analysis and mission support that went into it – it's just been a tremendous job. Our NASA and SpaceX teams worked seamlessly not only in the lead-up to the flight but in how we managed the flight," said Steve Stich, deputy manager of NASA's Commercial Crew Program.

Crew Dragon carried a passenger on this flight test – a lifelike test device named Ripley, which was outfitted with sensors to provide data about potential effects on humans traveling in the spacecraft. After SpaceX processes data from this mission, teams will begin refurbishing Crew Dragon for its next mission, an in-flight abort test targeted to take place this summer. Demo-2, the first crewed test flight, will carry NASA astronauts [Bob Behnken](#) and [Doug Hurley](#) on the spacecraft's final flight to certify Crew Dragon for routine operational missions.

"For the first time, we've gotten to see an end-to-end test, and so now we've brought together the people, the hardware and all the processes and procedures, and we've gotten to see how they all work together, and that's very important as we move toward putting people onboard," said NASA astronaut Mike Hopkins, who will crew SpaceX's first operational mission to the space station following Demo-2. "I'm, personally, very anxious to hear how Ripley is feeling after they pull her out of the capsule and get her onto the recovery vehicle."



## CURRENT EVENTS IN SPACE EXPLORATION

March 14, 2019 - [ROSCOSMOS](#)

**Soyuz MS-12 spacecraft successfully took off for ISS and entered the planned orbit**



On March 14, 2019, at 22:14 MSK, Soyuz-FG launch vehicle with Soyuz MS-12 manned transport vehicle took off from launch pad №1 (Gagarin's Start) of the Baikonur Cosmodrome.

At 22:23 MSK Soyuz MS-12 spacecraft detached from the third launch vehicle stage under normal conditions at the planned near-Earth orbit and continued its autonomous flight to the International Space Station under the guidance of the specialists from the Russian Mission Control Center.

The approach of Soyuz MS-12 to the station and its docking to the Rassvet small research module will be done automatically using the four-orbit maneuver. The spacecraft's docking to the ISS is planned for March 15, 2019, at 04:07 MSK.

Soyuz MS-12 is carrying the crew of the ISS Expedition 59/60: Roscosmos cosmonaut Aleksey Ovchinin, and NASA astronauts Nick Hague and Christina Koch.

March 15, 2019 - [ROSCOSMOS](#)

**Mission Control Center. Soyuz MS-12 docks to ISS**



On March 15, 2019, Soyuz MS-12 manned spacecraft successfully docked the docking unit of Rassvet small research module of the Russian segment of the International Space Station. The docking took place at 04:02 MSK.

The flight program envisioned the four-orbit rendezvous.

The approach was done automatically under control of the specialists of the Chief operational crew for the management of the Russian segment of the ISS at the Mission Control Center and of the Russian members of the station and spacecraft's crews.

Soyuz-FG launch vehicle carrying Soyuz MS-12 manned spacecraft took off on March 14, 2019, at 22:14 MSK. The spacecraft delivered to the ISS the members of ISS Expedition 59/60: Russian cosmonaut Aleksey Ovchinin (Roscosmos), and American astronauts Nick Hague (NASA) and Christina Koch (NASA).

The crews of the transport vehicle and ISS are currently preparing to open transfer hatches so that the spacecraft's crew can move to the station.

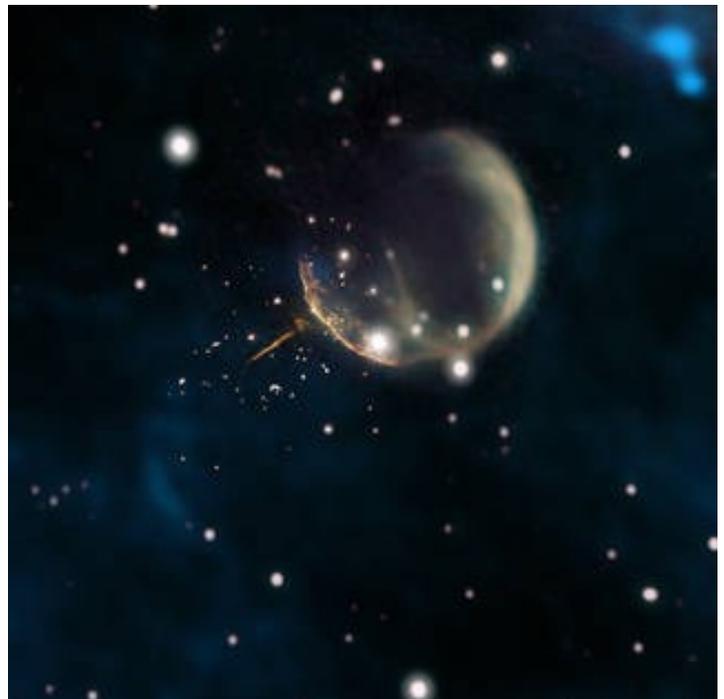
March 19, 2019 - [NASA Fermi Space Telescope](#)

**Fermi Satellite Clocks 'Cannonball' Pulsar Speeding Through Space**

Astronomers found a pulsar hurtling through space at nearly 2.5 million miles an hour — so fast it could travel the distance between Earth and the Moon in just 6 minutes. The discovery was made using NASA's Fermi Gamma-ray Space Telescope and the National Science Foundation's Karl G. Jansky Very Large Array (VLA).

Pulsars are superdense, rapidly spinning neutron stars left behind when a massive star explodes. This one, dubbed PSR J0002+6216 (J0002 for short), sports a radio-emitting tail pointing directly toward the expanding debris of a recent supernova explosion.

"Thanks to its narrow dart-like tail and a fortuitous viewing angle, we can trace this pulsar straight back to its birthplace," said Frank Schinzel, a scientist at the National Radio Astronomy Observatory (NRAO) in Socorro, New Mexico. "Further study of this object will help us better understand how these explosions are able to 'kick' neutron stars to such high speed."



# VENDOR NEWS

## Estes Industries

Following in the wake of the recent 1/100 Apollo 11 Saturn V is the [Estes 1/200 RTF Saturn V](#). It is due to be released in early April. It will include a clear plastic fin unit for flight, display stand, and free poster offer that Estes will mail to you at no cost. This makes a lot of sense as it would not likely fair well in the Saturn packaging. The only recommended motor is the C6-3 and it retails for \$69.99.



## eRockets

There has been quite a bit happening with eRockets recently. They have added two versions of the [Relay Rocketry Tracking Sirens](#). They come in a 1 or 2 N



cell battery version and cost \$.99 or \$8.99 respectively.

Apparel is expanding including extreme [headware](#) to save you from the sun.

### [Screw together Semroc couplers](#)

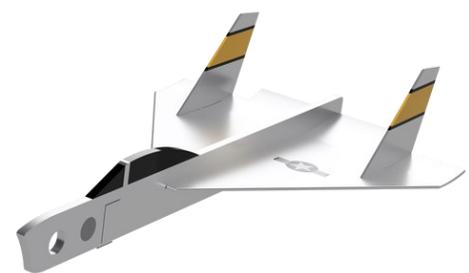
are a thing. These will make transporting tall rockets easily and come in four sizes.



Shrockets kits are now available. Designed by Doug Shrox, his futuristic creations have been popular for many years. Kits include; Skonk Wulf (\$63.99), Ibis (\$41.99), Sea Sting (\$37.99) and Johnny Star Commander (\$41.99)



Finally, there is the Semroc Sabre parasite glider. You can attach it to any rocket similar to a Big Bertha and it pops off at apogee. It includes laser cut parts, has a 3.8" wingspan and is 6" long



**Miller Motor Works**  
<http://www.millermotorworks.com/>

## LOC Precision

Also getting in on the 50th anniversary of Apollo 11 is LOC Precision with their monster seven and a half foot tall, [LOC Custom Saturn V](#). The diameters are 7.5" to 5.5" to 3". It comes with fiberglass fairings and transitions, milled wooden capsule, laser interlocking tower, and StickerShock/LOC vinyl decal set. It also comes with a commemorative poster. The cost range is between \$535 to \$665 depending on optional equipment.

