LUNAR

LUNAR 'clips

Livermore Unit of the National Association of Rocketry

Volume 5, Number 3
May/June, 1998

I. In This Issue

LUNAR'clips is also available on-line at

http://www.starship.org/LUNAR/LUNARclips

II. LUNAR Meeting, Thursday, May 21

Thursday, 7:00 p.m. - 9:00 p.m.

Lee Teicheira will discuss adhesives, glassing joints, pressure bonding and other sticky subjects at LUNAR's next meeting, starting at 7:00 p.m. in the community meeting room at the Livermore Police Station, 1110 South Livermore Avenue. Lee's presentation will follow a regular club business meeting starting at 7:00 p.m.

III. "VandyBlast," June 27-28, Vandenberg

"VandyBlast" will be a two-day rocketry event at Vandenberg AFB, near Lompoc, California (the U.S. Western Spaceport). Launching of 1/4A through M rockets is scheduled for June 27th and 28th.

Pads with 1/8" through 7/16" rods will be provided. For other configurations, special needs, etc., please write with your request. A 5,000' AGL waiver has been applied for, however the final altitude may be HIGHER. Launching should take place both days starting around 8 a.m. and running until the winds pick up around 2 or 3 p.m.

Camping may be available on-base. A local hotel has been contacted and a group rate is being organized.

Since this is taking place on a military base, advanced registration through CCAMS will be required to get on base. Please call our voice mail at **(800) 549-9688** for updated information as it becomes available, or visit our Website at

http://www.geocities.com/~ccams

for more details and registration materials.

IV. The Range Head

by Jack Hagerty, LUNAR #002

1. BACK ON TRACK

I guess that people really believed that winter is over since the April launch set another high water mark for launch volume. The previous record, set May of last year, was shattered by nearly 30 flights! Of course, this was an extended launch started early to accommodate both some Indian Guide tribes and a Cub Scout pack, but in retrospect it only ran about an hour longer than our regular launches. It was also supposed to be our first night launch of the year, but red tape at the FAA held up our waiver renewal so we had to quit at dusk (8 PM) rather than the planned 9 PM.

Here are the stats:

April, 1998

Total Flights: 259
Total Motors consumed: 264 + 9 unknown
Total Impulse expended: 5,751 Nt-s
Average Impulse: 21.8 Nt-s (a low end "E")

Motor Use Breakdown:

1/4A	1/2A	A	B	C	D	E	F	G	H
0	4	31	49	96	41	8	17	13	5

Most of the IG's and Cubs were flying "C" motors which, all by themselves, had more flights than some previous launches totals! This dragged our average impulse down a bit. Also, there were a high number of people who didn't list a motor on their flight cards, but they were all single motor Estes kits.

Even though it was disappointing not being able to fly in the dark, everyone had a really good time and the weather was perfect all day. Even after my four hour LCO shift, I hung around to the bitter end talking to everyone and enjoying myself.

2. RAIN, RAIN, GO AWAY!

Things didn't go nearly so well in March. I don't know what we did to offend the rocket gods that month, but they certainly sneaked in a zinger past all of the local forecasters.

After three weeks of almost completely dry weather, a front started moving in Friday night. The soothsayers, however, said that it had stalled and wouldn't reach California until Saturday night, and even then only the far northern end. It was with great confidence, then, that we set up the equipment and got our first launch of the year going. Once it was underway, Joe Heckenbach and I set up the trackers

for the altitude section of the contest which had been delayed since last December!

The crowds were not the mob I had expected, in fact they were relatively light. Maybe people were just gun shy, but those that showed up had some very nice flying conditions during the morning with mild temps and light winds. Contestants flying in the C-Alt event weren't so lucky. The mass of featureless gray clouds overhead were exactly the color of tracking smoke and the contest rockets disappeared as sure as if they'd had a Klingon cloaking device! After five of the seven flights were no-tracks due to one or the other (or both) trackers loosing it, Contest Director Dan Davis called the contest and we moved on to Spot Landing. By now it was after 12:30 and just about the time we would normally start packing up. There were still plenty of sport flyers along with the contestants and we didn't think much of a little sprinkle until it gradually escalated into a full blown downpour. I called the launch at 1:15 and we pulled the equipment down in record time.

Afterwards we found out that the damage was more than some frustrated contestants as our equipment meister Warren Massey explains:

> "I brought the trailer of equipment home after the launch and unloaded it into one bay of my garage just to get it all spread out and drying.
>
> It was not a pretty sight.
>
> The particle-board tops of the tables are starting to show signs of moisture exposure. The LUNAR banner has a mildew problem (it was put away wet the previous launch).
>
> The launch rod standoffs are probably the worst since they were made with dissimilar metals (steel & aluminum) in contact and are covered in exhaust residue that turns quite acidic (black powder motors = sulfuric acid, composite motors = hydrochloric acid) when it gets wet.
>
> Note that even our stainless steel blast deflectors and launch rods are vulnerable to the hydrochloric acid.
>
> We are not an all-weather organization and cannot try to be. If there is a reasonable chance of rain, we are going to have to refuse to setup in the first place or else start to take down just as soon as it becomes apparent that the rain will start in the next few hours. It doesn't matter how long it's been since we last flew or how much we want fly or finish flying on a particular day. The "wet" just takes too great a toll on the equipment otherwise."

I have no choice but to agree with Warren here. The investment in our equipment is too great to risk loosing it. It's taken years to build it up to the current performance levels and the only reason we've been able to keep, and even expand, our capabilities is Warren's tireless efforts. If we were to suddenly have to replace large portions of the flight and/or support equipment we might not be able to do it. We would certainly have to have a sizable dues increase!

I'm going to make this an agenda item for the May meeting so that we can come up with some reasonable "wet threat" guidelines.

3. LOST & FOUND

Last January I made a proposal to start auctioning off items that were left in the Lost & Found box for more than six months. I guess all you have to do is threaten to start selling off their stuff and people start coming out of the woodwork! At the past two launches people showed up to pick up the Initiator, Black Brant, Bullpup and a bunch of odds and ends. In fact, I only came back from the March launch with one new rocket and that was a very nice ASP that had been contest prepped. I knew I wouldn't have it for long because the owner had placed an info sticker on it with his name, phone number and NAR/LUNAR/Tripoli/AMA numbers on it! When I informed Ken Biba that I had his model he replied:

> "Good that someone found the model - I certainly couldn't. This now qualifies for as the third "given-up-for-lost" model that's been returned to me due to those tags including two lost during the Poseidon flying at the

Berkeley Marina and later washed ashore."

I can't say it often enough: Get a roll of address stickers printed up, 200 for $5, and put them on every part of the rocket that might come down separately. You'll be glad you did. Ken certainly was, he picked up the ASP at the April launch. I came home from that launch with only one new lost rocket: the tail end of an Aerotech Arreaux with a $40 reloadable casing in it owned by...Ken Biba! Make that four, Ken.

4. MAY MEETING

The meeting this month is on Thursday, May 21 at 7:00 PM at (as usual) the public meeting room at the Livermore Police Station. The featured speaker will be Lee Teicheira who will enlighten us with a talk on strengthening your models by fiberglassing. There is one other short item in between the business part of the meeting and Lee's talk.

At the top of the previous section I mentioned that my proposal to auction off old L&F items had been unanimously adopted. Well, May is the time to get rid of everything more than six months old. As I said above, most of the really nice stuff was claimed by the owners, but there are still quite a few odd's and ends (some of it non-rocket related) to be had. I have a few surprises of my own to throw in there. All of the proceeds go into the club general fund which will help offset the loss of the Kiwanis funds.

5. F/F SCALE CONTEST

Just a reminder that this month is the Fiction/Future Scale contest. Even though it's a bit late to get started on a model for this just-for-fun contest, it's still worth the effort to build a scale model of your favorite fictional rocket or proposed future design. You'll also be helping the NAR shake out the rules for a whole new contest. See the March 'clips for the official contest rules, or e-mail me for a copy.

If you still want to enter but can't figured out what to build in such a short time, Jim Fackert has an article (with enough detail to satisfy the "background data" requirement) and a set of plans for the "Luna" from the movie "Destination Moon." The plans are based on a couple of Estes PNC-55AC nose cones, but he gives optional choices for scaling it up or down using parts from other manufacturers. The parts are all off-the-shelf Estes pieces or easy to fabricate using simple hobby tools.

6. LOCAL HEROS

The March/April edition of Sport Rocketry magazine published the winners of last year's photo contest (they're inside the front cover) and two of the five are LUNAR members! Judy Heckenbach got her shot of Joe's upscale Mosquito taking off while Robert Jennings got a shot of a White Lightning powered model at the instant of ignition taken at last October's night launch. It was taken during dusk so everything is still quite visible, but the illuminated smoke cloud at the base is absolutely stunning! Actually, Robert isn't a member but attended as a guest of the Heckenbachs.

Congratulations, folks!

V. To Boldly go ..... Silver

by Geoff Canham, LUNAR #493

"... 3 ... 2 ... 1 ... lift off". The egglofter lifted off perfectly, then weathercocked over into an almost horizontal flight, but maintained a good altitude. There was the puff at ejection, then "Houston, we have a problem!". Where's the parachute? Oh. no! The motor had ejected instead of the recovery system. The splat at impact was loud and clear, and the remains looked tragic. The plastic egg housing was basically a collection of splinters, but with a lot of Goop adhesive and a considerable amount of paper, the QCR Easter Egg was back ready for a second flight a week later.

It was the end of April 1997, and my stepson, Matt Kennedy, and I were starting out on the NARTREK (NAR Training Rocketeers for Experience and Knowledge) silver level. The requirements were:

1. A successful payload flight
2. A rocket powered glider flight (either a boost glider or a rocket glider) of at least 30 seconds duration, using not greater than a B motor (preferably an A)
3. A successful cluster rocket flight, using 3 or more motors
4. A flight with a scale model rocket

Matt got the NARTREK Silver kit from QCR which included rockets for the first three categories, and an Estes Phoenix for the scale model. I started out with three Estes rockets: Astrocam for the payload, TransWing for the glider, and Mercury Atlas for the scale, with MIRV Gryphon from Seattle Rocket Works for the cluster.

Matt's egglofter was the first to fly, and its follow-up flights went much the same way as the first. Even after getting the motor taped in properly, the parachute failed to open fully and the eggs continued to die. The egg housing ended up with probably more Goop than plastic, and the body tube was held together with Scotch tape. It took a while to achieve success here, and Easter Egg became known as the Egg Scrambler.

My payload rocket, Astrocam, flew well on its first flight (a

week after the egglofter's first flight), but with a 24 frame film loaded, I had to fly it a few times before getting the film developed. Most of the frames were used up taking pictures of the various meets, only six frames actually being used on flights. The fourth flight had the shockcord break, but only minor damage ensued. The next flight was more problematic when it landed on a roof, and the search and rescue team (me) had to employ a bit of ingenuity to retrieve it. When the film was developed, the only frame taken on a flight that showed more than cloud and sky was the one taken on the final flight, at the May 1997 LUNAR launch.

That May launch also saw the Egg Scrambler finally leave the egg unscrambled. The same day the two cluster rockets (Matt's QCR 270, renamed Zippety-do-da, and my MIRV Gryphon) made successful flights, along with Matt's Phoenix, which had a picture perfect first flight. Also, my TransWing made a 34 second flight, but on checking my motors afterwards, I realized I may have used a C motor, rather than a B.

From previous TransWing flights I didn't think I was going to achieve the required duration on a B, so I set about building a Status-4 rocket glider, the design for which was included in the NARTREK package (although I did vary the design a bit). My Status-4 was ready for the June LUNAR launch and achieved a 35 second flight on its first flight, using an A10-3T motor. That same launch saw my Mercury Atlas make a beautiful flight on a D12-3, completing my silver requirements.

Matt just had his glider flight to complete, and his QCR Never Loop was ready to fly at the July LUNAR launch. It didn't live up to its name, looping several times, which was ideal because it meant there wasn't too far to go to recover it at the end of its 37 second flight on an A3-4T. On its seventh flight (at the December 1997 launch) it flew too well and disappeared from view, never to be seen again. A rebuild of the glider has been made, but it tends to float down rather than glide.

To date Matt's egglofter has flown six times, Zippety-do-da four times, Never Loop eight times (including the rebuild) and Phoenix seven times. My Astrocam has flown six times, MIRV Gryphon four times, TransWing seven times, Status-4 four times, and Mercury Atlas three times.

The NARTREK bronze level employed standard kits, but silver level, especially the glider requirement, needed more involved construction. We are now working on the Gold level, which involves designing and constructing a rocket from scratch. We'll let you know how we get on with it.

(Ed: Also see Geoff's earlier article "To Boldly go .. Bronze" in the March/April 1998 issue of LUNAR'clips.)

VI. Tools for Computing the CP of Model Rockets

by Lynn Kissel, LUNAR# 009

A rocket stabilized with fins generally requires that the CP (center of pressure) be located aft of the CG (center of gravity). While it is fairly easy to experimentally locate the prelaunch CG (by finding the point where the prepped rocket "balances" on a knife edge, or by suspending from a string, for example), measurement of the CP is more difficult – a wind tunnel of sufficient quality to measure the CP is a tool that is not usually available to most rocketeers. Fortunately, we have access to programs that let us easily estimate the CP of our creations.

We now understand that the CP of the rocket changes with varying angle of attack. The angle of attack is the angle between the centerline of the rocket and the relative wind – the air flow relative to the rocket caused by the motion of the rocket and any movement of the air due to winds or other atmospheric conditions. Generally, it is believed that the CP moves aft as the angle of attack increases, tending to decrease the stability of a rocket as it is buffeted by lateral winds. As a general rule of thumb, model rockets are often designed with the CP 1-2 calibers (body diameters) or more aft of the CG as a safety margin.

A rocket is particularly vulnerable to this wind-generated instability as it leaves the launch rod or tower, when its speed is still relatively slow. Depending on relative positions of the CP and CG, the rocket will tend to "weathercock" and fly up wind (if its stable), or it will tend to loop and crash down wind (if its unstable). A good analysis of this subject has been published in the March, 1998 issue of *High Power Rocketry* ("Wind Caused Instability," by Bob Dahlquist, p. 17).

I had a vividly painful experience of wind caused instability on August 10, 1995, when I launched *Scorpius* (a PML Io, with an added payload section) in an 18 mph wind with a low-thrust F22 "black jack" motor. The disaster, which created my second powdered altimeter-in-a-bag, is described in more detail in "The Phoenix Altimeter"

http://www.starship.org/LUNAR/LUNARclips/v2/v2n5/Phoenix_altimeter.html

Fortunately for us, methods exist to allow us to estimate the CP of a rocket for 0-10° and 90° angles of attack. For 90° angle of attack (not a mode wherein most of us want our rockets to be flying), the cardboard cutout method is an effective low-tech approach – a cutout of the lateral (side-ways) outline of the rocket is made and the CG of this cutout is your estimate of the 90° angle of attack CP. Some CP programs can also compute this value numerically.

The real breakthrough in designing stable rockets came in 1966. Jim Barrowman, a NASA aerospace engineer developed a series of equations for estimating the small-angle-of-attack CP which have become the basis for most current estimates of the CP used by rocketeers. These equations were subsequently published in 1970 as Centuri TIR-33. This report, which has long been out of print, has been reprinted in the March, 1998 issue of *High Power Rocketry* ("Centuri TIR-33: Calculating the Center of Pressure of a Model Rocket," by Jim Barrowman, p. 74).

It is important to remember that the Barrowman equations make seven assumptions that can severely restrict their validity (near 0° angle of attack; speed much less than speed of sound; smooth air flow; rocket thin and long; nose comes smoothly to point; rocket is axially symmetric; fins are thin flat plates). The Barrowman equations are not valid for non-axially symmetric models (such as boost gliders and the rocket from *It! The Terror from Beyond Space* shown elsewhere in this issue), and for transonic flights.

A number of commercial, shareware and freeware computer programs are now readily available to aid in rocket design. The Rocketry Online web site has pointers to over a dozen programs that can simulate flights, model motors, compute CP/CG and otherwise support rocket design at

http://www.rocketryonline.com/

Two programs that compute CP/CG have caught my attention. *VCP* is a **free** program for Windows-based computers that is great for computing CP based on the Barrowman equations

http://www.impulseaero.com/Software/VCP/index.html

VCP can support one-, two- or three-stage rockets. One really nice feature is the ability to enter data in mixed units; millimeters here, fractional inches there. *VCP* automatically converts all your input to the units that you've selected. A quirk (or feature) of *VCP* is that distances are measured relative to the aft of a component – the main reference point is the aft of the sustainer stage. A graphical display of your input is built up as you go, allowing you to visually check the validity of your input.

RockSim 2.0 from Apogee is another interesting program. Although it isn't free, the $35 cost is not too high, and a demo version can be downloaded for free from

http://www.apogeerockets.com/

RockSim 2.0 claims to be a complete design program, computing not only CP/CG, but it also produces flight simulations, aids design of recovery systems, outputs templates for fin construction, and more. Some particularly nice features of *RockSim 2.0* is that it contains an extensive library of predesigned parts, and you can add your own parts to the library. It also has some intelligence about materials – it has default properties for lots of materials such as balsa, basswood, paper, and plastics, so that it can estimate the mass and CG of new custom components based on their dimensions and composition. A graphical display is built up as you add components to your design, allowing for visual verification of your input.

RockSim 2.0 utilizes a new "*Fossey/RockSim*" stability technique that claims to go beyond the Barrowman predictions, which are also computed by the code. I'm not aware of another CP program that claims to go substantially beyond the Barrowman equations.

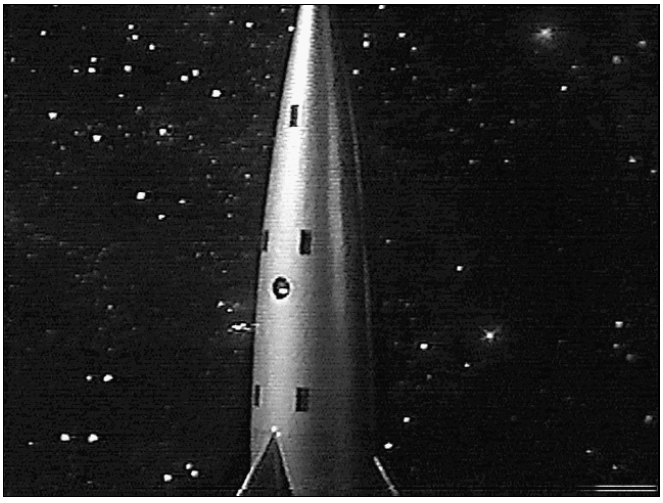
Unfortunately, all the CP programs that I've seen permit the design of only symmetric rockets with 3 or more fins. I'm not sure how well one could compute the CP for highly asymmetric designs (such as the spaceship from *It!*). The Barrowman equations for fins scale with the number of fins. But, would one get reasonable CP estimates using these equations for 2 or 1 fins? You can watch my flight of *It!* at the May launch and we'll both learn if it is stable!

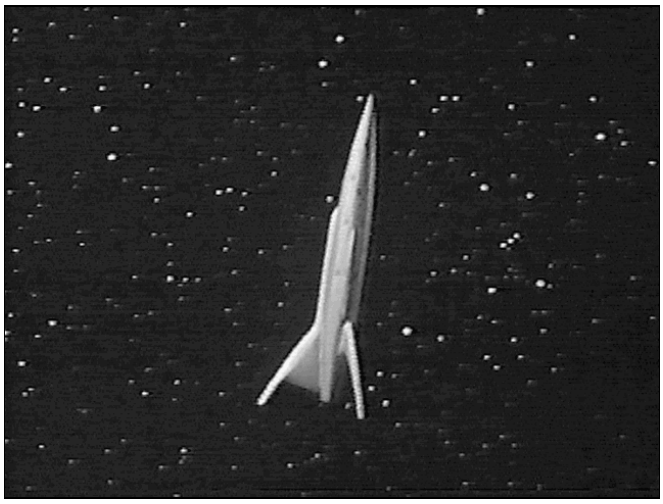
VII. It! The Terror From Beyond Space

by Jack Hagerty, LUNAR #002

[The following article is excerpted from the upcoming Saturn Press release *Spaceship Handbook* which should be out at the end of the year. © 1998 ARA Reprint Services, all rights reserved.]

Film producers are a shameless lot, especially those of low budget films. George Pal worked with Robert Heinlein on their epic *Destination Moon* (1950) and they hired Chesley Bonestell to both do the background paintings and help with the design of spaceship *Luna*. Bonestell offered them a





design which was a mild reworking of the *Transcontinental Transport*, but for reasons that must have seemed good at the time, the producers rejected the design. *Destination Moon* was a huge success both critically (it won the Academy Award for Special Effects) and at the box-office. Naturally, all of the exploitation film makers started lining up to do low budget knockoffs, including *Flight to Mars* (1951) which provides an interesting footnote in the evolution and use of the "winged rocket" concept. One of the producers of FTM had worked on *Destination Moon* and knew of the discarded Bonestell design. Since it was already paid for, he was able to put a genuine Bonestell design into his film for only residuals!

The rocket from *Flight to Mars* wasn't quite done with it's travels to that planet. Seven years after that worthy effort, it resurfaced in the Sci Fi/Horror film *It! The Terror From Beyond Space*. Genre buffs will recognize this 1958 cheapie as the inspiration for the 1979 hit *Alien*. A deep space mission is returning to earth with a crew of five men and two women. Unknown to the crew, a hostile alien has gotten aboard and proceeds to dispose of the crew one-by-one, starting with the captain in one of the ventilation ducts. All efforts to kill the thing fail until someone notices it's an air breather and thinks to open a hatch. If you're a bit confused as to which film we're discussing, that's because the above description applies to both of them!

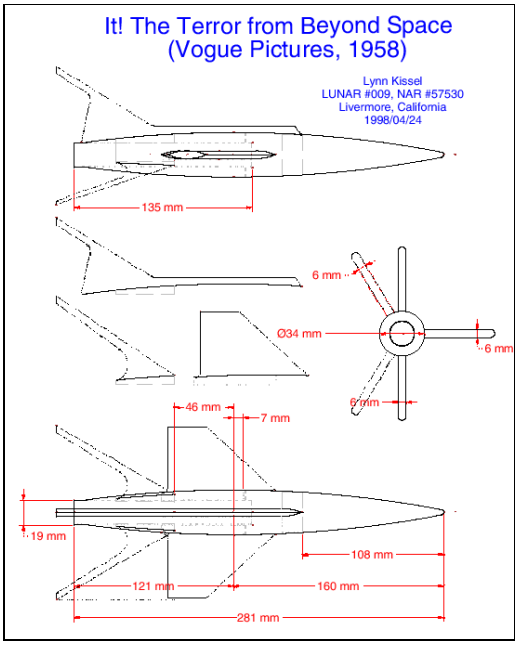
For the exterior shots of the Challenge 142 [a name chilling in its similarity to another spacecraft crewed by five men and two women which suffered a horrible, non-fictional fate] we find the already-once-recycled ship from Flight to Mars. It is unmistakable with its ogive hull, three-stick landing gear and with the area under one of the legs filled in to form a single fin. Director Edward Cahn, though, was quite stingy with his SFX shots and there are only two scenes showing all of the ship's exterior: one of it taking off from Mars at the beginning of the film (with a huge display of sparks and smoke) and a "coasting" shot of the rocket from a considerable distance drifting from the bottom to the top of the frame. This latter shot is repeated, without variation, no fewer than 10 times throughout the film any time the director wanted to fade between scenes.

Additionally, there is a gratuitous space walking sequence where two crew members try an "end run" around the monster by going out one of the upper level airlocks, walking down the ship to a lower level airlock. Mostly what this does, in the one medium shot of the exterior, is establish that the rocket is riddled with airlocks, at least 10 of them, since they are necessary to the plot.

One curiosity concerning the treatment of the model in this film is that, apparently, the director didn't like the idea of a winged rocket. After all, both the Soviet Union and the U.S. had orbited satellites by the time this film came out, an none of the "real" hardware had wings. Therefore, in all three scenes showing the exterior, the model is held with the right wing square to the camera such that the tip and root chords (which lie on top of one another from this viewpoint) just look like pieces of plumbing running down the side.

Quickspec: Rocketship *Challenge 142*

Vehicle Morphology	BFNC
Year	1958
Medium	Theatrical Film
Designer	Chesley Bonestell
Length	142 ft (43 m)
Max Diameter	13 ft (4,0 m)



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Volume 5, Number 3
May/June, 1998

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Who We Are...

LUNAR is the Livermore Unit of the National Association of Rocketry, Section #534

LUNAR is located in Livermore, California, about fifty miles southeast of San Francisco. We are organized to supply a safe, educational and legal means of furthering the hobby of model and high-powered rocketry in northern California, to aid and encourage the development of all club members' knowledge and expertise in the area of rocketry, to promote youth education and community involvement, and to engage in scientific, educational and related activities. LUNAR is open to rocketry hobbyists of all ages to further the sport and science of hobby rocketry within the NAR (National Association of Rocketry) and Tripoli safety codes. These codes have allowed hundreds of millions of model rocket launches by hobbyists since the late 1950's without serious injuries.

LUNAR also supports assorted rocketry activities of community youth groups. We have hosted launches (and in some case building sessions) for the Boy Scouts, 4H, Indian Guides, the GATE program, and LARPD Science Camp.

Launches

Section launches are usually held from 8:30 a.m. to 12:30 p.m. on the **third Saturday of the month**, unless preempted by other civic events. Our launch site is in Livermore at the soccer practice field of Robertson Park, adjacent to the rodeo grounds, in the southeast corner of town. Generally these are *sport launches*, although we occasionally hold sanctioned *contest launches* for points in the NAR national contest standings, *theme launches* where we focus on a particular class of rocket, and *night launches*.

LUNAR's launch site has been certified by the Fire Marshall up through "H" power, and is the only place in northern California where this level of power can be legally flown.

The LUNAR Hotline - (925) 443-8705

The Hotline is available to provide up-to-date event information. It's a good idea to call our Hotline to verify the date of the next launch or meeting.

On launch days, the Hotline recording is updated by 7:00 a.m. to reflect the Go/No-Go status of the launch. On launch days with questionable weather, it is especially important to call the Hotline to get the latest information. You can also leave messages on the Hotline.

Meetings

The LUNAR annual meeting is held during the first quarter of the calendar year at a time and place announced to the membership. At this meeting, officers are elected and other club business is conducted.

Other section meetings are currently held on a bi-monthly bases. These meetings cover section business, and typically include presentations by club members or other experts on some aspect of the hobby, ranging from simple building tips to advanced science and engineering principles.

WWW site!

LUNAR maintains a World-Wide-Web site on the Internet. It is accessible via the URL (uniform resource locator)

http://www.lunar.org

There's a lot of stuff to see there, and it always contains the latest information about LUNAR and our activities. For example, you'll find our latest launch and meeting calendar, directions to our launch site, a gallery of photos from past launches, the on-line issues of the LUNAR'clips (the section newsletter), our section bylaws, pointers to member rocket pages, pointers to other rocket and space related information on the Internet, and lots more!

The on-line version of the LUNAR'clips is in some ways better than the hard copy version that we mail to the membership. For example, the on-line version often has color images or additional visual material that doesn't appear in the hard copy version.

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LUNAR Calendar

Launches at LARPD Soccer Fields, Robertson Park (N 37° 40.10´, W 121° 45.36´)
Meetings at community meeting room, Livermore Police Station, 1110 S. Livermore Ave.

WARNING! Times and dates are subject to change with little or no notice. For launch confirmation call the LUNAR Hotline **(925)443-8705** after 7 am on launch day. Otherwise, visit the LUNAR web site at ***www.lunar.org*** for the latest information.

May 21, 1998, MEETING
Thursday, 7:00 p.m. - 9:00 p.m.
Lee Teicheira, on glassing fin joints and adding strength where it is needed

May 23, 1998, LAUNCH
Saturday, 8:30 a.m. - 12:30 p.m.
Science Fiction and Future Scale competition

June ?, 1998, Special LAUNCH
sometime week of June 1-5
Mendenhall Middle School

June 20, 1998, LAUNCH
Saturday, 8:30 a.m. - 12:30 p.m.

July 9, 1998, MEETING
Thursday, 7:00 p.m. - 9:00 p.m.
Royce Longacre, finishing techniques

July 12, 1998, LAUNCH
Sunday, 8:30 a.m. - 12:30 p.m.

August 8-14, 1998, NARAM 40
NAR annual meet
Muncie, Indiana

August 15, 1998, LAUNCH
Saturday, 8:30 a.m. - 12:30 p.m.

September 24, 1998, MEETING
Thursday, 7:00 p.m. - 9:00 p.m.

September 26, 1998, LAUNCH
Saturday, 8:30 a.m. - 12:30 p.m.

October 17, 1998, LAUNCH
Saturday, 4:00 - 9:00 p.m.
night launch!

November 19, 1998, MEETING
Thursday, 7:00 p.m. - 9:00 p.m.

November 21, 1998, LAUNCH
Saturday, 8:30 a.m. - 12:30 p.m.

December 19, 1998, LAUNCH
Saturday, 8:30 a.m. - 12:30 p.m.

LUNAR
912 Loyola Way
Livermore, CA 94550-7286