# SNOAR NEWS

August 1990 — THE LEADER IN SPACEMODELING — $2.50

## EXCLUSIVE! PATRIOT SCALE DATA!

*Model Rocketry's Longest Publishing, Most Controversial Newsletter!*

August 1990 Volume 16, Number 2


# *TRIPOLI:* Will It Stay, Or Will It Go?

The National Association of Rocketry is poised to make one of its most sweeping decisions ever. When the Board of Trustees makes the decision whether or not to incorporate Advanced High Power Rocketry (APHR) into the association, it will have vast implications. One of the most interested parties will be the Tripoli Rocketry Association, Inc.

Assume, for the sake of discussion, that the NAR forms a new AHPR division. Suppose that the NAR makes provisions to certify and control Class B rocket motors up to "J" or "K" classes, provides a mechanism in which members can become qualified to purchase progressively larger Class B motors, provides insurance for AHPR activities, works with local, state, and federal officials *(Continued on Page 21)*

## Legal, Accounting, Personnel, and Department

### QUOTABLE ...

**"Unless the high power consumers recognize that the real "bogey man" ain't the NAR, but the public safety officials and legislators who will write restrictive codes and regulations with or without consumer input... this will be a tragic mistake for the future of sport rocketry in this country."**

J. Pat Miller Jr., discussing the NAR's AHPR study.

### COVER STORY:

**The Patriot Surface to Air Missile Blasts off...** and you can, too, with your own scale model made from the exclusive data presented in this issue. *(US Army photo)*

### CREDITS:

Don't play this newsletter backwards on your stereo! Don't do it! There are no subliminal messages! And now we start that funky white boy rap, see...

Da big Boss Man is JD McNeil...his helper be Mr. Matt M. Steele... Other folks been helpin' out, too.... there's Robyn, George, and Scooby Doo.... Chris and Dan and Terry Lee.... Gary, Mary, and the KGB...

Tony Willams gets special thanks... wonder if he's switched to tanks.... there's Mary, and Gary, and Connie and Ronnie... and Sally and Harry.... Butch and Bud, Larry, Curly, and Elmer Fud.

Dat's all! Hammer, Don't hurt 'em... hear?

### *IMPORTANT STUFF*

SNOAR NEWS will be published for a few more issues by SNOAR, NAR Section #337.



Subscriptions are no longer available, except to get the remaining few issues to be published. Contact Matt Steele to get more info on costs at: 13011 Branscomb Rd., Huntsville, AL 35803.

You can reach our editorial offices at: 8151 Oldfield Drive, #6, Huntsville, AL 35802.

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**Published with a Mac SE and a Laserwriter IINX.**

**Th..Th..Th..That's all, folks!**

# Clustering

By George Gassaway

## Introduction

Model rocket engines were first flown in a cluster in the very early days of the hobby, 1958. Back then, clusters were the only way to have high liftoff thrust. The only engine available was the M.M.I. type A engine (equivalent to an A3-3). Yet today with wide availability of many types of engines, including high power-high thrust D, E, F, and G engines, models using clustered engines are still with us.

Right away it should be pointed out that clustered models are trickier to fly than most. They require special attention to flight preparation of the engines. If an engine fails to ignite there will be an imbalance in thrust which will cause the model to pitch over during launch, reducing the altitude capability and sometimes crashing into the ground while thrusting. Therefore, it is important to understand the design ignition techniques of clusters before trying your first cluster model.

It is generally best to use a single high power motor if it can fulfill your needs as well or better than a cluster. Some people will use clusters as a lower cost alternative. A model using a cluster of three D12's can fly in an F class event for about half the price of a suitable thrust composite F engine. Some people like the aesthetic "fire n' smoke" exhaust of clustered black powder engines, since early composite engines had little or no visible exhaust. And of course, some scale type models are more realistic if they use clustered engines as the full size vehicles did.

Clustering is usually used to develop high thrust for heavy rockets or to lift heavy payloads. The modeler needs to decide how many engines are necessary to do the job, depending on the liftoff mass (including the engines), the desired acceleration rate, and required performance. When engines are fired simultaneously in a cluster, the total thrust is equal to the sum of the thrust of all engines used. Likewise, the cluster total impulse is the sum of the total impulse of all of the engines. Thus a cluster of three C6 engines will be roughly equivalent to a hypothetical E18 engine of 27 Newton-seconds (three engines times 9 n/sec per engine). The time/thrust curve also triples in thrust value, such that the maximum thrust of the cluster will be 40 newtons (13.33 newtons max thrust per engine). It is very important to keep these in mind when deciding on the number of engines, their n/sec rating, their average and maximum thrust, and the design and structural strength of the model they will power.

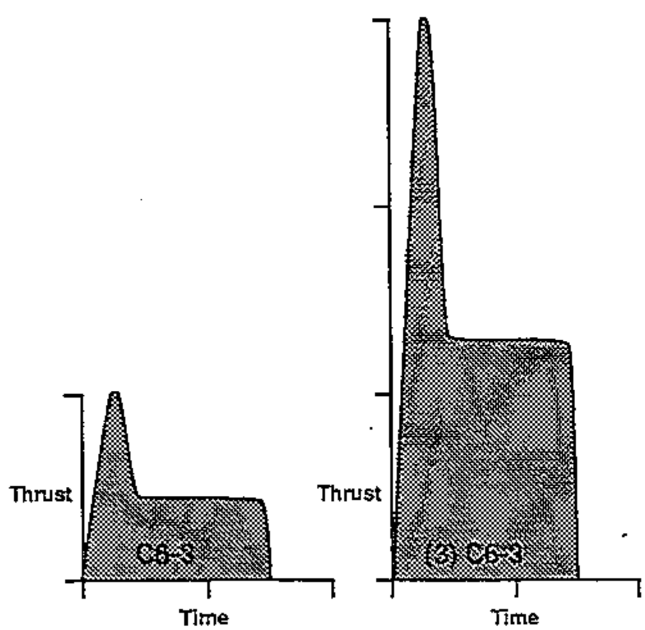
Without using Estes' TR-10 Altitude Prediction equations or a computer program, you can get a general idea of the performance by comparing your planned cluster design to a known similar size single engine rocket with roughly the same drag. If that single engine design flies up to 300 meters on a D12 and weighs 7 ounces at liftoff you can expect your similar cluster model to fly to about 300 meters if you use two D12 engines and have a liftoff mass that is double, 14 ounces. This is a big oversimplification, but will be a good ballpark guide for initial power and performance considerations.

## Cluster Configurations

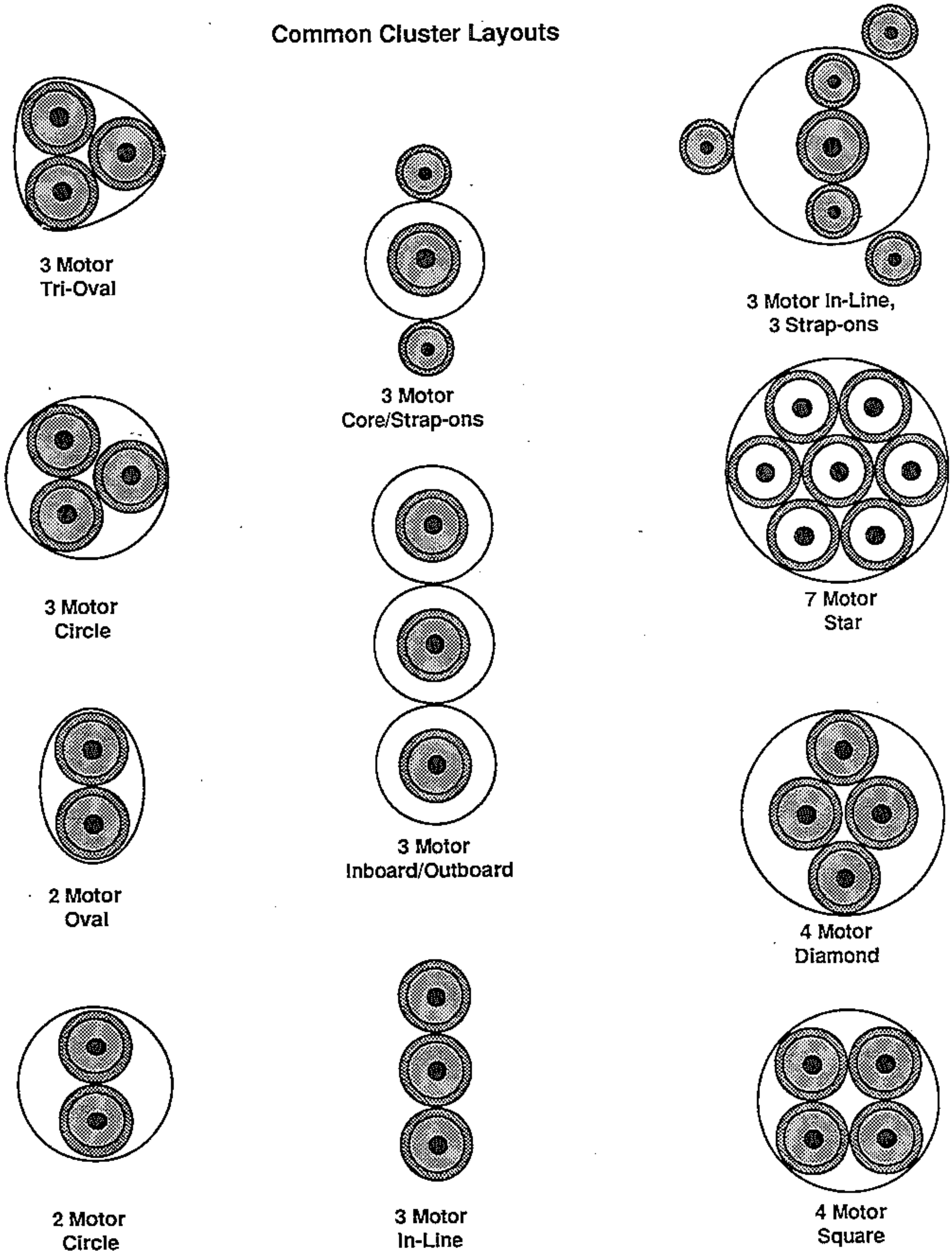
Many cluster designs use three engines, in part because that often is a good tradeoff for performance and economy (obviously the more the engines, the more expensive the model is to fly). Three engines also happen to fit perfectly in a triangular layout inside certain larger body tubes, such as three BT-20 mount tubes in a BT-60 or three BT-50 mount tubes in a BT-70. A parallel layout of three engines is also good, with the three engines side-by-side, although with some designs this presents more frontal area and thus more drag. This includes the "strap-on" approach, which is simply adding two small engine pods to the sides of the model. It adds some expense (two small nose cones, plus longer mount tubes), but does avoid the problem of sealing the gaps between the engine mount tubes in the main body (just use a normal single engine mount in the main body).

The two-engine cluster is uncommon, although it is certainly the cheapest and most reliable way to cluster (the fewer the engines, the fewer to potentially fail to ignite!). It is possible to perform some slick modeling tricks to put two engine mounts inside of a body tube that is less than double the diameter, by compressing the main body tube into an oval cross section at the tail. In this manner, two BT-20 mount tubes can fit inside a BT-55 or with extreme care two BT-50 mount tubes can fit in a BT-60. This type of pinched tail method usually requires that the model use 4 fins, as it is very tricky to align three fins on an oval cross section tube.

Typical Time-Thrust Curve
for Single Motor vs. Clustered Motors



## Common Cluster Layouts



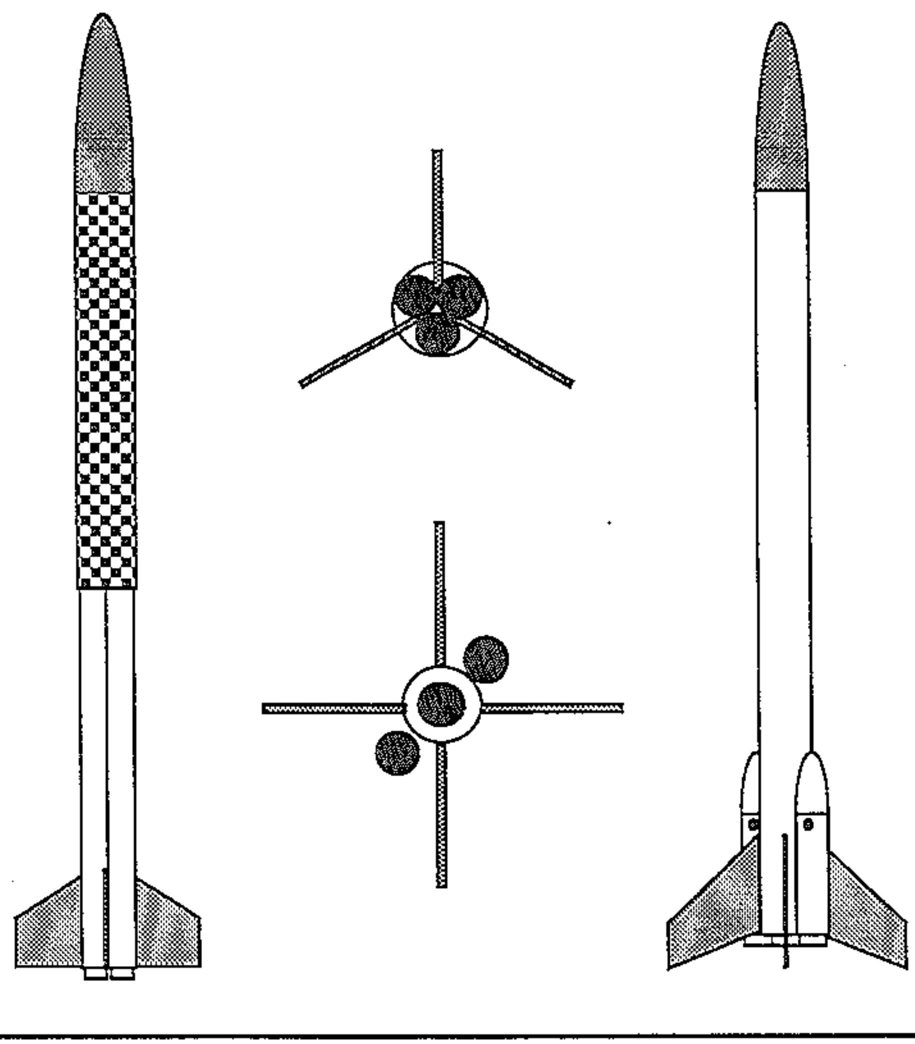
Four engine clusters can do the jobs that three can't. The engines can be aligned in a square pattern equally with a small space in the center, or a diamond pattern with two mount tube touching at the center and two others flush against those center-most mounts. There are not many reasons to use four engines aligned parallel. With a four engine square or diamond cluster you can simplify things a bit by just using two of the engines' ejection charges to activate the recovery system (unless the model has a lot of body tube to pressurize), the other two engines' ejection charges vented. This can let you use the proper delay engines for two of the mounts and any delay or even boosters for the other two (just be SURE to put the right engines in the right mounts!). Another thing this allows is flying the model with just two engines on some occasions, if it is light enough to fly safely on just two engines.

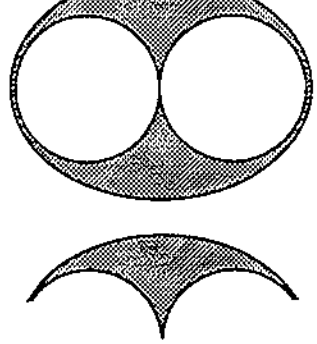
The four engine square technique also lets you use a "Mix n' Match" approach to clustering. You can tailor the thrust characteristics of a given model by combining two distinctly different types of motors to get a spectacular effect. For example, two D12's clustered with two E6 motors has all the smoke of a black powder liftoff wit the long burn of the E6.

There are many different engine arrangement combinations possible. While there have been over a dozen model rocket engines clustered successfully, there really is little reason to cluster so many. The use of two, three, or four engine clusters are adequate for most any legitimate clustering requirements. The more engines used, the more likely there will be one engine to fail to ignite (if 1 out of every 30 engines fails to ignite, a three engine cluster will have one failure out of 10 flights, a six engine cluster one failure out of 5 flights). It is also easier to spot trouble or avoid mistakes when working with just a few engines.

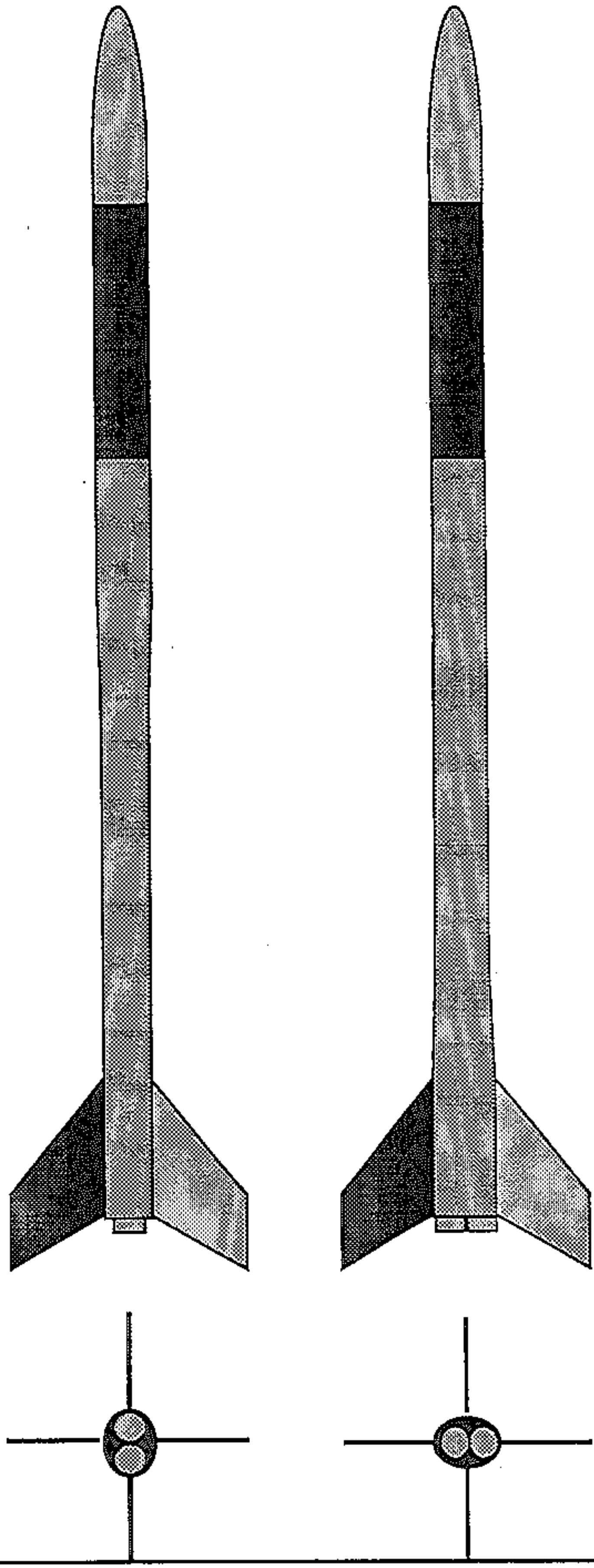
Regardless of the number of engines used, the engines must be arranged so that their thrustlines and thrust levels equally lift the rocket through the rocket's center of mass. In this case the center of mass should be considered from a rear-view roll-axis aspect, but we will refer to it as the centerline. The centerline should run through the center of the model's main body tube for all but the most unusual designs. The engine arrangement should be equal such that if a triangular three engine cluster has one engine placed 1/2" away from the centerline, the other two engines must also be

## Cluster Model Concepts





Oval Rocket
Centering Detail



Typical
Oval Rocket Cluster
Applications

placed exactly 1/2" away from the centerline. Further, those two engines must be spaced equally away from the first engine just as a three finned rocket has the fins spaced equally apart. The way to determine the angle is to simply divide 360 by the number of engines that will be at the same distance from the centerline (you probably know by instinct that a three engine triangular cluster should have the engines spaced 120° apart, but might not know that for a five engine pentagonal cluster the engines would need to be 72° apart). Many engine combinations will take away the need to calculate the arrangement, such as three BT-20's fitting perfectly aligned in a BT-60, but keep this in mind for unusual combinations.

Avoid placing the engines far away from the model centerline, such as gluing engine pods to the fin tips. Increasing the engine distance from the centerline increases the effect of a late or failed engine ignition to pitch the model severely during launch. The closer together the engines are to the centerline, the less pitching effect there will be from a late or failed engine ignition.

Clustered models almost always are more tail-heavy than single engine designs, and the more engines used the more tail-heavy it will be. Therefore, clustered designs usually require more fin area or noseweight to be stable. If the cluster model is designed to carry a payload, it is likely that the payload will be heavy enough to allow the model to be stable with normal fin size. It is a good idea to build all of the model except for the fins, insert all engines and additional liftoff masses (such as payload & recovery system) in their proper locations, and place some weight approximating the intended fin weight at the tail. Balance the model horizontally to find the center of mass. If the center of mass is more rearward than you expected, or your stability calculations planned for, you will have to increase the fin area or add noseweight to compensate. Unstable single-engine models are safety hazards, clustered ones are even more so.

When the fins are made, be sure they are strong enough to take the high speed and resulting high stress that most cluster models achieve. C-Grain 1/8" balsa or 1/16" plywood is sufficient for most clusters of three C engines. Higher power model rockets using black powder engines can require fins of up to 1/4" thick balsa or 1/8" plywood. The fins must be securely mounted to the model, using thick strong glue fillets (Epoxy may be somewhat heavy, but it does a good job). Extra strength can also be had by the "glue rivet" method of punching a few small (1/16-3/32" diameter.) holes into the main body tube along the fin root area. Rub some glue into the holes before gluing the fins on so that the glue will form "rivets" inside the body tube that hold the fin to the body tube more securely. Some models like the old Enerjet 2650 achieve good fin bond strength and perfect alignment by having the fins glued in-between where two of the three triangular configuration engine mount tubes meet, a trait many cluster models use today.

It is very important to fill any gaps between the clustered engine mounts and the main body tube. Otherwise, the ejection gases will escape through the gaps and not eject the recovery system. An easy way to do this with three BT-20 mounts in a BT-60 is to use an AR-2060 centering ring as a gas seal around the outer edges of the BT-20 mounts, but the center gap still must be filled. The long-time method for filling gaps is to mix a little white glue with facial or toilet tissue and jam portions of the glue-soaked tissue into the gaps. This is somewhat messy, but effective. It is neater and lighter to cut out a proper shape seal from 1/32 plywood and glue it into position. Just make sure it is securely glued, especially around large gaps. For models that have some free space between the outer engine mounts and the inner main body tube, it it best to make special centering rings to align the engine mounts. The centering rings should be strong enough to take the force of the maximum thrust of the engines. For models with a total maximum thrust up to 80 newtons (two D12's), 1/32 plywood is adequate, otherwise 1/16 or thicker plywood may be needed. If you do make special centering rings, be very careful that the holes are spaced equally apart from each other and the center. If not equal they could cause the thrustline to be out of alignment with the center of mass, with thrust-induced pitching problems.

Whether centering rings are used or not, all engine mounts must be aligned equally, usually exactly parallel to each other and the main body tube. If an entire cluster mount is a couple of degrees out of parallel from the roll axis centerline, the model will pitch to one side during thrusting causing a non-vertical flight at best, an arcing boost into the ground at worst. It is not too difficult to build cluster mounts correctly, but this is what may happen if you're careless.

It is possible to reduce the effects of an engine failure by canting the engine mounts inward toward the center of mass. It can also help to cause the rocket to roll by slightly tilting the engine mounts equally in the same clockwise or counter-clockwise direction. The rolling effect will help to even out the pitching effect if an engine fails to ignite, but even this may not keep the model from crashing.

You can mix and match groups, achieve a 5 engine cluster with a conventional triangular three engine cluster inside of the main body tube and add two "strap-on" type engine pods to the outside spaced 180° apart. That can be considered a five engine cluster with a three engine sub-cluster and a two engine sub-cluster. It is important to use the same engines for equal thrust levels and burn times. However, in a model with sub-clusters it is permissible to use one type of engine in one sub-cluster and another type of engine in another sub-cluster, such as three C6's inside the main body and two B4's in the outside engine pods. Here are some other examples of sub-clusters:

A four engine square or diamond cluster can also be considered as having two sets of two engine sub-clusters.

A three engine parallel cluster can be considered as having a conventional single engine (center engine) and a two engine sub-cluster (side engines).

The performance of clustered models can be improved by dropping burned-out engines or pods containing burned-out engines with a sustainer engine or engines to continue accelerating the model. An example of this would be a model using a F7 engine with 8 second burn in the main body and two D12-0 engines with 1.5 second burn as "strap-on" engines. Such a model would have very high thrust to accelerate quickly until the D engines burned out, then they could be made to drop away so the F7 could continue to push the model without the extra weight and drag of the D12's and their mounting pods. Cluster-staging can achieve much the same effect and is usually simpler. An example of cluster-staging would be a first stage of three D12's arranged in parallel so that the center engine can directly ignite the upper stage engine (another D12, for example). Such cluster-staging is well-suited to flying payloads.

## Cluster Igniters

There are several ways to ignite two or more model rocket engines simultaneously. We are limiting this article to igniters used for black powder type engines as sold by Estes and FSI. Engines using composite propellant, as sold by Aerotech and Vulcan Systems, often have special ignition needs that most black powder type igniters do not fulfill.

The first model rocket clusters were ignited by using relatively long 3-4" Jetex type fuses leading from each engine to a central point underneath the model where one nichrome igniter set off the whole group. This left a lot to be desired. The fuses were unreliable and sometimes the long slow-burning fuses resulted in some engines igniting late or not at all if the rocket liftoff caused the fuses to be yanked out of the nozzles.

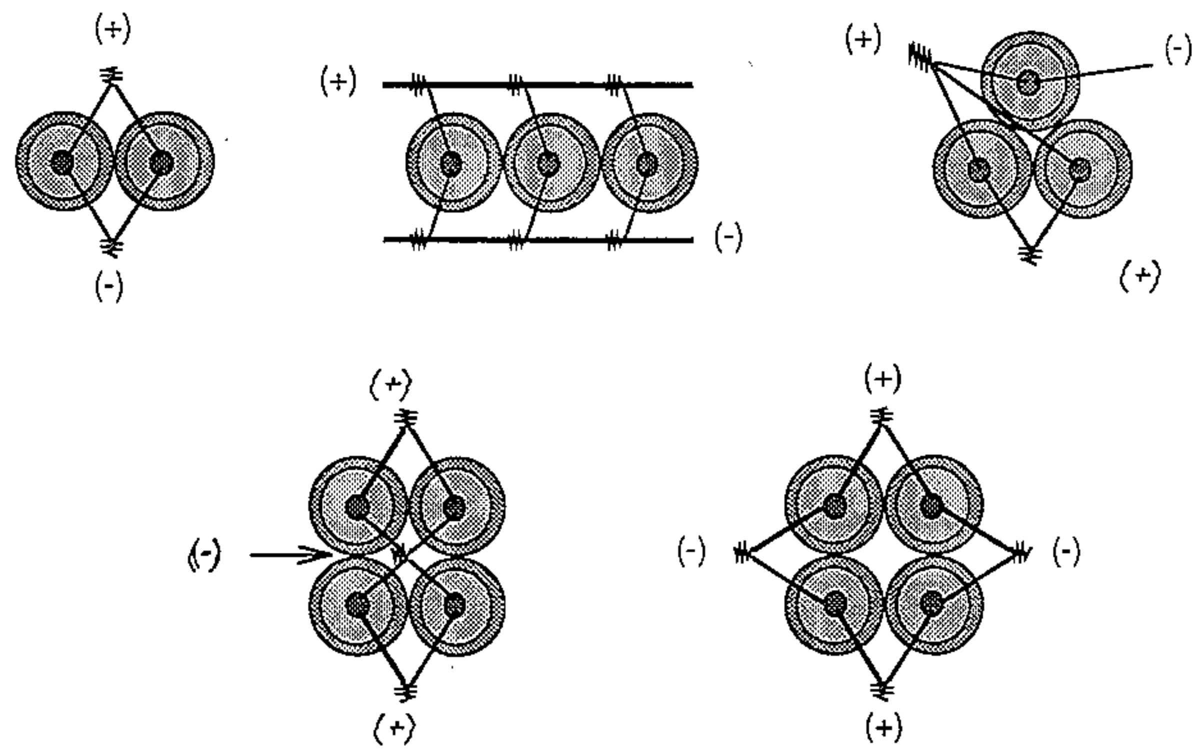
Later on with the improvement of nichrome type of igniters like the "Astron" type, it was possible to achieve near-simultaneous ignition of all engines by using an electrically activated igniter in each engine. This required very special care to avoid any shorts or poor connections or one or more engines would fail to ignite.

Reliability was improved with the Centuri "Sure-Shot" igniters. The Sure Shot consisted of a piece of nichrome wire and a short fuse wick. Electrical current through the nichrome wire heated it enough to set off the short fuse wick, which burned up into the nozzle to ignite the engine. It was slightly slower, but was consistent and not so slow as to have uneven ignition. The demise of the Sure-Shot came about when the special fuse wick could no longer be obtained by Centuri.

The Estes Solar igniter was Estes' answer to the Sure-Shot, but has never been quite as reliable. The biggest feature of the Solar is that it takes less current than most other igniters so that just four AA batteries are adequate to set it off. Some people have had success with Solars for cluster ignition, but they are not the best way to go for clusters. If Solar igniters are used for a cluster, choose igniters which have a good thick pyrotechnic coating (the black "blob" on the end of the igniter), as some Solars have more of a coating than others. The pyrotechnic coating is heated by a very thin nichrome wire element until it ignites, so obviously the coating is very important to the reliability of ignition. Extreme care must be taken in installing the igniters so as not to break the fragile nichrome element and hooking up the micro-clips to avoid shorts or loose connections.

In the early 1970's John Langford developed cluster ignition by using igniters incorporating camera flashbulbs, called "flashbulb ignition". It consists of using one flashbulb and one short Centuri Sure-Shot igniter fuse wick. The flashbulbs can be wired up very securely and insulated from shorts, and require little current to set off (so little current that checking continuity can provide enough current to set them off). The heat of the flashbulb going off is enough to ignite the fuse wick, which in turn ignites the engine. The Flashbulb ignition method has proven over the years to be the most reliable method for igniting black powder engines.

### Cluster Rocket Wiring Schemes



## Wiring Igniters

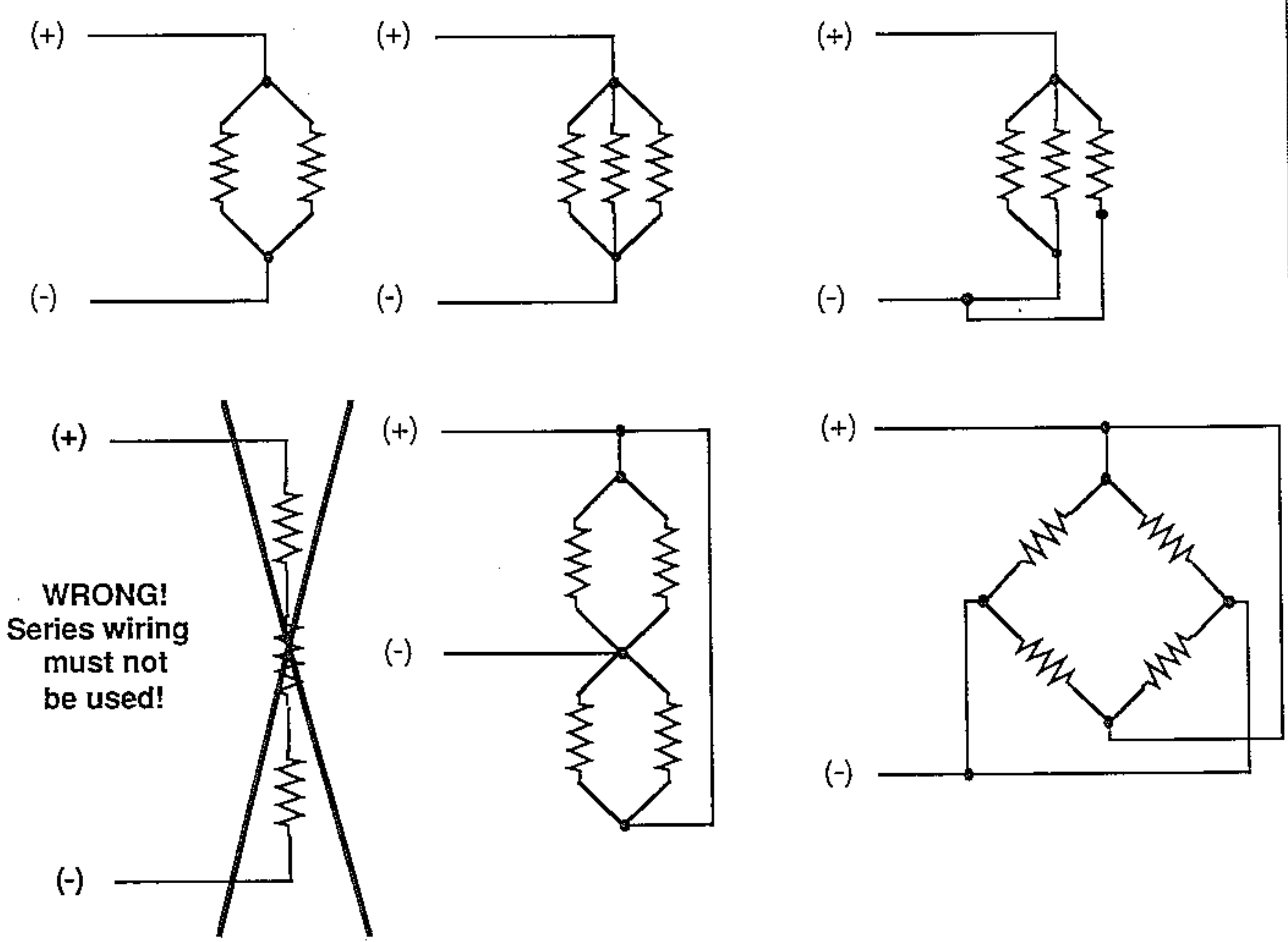
All igniters must be wired in PARALLEL, so that the current will be sure to pass through all igniters properly. Parallel wiring means that each of the two igniter leads are connected to the firing leads directly, not through another igniter. If the igniters are wired in series, with the igniter leads "daisy chained" from one to the other, it is almost certain that one igniter will happen to go off first and break the current flow to the other igniters, like a bulb going out in series-wired Christmas tree lights.

There are several ways to wire up the igniters in parallel, depending on the number of engines and the arrangement of the engines. The best way is to have extension wires coming from the igniters, as with Flashbulb ignition. The extension wires can be medium gauge hook-up wire about 6" long with 1" of insulation removed from each end. As with flashbulb ignition, wrap one end of the extension wire around each igniter lead, and insulate with tape. It is modeler's preference whether to add the extension wires before or after the igniter has been installed in the engine. The extension wires can be bundled together, one bundle for the positive (+) igniter lead and one bundle for the negative (-) igniter lead. The bottom end of positive and then negative extension wires twisted together to form the two bundles. In truth, igniters are not polarity sensitive, but it is a good idea to think of the two igniter leads as positive and negative for purposes of connecting them in parallel with other engines. You don't want to connect BOTH igniter leads to the same firing lead!

If you do not use flashbulb ignition or add wire extensions to conventional igniters, you can use the tried and true methods of the past. A twin engine cluster can be easily done by twisting the two igniter leads together if the two engines are close enough and the igniter leads are long and flexible enough. The catch-all is to make up extra sets of micro-clips to do the extension job. Rather than use a pair of micro-clips for every engine, it may be possible to twist together some igniter leads. Remember to keep the wiring in parallel, it would be a good idea to sketch out what you need to do and use the sketch at the field as a sort of "wiring checklist". Also double check that no wires or micro-clips are shorting.

Generally, cluster ignition requires much more electrical current than single engine ignition. A 12-volt car battery is preferred for all cluster launches, especially non-flashbulb

### Cluster Wiring Schematics



ignition types. The firing system should not use light gauge wire for the firing leads, as the thin wire may not deliver enough current to fire the entire cluster. Use at least 18 gauge wire (most extension cords are this gauge) or even 16 gauge.

## Flashbulb Preparation

The following are needed for flashbulb ignition:

Flashbulbs (individual AG-1 bulbs, or bulbs removed from Flashcubes).
Igniter fuse wick (Sure-Shot or Thermalite)
Thin electrical hook-up wire (about 20-24 gauge).
Plus: masking tape, pliers, and knife or wire strippers.

If the bulbs come from conventional Flashcubes, carefully remove the bulbs from the plastic case. The wire leads from Flashcube bulbs can be easily straightened for wire hook-up.

For most clusters about 5-6" lengths of hook-up wire will be sufficient, so cut two lengths for each engine (preferably using two colors of wire). Remove one inch of insulation from each end of the wire. Twist the bare wire end around one of the flashbulb leads. If the flashbulb is an AG-1 type with wire loops it will be necessary to twist and crimp tightly to assure of a secure connection, but be careful not to damage the bulb or wire. If you cannot get a secure connection any other way, it will be necessary to solder the lead wires to the bulb leads. Put a wrap of tape around the wire connection to the flashbulb to electrically insulate it. Repeat this procedure for the second wire to the flashbulb.

Sure-Shots are no longer available, so a substitute must be used. Thermalite is a professional pyrotechnic fuse somewhat similar in burning rate and consistency to the old Sure-Shot wick. However, it has both a protective plastic wrapping and a spiral-wrap of nichrome wire. The plastic wrapping must be completely removed. At least part of the nichrome should be removed to insure the wick itself contacts the bulb surface for proper heat transfer to ignite the wick (Removing all of the nichrome wrapping is best IF the wick is not so brittle that parts of it break away when it is bent to go in the nozzle). Thermalite is available from companies selling high power rocket engine supplies such as FSI (it is their standard igniter) and North Coast Rocketry. A piece of Thermalite one inch long is sufficient for most engines, but for engines with unusually deep nozzles and engine cores longer wick length will be necessary.

Place the fuse wick in the nozzle of the engine and then push the flashbulb up snugly against the nozzle. This will cause the fuse wick to bend out at an angle, so bend it back flush against the side of the bulb (this will give the wick a slight "z" bend). Check the wick for any major breaks as the thermalite is a bit brittle, discard the wick and try again if parts of it have broken off. Use a 1-2" long piece of masking tape to secure the fuse wick to the side of the flashbulb. It is important to be sure that the fuse wick is touching the side of the bulb so that the flashbulb heat will be properly transferred to ignite the fuse. It is also important to use masking tape for this, as other tapes such as Scotch cellophane tape can melt and literally let the fuse fall out before the engine ignites.

At this point you can separate the prepped flashbulb from the engine and wait until shortly before flying to continue prepping. There is a slight possibility of static electricity setting off the flashbulbs, some some people prefer not to have the flashbulb igniters in the engines until needed. In any case it is a good idea to twist the two wire leads of each flashbulb together temporarily to provide a short against static electricity during storage.

In prepping there are two ways to go, install the engines in the model first and then install the flashbulb igniters, or vice-versa. I prefer to have the flashbulb igniters fully prepped in the engines and then put the engines in the model, being careful not to put stress on the flashbulbs.

The final step in preparing each engine is to make a masking tape "collar" around the base of the engine so that with 3/4" wide tape about 1/4" sticks to the base of the engine and 1/2" protrudes down. Put the flashbulb igniter into place inside the collar, with the fuse wick inside the nozzle. Then press the collar down around the flashbulb to secure it to the engine. For 24mm diameter (i.e. D12) engines a longer collar may be necessary to properly secure the flashbulb.

With the engines installed into the model, connect the ignition wires together (undo the temporary twist shorting the flashbulbs first). This will be an easy task if the wires are color-coded, just connect all of the wires of one color together and then connect the wires of the other color together in a separate bundle. If not color-coded, be sure that only one wire from a flashbulb goes to one bundle, and that the other wire goes to the other bundle. If two wires from the same flashbulb go to the same bundle, that engine is not going to ignite! Temporarily short the two wire bundles together until the model is put on the pad and nearly ready to launch.

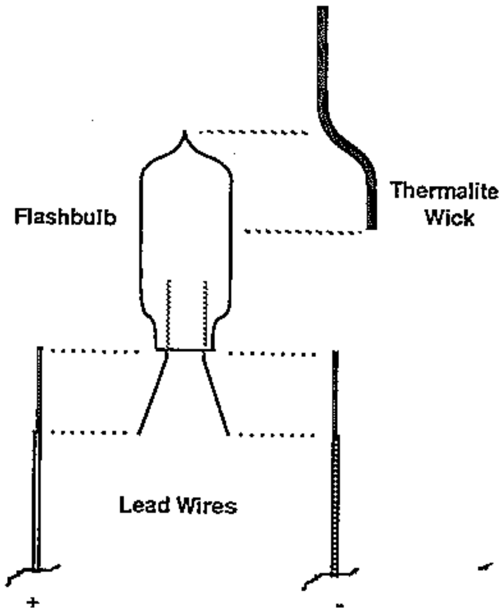
Before hooking up any ignition system, understand this. Flashbulbs require so little current to go off that MOST regular model rocket ignition systems can set them off during a continuity check. DO NOT CHECK CONTINUITY! The simple way to avoid problems is to disconnect the power source from the launch system, if possible, or otherwise make certain that no current whatsoever can flow through the firing leads. This means making certain the safety key is not in place. Once the firing leads have been connected to the separate wire bundles, remove the temporary short between the bundles.

When ready for flight, do not check continuity, or the model may take off earlier than you want. Since most firing systems have the continuity automatic when the safety key is inserted, either remove the continuity light bulb or do not activate the safety key until the desired ignition time, pressing the firing button simultaneously.

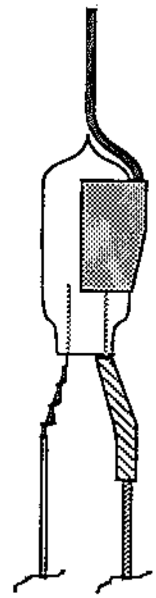
## Launching Cluster Models

It is preferable to use a large diameter and longer than normal launch rod when launching clustered models. A 3/16" diameter rod 4' long is the minimum for clusters of 20 n/sec or less, and rods up to 1/4" diameter and 6' long are highly recommended for model rocket clusters over 20 n/sec. If one or more engines ignite out of sync with the others there can be enough uneven thrust for the model to bend a regular 1/8" diameter rod. The extra rod length will keep the model straight for a longer distance until hopefully all engines are running, or at least give the model a faster vertical velocity before it is free to pitch over.

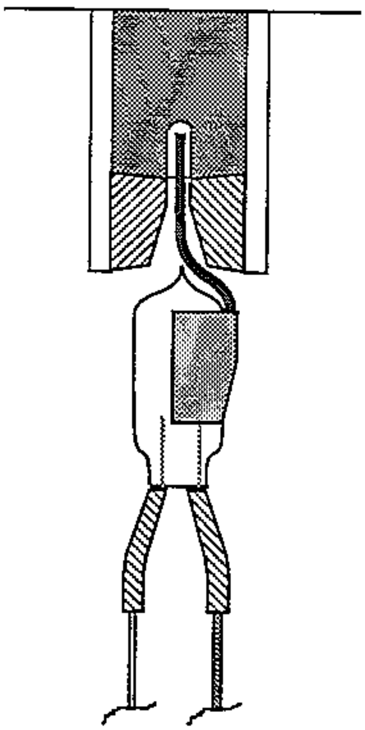
A good blast deflector is needed too, as the multiple engines create a lot of exhaust. One good effective blast deflector is a 90° elbow-bend piece of 3-4" diameter duct pipe, available at most hardware stores for about $2-3. This type of deflector will disperse the exhaust horizontally like most full



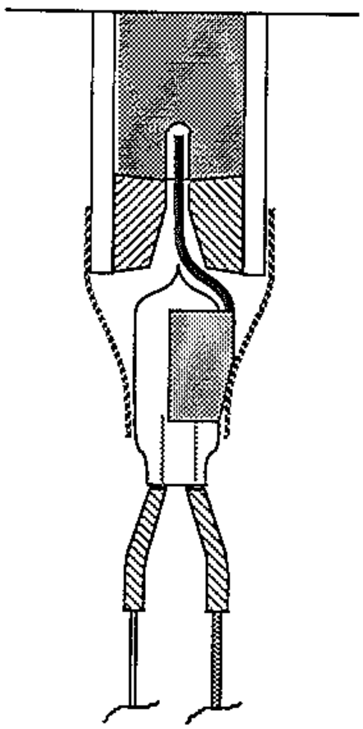

1) Flashbulb Assembly



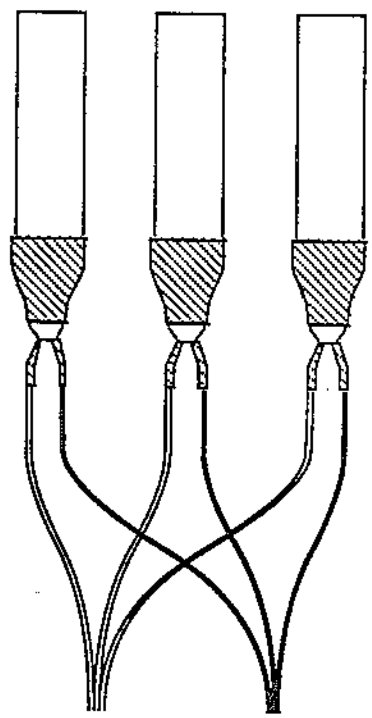
2) Completed Flashbulb



3) Insert the Wick



4) Tape the
Igniter
to the Motor



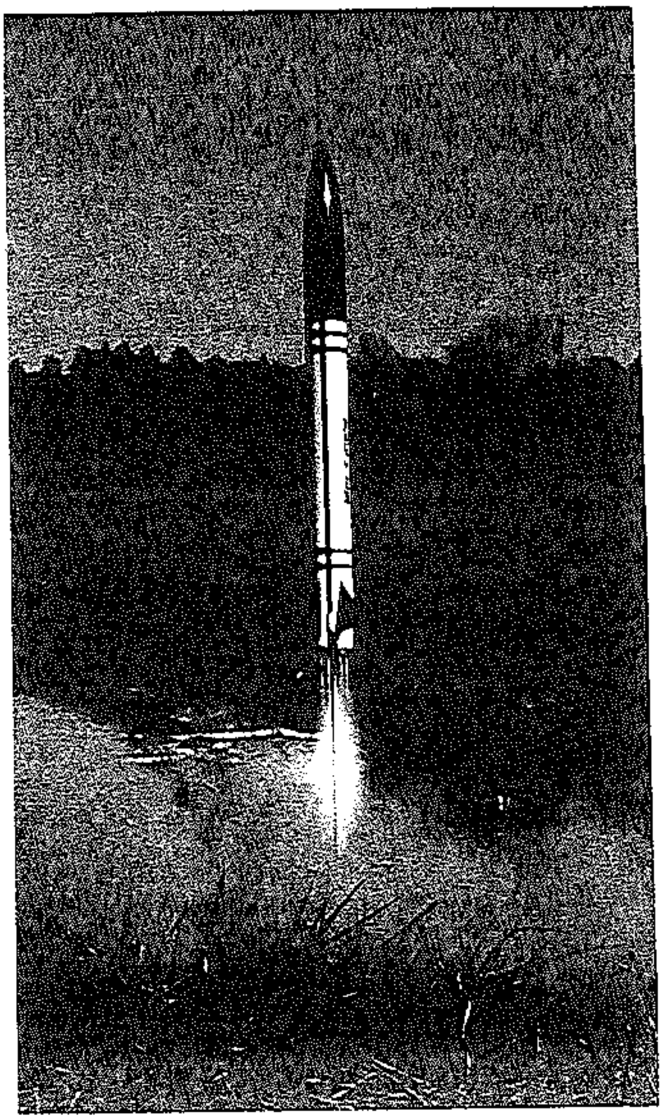
5) Tape the Leads
Together

size rocket launch pads. When this type of deflector is mounted at least a couple of feet above ground level, it is extremely unlikely that the exhaust can cause a fire in the launch area.

Carefully set the model on the pad. Be sure that the launch system is turned off or otherwise disabled. Hook up the micro-clips to the appropriate extension clips or extension wire bundles. Give the wiring connections one last look, and when everything is right clear the pad area.

Enable the launch system, but if flashbulb or other sensitive igniters are being used, do not check continuity (on most systems, this means don't insert the safety key until the moment of launch). Alert everyone in the area that a cluster flight is imminent, both for safety and to be sure they don't miss the excitement. Count down and launch. You should be rewarded with a pleasing roar of multiple engines and the sight of lots of "fire n' smoke" pushing your model quickly into the sky. . . .

Below: Ed Holland's Mini Katana lifts off under the cluster power of an Aerotech E15 and seven Estes B4 motors!



# Current Top Competitors List

July 16, 1990

| | | | NAR# | SEC | PTS | CF |
|---|---|---|---|---|---|---|
| *A DIVISION* | | | | | | |
| 1. | GOTTUNG | MARSHALL | 43234 | 471 | 5,454 | 12 |
| 2. | WEAVER | CHRIS | 41889 | 203 | 5,298 | 12 |
| 3. | MOSER | WILLIAM | 38831 | 459 | 3,630 | 12 |
| 4. | WHYMARK | MATTHEW | 46575 | 439 | 3,398 | 12 |
| 5. | MOSER | SAMANTHA | 40761 | 459 | 2,871 | 12 |
| 6. | KMETZ | JOHN | 44762 | 511 | 2,715 | 12 |
| 7. | MC BROOM | BOB | 47110 | 117 | 2,543 | 10 |
| 8. | LONG | COLE | 46392 | 511 | 2,535 | 12 |
| 9. | WHYMARK | JASON | 44382 | 439 | 2,079 | 12 |
| 10. | ATKINSON | MARK | 45967 | 403 | 1,872 | 9 |
| *B DIVISION* | | | | | | |
| 1. | SIAS | MATTHIAS | 43745 | 511 | 5,856 | 12 |
| 2. | BARKLAGE | TIM | 44211 | 475 | 4,944 | 12 |
| 3. | LA VALLEE | JEAN-ETENNE | 39244 | 471 | 4,010 | 10 |
| 4. | SNOWDEN | BRYAN | 43949 | 498 | 3,897 | 12 |
| 5. | ATKINSON | DAVID | 45966 | 511 | 2,340 | 9 |
| 6. | KIDWELL | CHRIS | 45225 | 203 | 1,500 | 6 |
| 7. | MITCHELL | JOHN | 51613 | 471 | 1,428 | 8 |
| 8. | TABOR | SEAN | 41687 | 203 | 1,376 | 5 |
| 9. | NAUS | PETER | 46155 | 480 | 864 | 3 |
| 10. | GLEMBOCKI | EDDIE | 39223 | 439 | 796 | 5 |
| *C DIVISION* | | | | | | |
| 1. | VINCENT | JEFF | 27910 | 471 | 5,035 | 12 |
| 2. | WEAVER | KEN | 44000 | 203 | 4,574 | 12 |
| 3. | SEXTON | JIM | 35936 | 461 | 3,661 | 12 |
| 4. | BERNATCHEZ | ROBERT | 29996 | 480 | 3,058 | 10 |
| 5. | WILLIAMS | FRED | 14198 | 487 | 2,950 | 8 |
| 6. | RUSSELL | CHAS | 9790 | 511 | 2,850 | 9 |
| 7. | FEVERYEAR | GLEN | 24931 | 503 | 2,593 | 12 |
| 8. | RICE | LARRY | 33323 | 113 | 2,412 | 11 |
| 9. | BARBER | TRIP | 4322 | 205 | 2,406 | 12 |
| 10. | MOSER | DAVID | 28979 | 459 | 2,293 | 12 |
| *TEAMS* | | | | | | |
| 1. | SOUTHERN COMFORT | | 553 | 511 | 5,490 | 12 |
| 2. | RINGER-RIVIECCIO | | 41 | | 2,417 | 9 |
| 3. | JPG SRB'S | | 5 | 71 | 2,234 | 12 |
| 4. | ACE DISASTER COMPANY | | 26 | 308 | 1,977 | 9 |
| 5. | JHBP STRAIGHT SHOOT | | 21 | 471 | 1,868 | 12 |
| 6. | JANKOV-PAVLOV+1 | | 489 | 205 | 1,839 | 7 |
| 7. | BARBER GIRLS | | 32 | 205 | 1,734 | 7 |
| 8. | THRUST YOU CAN TRUST | | 34 | 463 | 1,688 | 7 |
| 9. | MOM AND ME | | 18 | 486 | 1,679 | 12 |
| 10. | SHRADERS ASTROS | | 22 | 471 | 1,234 | 8 |
| *SECTIONS* | | | | | | |
| 1. | ROCKET CITY ACES | | | 511 | 28,221 | 12 |
| 2. | ASTRE | | | 471 | 25,125 | 12 |
| 3. | VIKINGS | | | 203 | 18,048 | 12 |
| 4. | GARDEN STATE | | | 439 | 14,942 | 12 |
| 5. | SMOKEY MOUNTAIN | | | 486 | 12,788 | 12 |
| 6. | DART | | | 317 | 11,743 | 12 |
| 7. | FORT WORTH | | | 480 | 10,529 | 12 |
| 8. | NOVAAR | | | 205 | 10,068 | 12 |
| 9. | RED STICK | | | 475 | 8,967 | 9 |
| 10. | NARHAMS | | | 139 | 6,654 | 12 |

Scale Data

# PATRIOT

## SURFACE TO AIR MISSILE ROUND OT III

by Matt Steele and George Gassaway

### THE MISSILE

The PATRIOT Surface to Air missile is a mainstay of NATO's defenses in Western Europe. The missile was introduced to replace the HAWK and NIKE HERCULES air defense missiles in the early 1980's. The missile is manufactured by Martin Marrieta Missile Systems in Orlando, Florida. The prime contractor for the Patriot System (including radars, communications system, missile transporters, etc.) is the Raytheon Company of Andover, MA.

Recent tests with upgraded software have allowed Patriot missiles to intercept and destroy incoming ballistic missiles (Lance missiles have been used in tests to date). Major software upgrades are planned for units deployed in Europe and Japan to take advantage of this capability in the next ten years.

### THE MODEL

The Patriot makes a great scale, sport scale, and scale altitude model. In fact, it has placed very well in scale altitude competition, including a first place in D Scale Altitude at NARAM-27.

If you look around, you can find a number of nose cones that will work well for sport scale versions of the Patriot. Good candidates are the Estes BNC-50K and the PNC-80K. A BT-80 sized model would be particularly impressive.

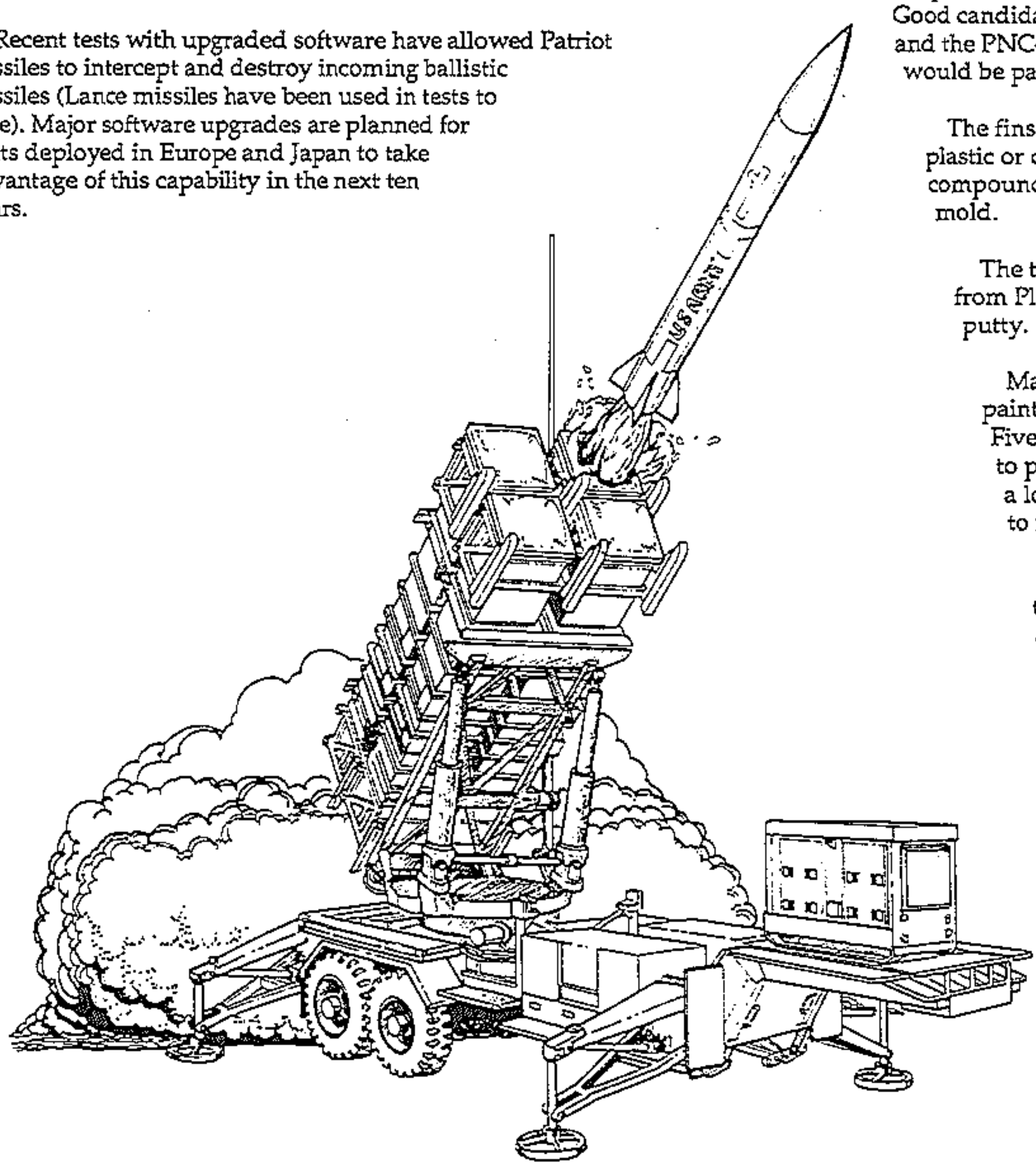
The fins can be built up from sheet plastic or cast from a plastic casting compound, using an RTV silicone mold.

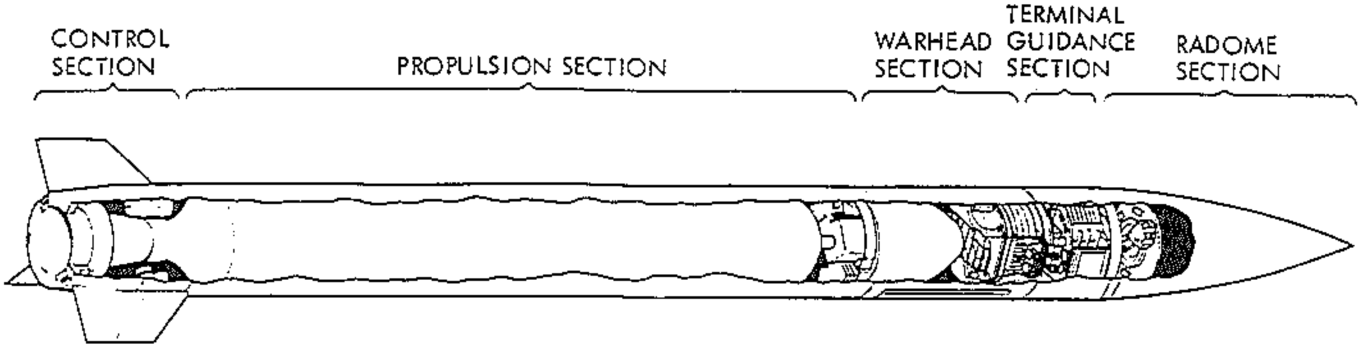
The tunnels can be constructed from Plastruct sheet plastic and putty.

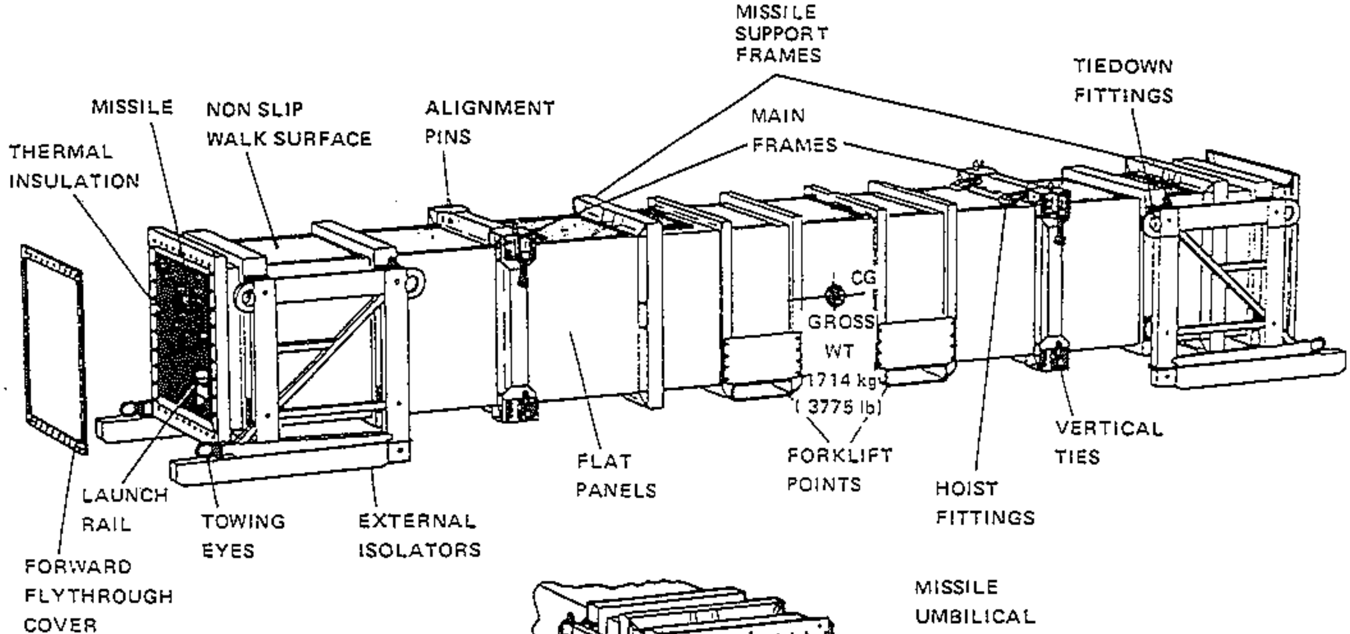
Markings can be applied with paint, dry transfers, and decals. Five different colors are needed to paint the model. We have had a lot of luck using black decals to make the roll pattern stripes.

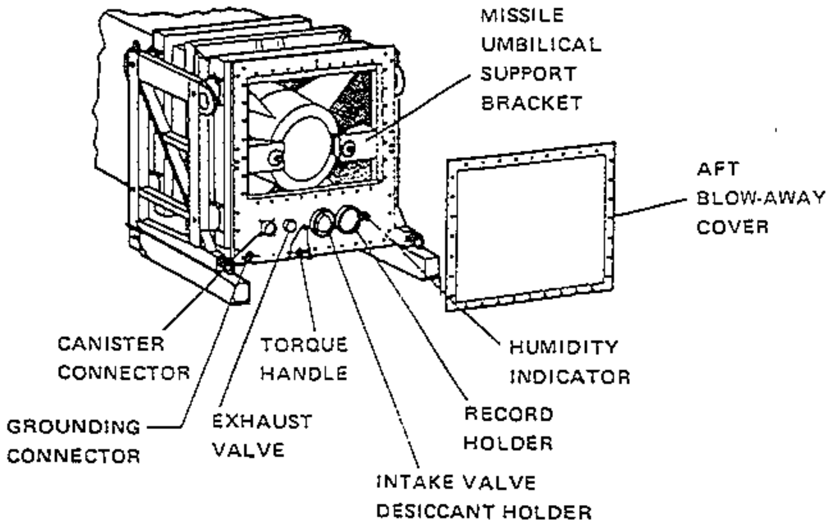
The lettering on one side of the missile ("U. S. ARMY") appears to be in Helvetica font, which is easy to find in many sizes of dry transfers.

For best performance, fly the model from a tower.

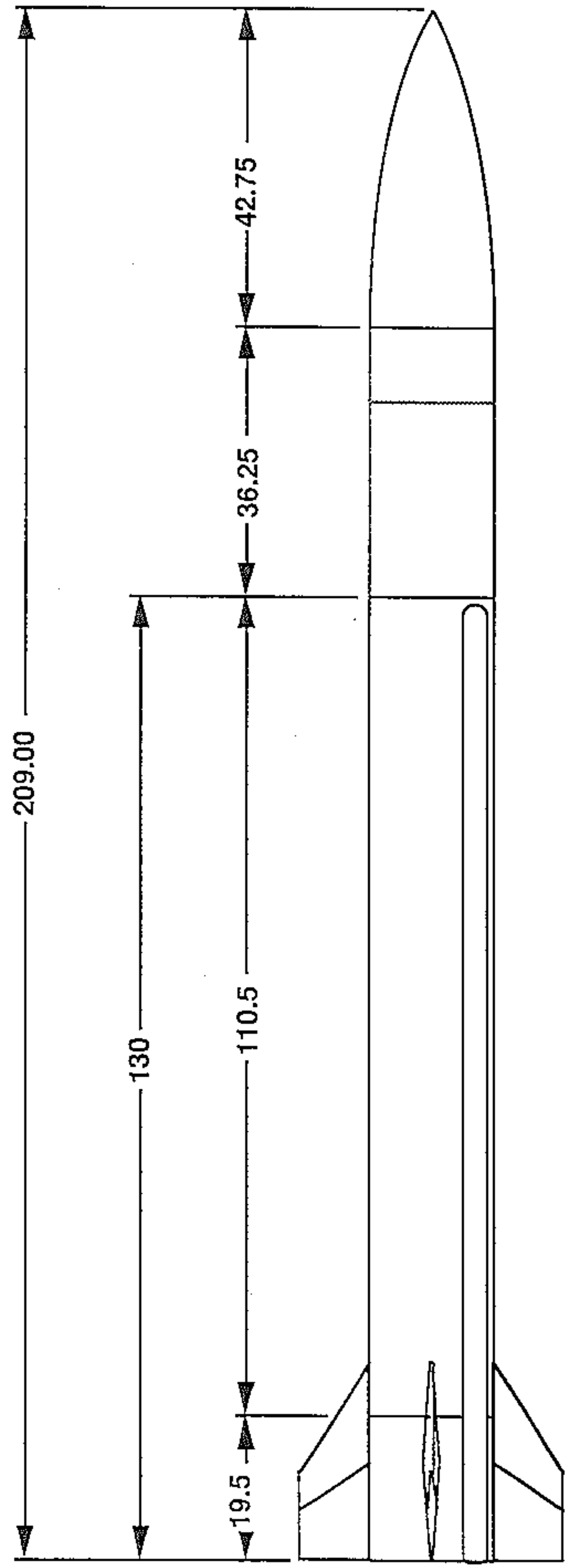


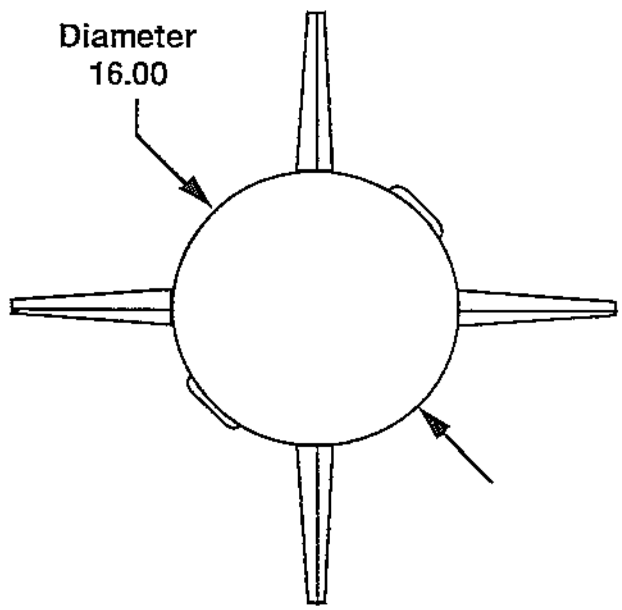

CONTROL SECTION
PROPULSION SECTION
WARHEAD SECTION
TERMINAL GUIDANCE SECTION
RADOME SECTION


MISSILE SUPPORT FRAMES
TIEDOWN FITTINGS
MISSILE THERMAL INSULATION
NON SLIP WALK SURFACE
ALIGNMENT PINS
MAIN FRAMES
CG
GROSS WT
1714 kg
(3775 lb)
LAUNCH RAIL
TOWING EYES
EXTERNAL ISOLATORS
FLAT PANELS
FORKLIFT POINTS
HOIST FITTINGS
VERTICAL TIES
FORWARD FLYTHROUGH COVER


MISSILE UMBILICAL SUPPORT BRACKET
AFT BLOW-AWAY COVER
CANISTER CONNECTOR
TORQUE HANDLE
HUMIDITY INDICATOR
GROUNDING CONNECTOR
EXHAUST VALVE
RECORD HOLDER
INTAKE VALVE DESICCANT HOLDER

| Patriot Overall View | |
|---|---|
| Full Size Dimensions | |
| G.C.G. | 10 Aug '85 |
| Drawing Scale: 1" = 22" | |




## End View

Cable Tunnel and Fin Layout (Enlarged View)

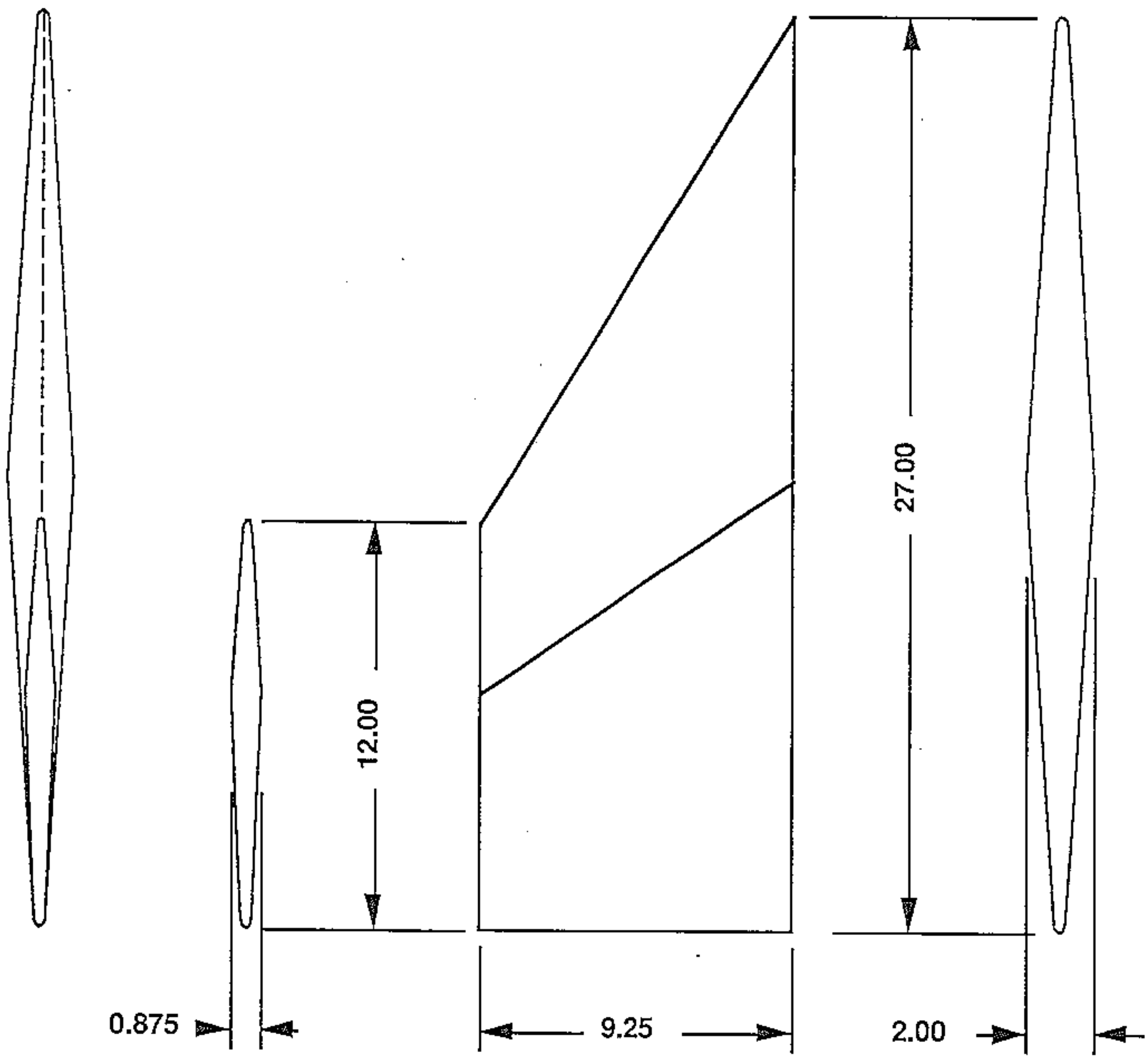
| Patriot Fin | |
|---|---|
| Full Size Dimensions | |
| G.C.G. | 6 Aug '85 |
| Drawing Scale: 1" = 5" | |

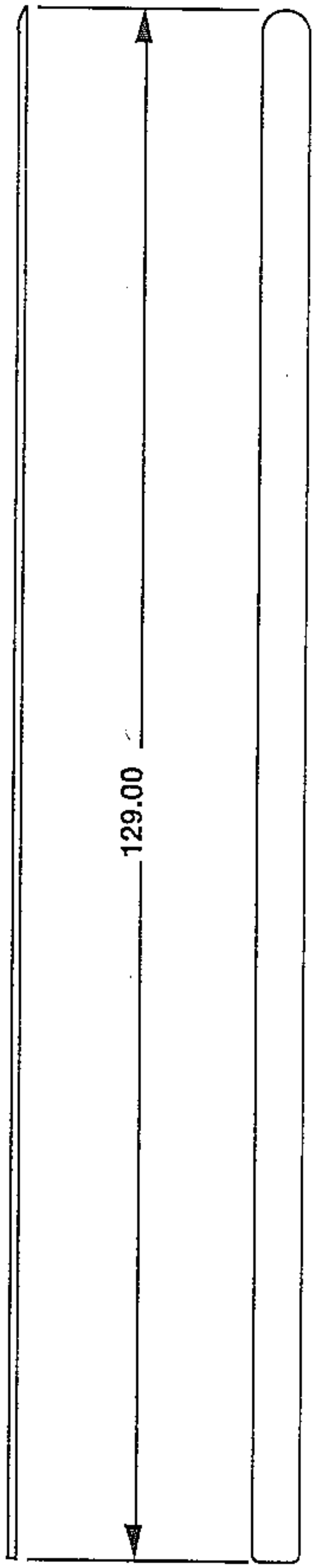
## Notes:

(1) Paint Ablative Red

(2) Four fins required for missile assembly

(3) Leading and Trailing edges are slightly rounded






Side and Top Views of Cable Tunnel

# Patriot Cable Tunnels

Full Size Dimensions

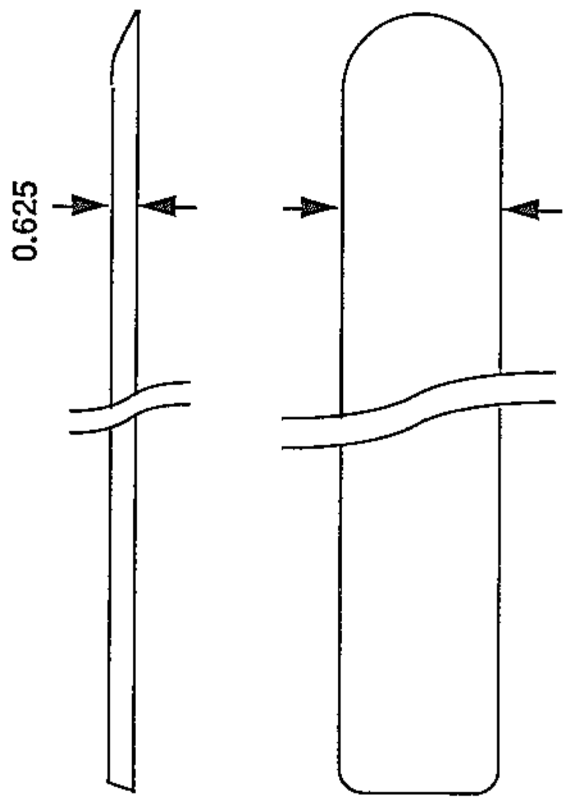
| G.C.G. | 10 Aug '85 |
|---|---|

Drawing Scale: 1"=15" & 1"= 5"

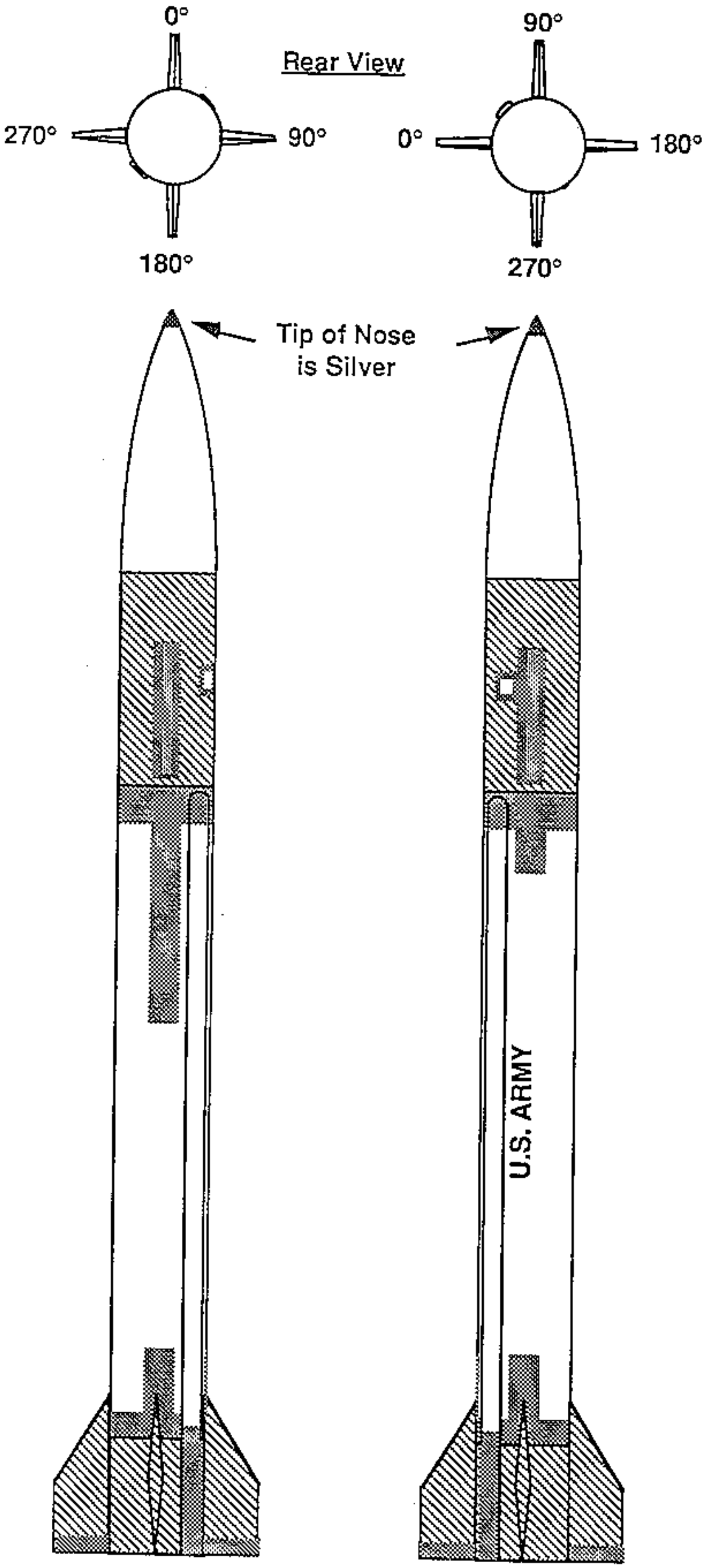
## Notes

(1) Patriot uses two cable tunnels

(2) Cable Tunnels are spaced 180° apart, 45° between fins

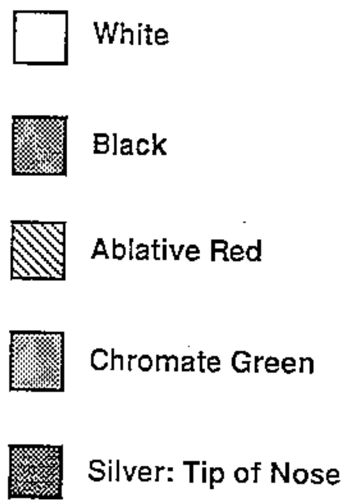



Side and Top Views of Cable Tunnel ends




| Patriot Paint Pattern | |
|---|---|
| 0° and 90° Rotations | |
| G.C.G. | 11 Aug '85 |

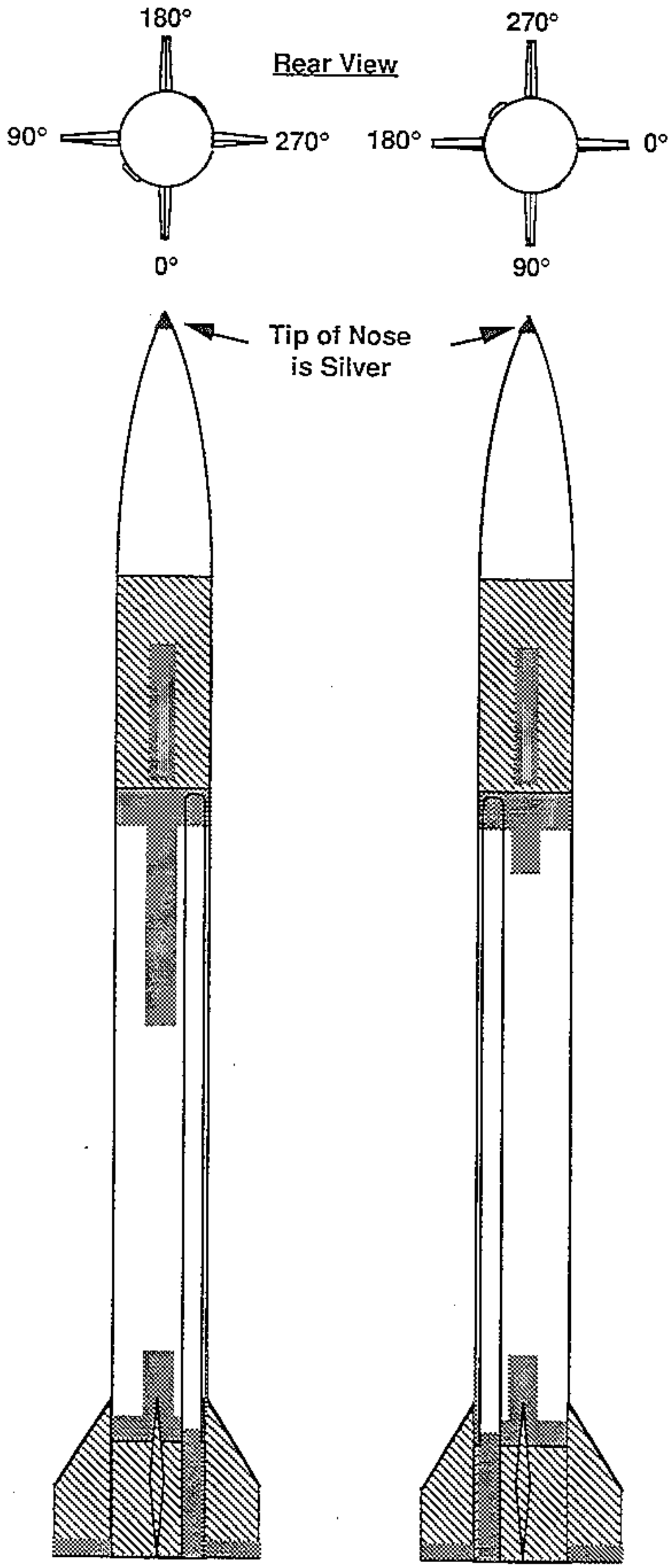
## Color Key



## Patriot Paint Pattern

180° and 270° Rotations

G.C.G. | 11 Aug '85




### Color Key

- White
- Black
- Ablative Red
- Chromate Green
- Silver: Tip of Nose

### *From Your Sometimes Sober Editors*

*(Continued from page 2)*


to get flying fields and FAA clearances, and covers the AHPR activities in American Spacemodeling? Where does that leave Tripoli? The bulk of activities and interests of Tripoli members will now also be offered by the NAR, leaving Tripoli with only the ultra-exclusive L motor and above rocket category.

Can Tripoli survive such a situation?

If Tripoli continues in its current sate, I'm afraid that the answer is no. Look carefully at Tripoli today and you will see the following significant problems:

1) A lack of a timely publication. One of Tripoli's biggest benefits is the publication of the informative Tripolitan. One of Tripoli's biggest problems in the past two years has been to maintain a regular publication schedule for the Tripolitan. Unless an individual comes forward and is willing to devote the time and effort that Tom Blazanin has in the past, Tripoli will lose one of its biggest benefits. To date, it doesn't look like this problem is solved.

2) Lack of coherent direction and leadership. Tripoli went through a terrible leadership crisis that ended in Chuck Rodgers replacing Ed Tindell. The crisis was damaging and destructive to the organization as a whole. Chuck has stepped in and done a considerable amount of damage control. But he is being hampered by a lack of support by the Tripoli Board (many of the members have never even met each other) and by a perception that there is an "East vs. West" problem. With the leadership focusing their efforts on resolving internal problems and squabbles, there is little time left to deal with the real issues that Tripoli needs to address, like the insurance, motor certification, and membership growth.

3) Lack of a stable organization. Every time one looks around, things are changing in Tripoli. The headquarters has been moved three times in about the last year. The national meeting location and date was not decided until early this spring. The magazine editorship, motor certification effort, and NFPA representative have all been "in transition" in the past year.

All of these problems point to a more basic problem: Tripoli is not being supported by its members. With the exception of Tim Blazanin (who is a common thread through all that works or worked in Tripoli), no one has stepped forward and assumed the necessary leadership positions in Tripoli for any length of time. No one wants to commit to edit the magazine; no one wants to organize LDRS; no one wants to travel to Board meetings and commit to making the key decisions. The only thing that most Tripoli members want to do is fly high power rockets. That's fine for a hobby; but it will do nothing to insure that Tripoli will exist as a hobby organization.

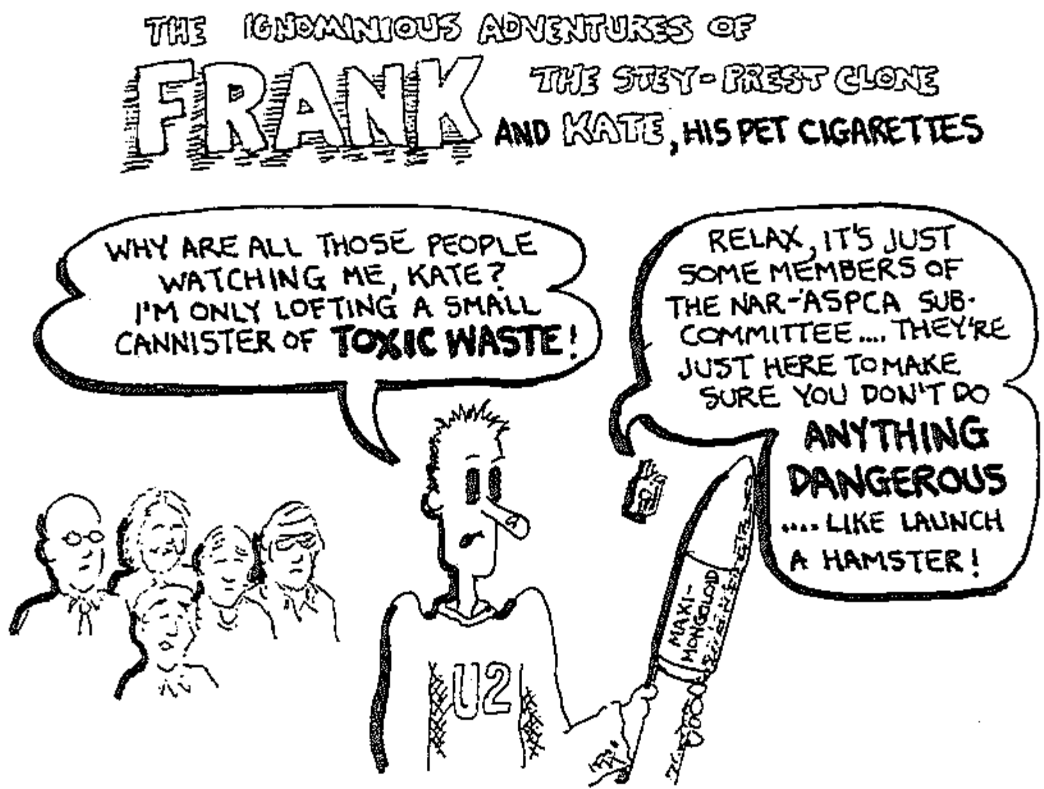
Unless Tripoli members step forward and volunteer to take care of the key positions that make an organization work, Tripoli won't survive. Right now, it's questionable whether Triopli's membership has reached the critical mass (in both number of volunteers and type of people likely to volunteer) to sustain the organization

If the NAR steps in and offers similar service programs, eventually Tripoli will lose the bulk of it's members to the NAR, largely due to the NAR's established volunteer base. If that scenario comes about, the NAR will probably be blamed for Tripoli's demise.

The real reason for Tripoli's demise (if it happens), though, will be a lack of commitment on the part of Tripoli's membership. If enough Tripoli members band together and hold the organization together, then Tripoli will survive. If the situation continues as it exists today, then Tripoli will probably disappear in the next few years. Given the track record, it's a good bet that the latter will take place.

Of course, I'd love to be proven wrong!

J. D. McNeil



# BULL SHEET

**Aerotech's industrial division, ISP, has just announced a new line of reloadable motors** from G to N class in a variety of diameters, lengths and total impulses. The cases and end closures are aluminum, and what is replaced is the propellant, liner, nozzle, and delay section. The initial cost is high, but after a few flights, the cost of the reload kits (RK's) is very inexpensive, especially if you are flying the higher impulse motors, like K to N. The best part is that motors up to and including the I motor are CLASS C SHIPABLE! They will be rolling out these motors at Black Rock II and will have some at NARAM for show. Some of the larger ones will be flown at LDRS-9 in Hartsel, CO.

**Three IRA terrorists that were Tripoli members were convicted of** conspiracy to create surface to air missiles. The plan was to manufacture a missile that could knock down a British helicopter, using model rocket type technology. Former Tripoli President Ed Tindell testified in the Boston case for the prosecution, after the FBI conducted a thorough investigation of Tripoli records. The total sentences for the group run to 54 years and $2 million in fines. The long term implications for high power rocketeers could be much stricter control and regulation.

**There is promising news regarding the FAA and the 3.3 lb change to the FAR's.** After the NAR pressure was applied through various political connections, the following letter was received:

"Dear Mr. Miller:

This is in response to your May 13 letters to Administrator Busey and me regarding your petition to amend Part 101 of the Federal Aviation Regulations.

We have placed your petition on the Federal Aviation Administration's regulatory schedule and we expect to publish a proposal regarding your request within the next 12 months.

The study commissioned to analyze technical aspects of your petition has been completed and its results will be included in the proposal.

Sincerely,
William H. Pollard
Associate Administrator for Air Traffic"

Action on the issue should be forthcoming in the next twelve months. At last, perhaps, the light is showing up at the end of the tunnel!

**North Coast Rocketry has obtained a number of Coaster E and F motors** which it will be offering for sale. The first lot of 10 each of the E and F motors is available now, with a limit of one of each type motor per person. For more information and pricing, please send a SASE to NCR, P.O. Box 24468, Mayfield Hts., OH, 44124. The guy we got them from told us he had actually flown about 10 of them, and they all worked fine! It makes you want to scream!!!

**Tripoli Headquarters is up and running** at a new address: Tripoli Rocketry Association, Inc., P.O. Box 40475, St Petersburg, FL 33743-0475.

**The NAR-AHPR Commission will complete its work** next February, with an interim report due at NARAM-32. The Board will also conduct a question and answer session at NARAM to gain a sense of what the NAR membership wants. The Board will eventually decide what direction the NAR will take in regards to service expansion for AHPR programs.

**NARCON-6 may be held this spring in Huntsville, Alabama,** if the NAR accepts a proposal now on the table. Hosts would be Matt Steele and the Rocket City Aces, and the idea would be to revive the national convention on a rotating basis, like NARAM is handled.

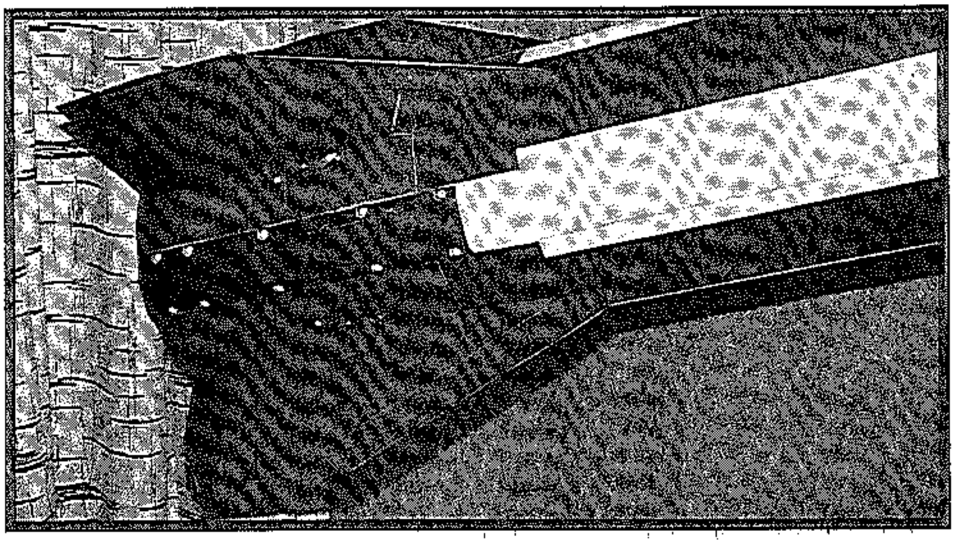
**Both partners in the now-defunct "rocket motor manufacturing company" Reaction Labs have had their previous phone numbers disconnected,** and the new ones are unlisted. The P. O. Box for them has also been closed. They were probably tired of hearing people complain about their motors, wanting their money back, or asking why it was taking so long to get their orders. Certainly, the legitimate rocket community won't miss them.

**Rocketflite is experiencing manufacturing difficulties** with their black powder motors. The black-powder, 38mm diameter, G100 motors are made in Indiana. They are kind of like large, heavy FSI F100's, except that 1) they're louder; 2) they're more powerful; and 3) up until recently, they've been more reliable . Rocketflite is testing out new casing materials for their G100 motors, because their old supplier started sending them poor-quality ones. Rocketflite is developing a 29mm F motor, with about 50-55 newton seconds total impulse. That's all you can squeeze out of 62.5 grams of black powder. We understand that the F motor will be submitted for NAR certification when developed.

**Harold Reese at FSI has indicated that** they've discontinued the F7 motor because of the reliability problems! He doesn't know why it's happening, since they mix their own black powder and they've been pressing the motors the same way for 10 years. They're experimenting with different casings; since that's the only part made out-of-house, it's the most likely problem. There may be a new steam machine F with a thicker casing in the future. FSI also has a new catalog out that's worth a look.

**NCR's new catalog will be out August 15,** with more kits and motors. Included will be a RC BG kit, a new altitude sensor payload, and a gliding high power kit.

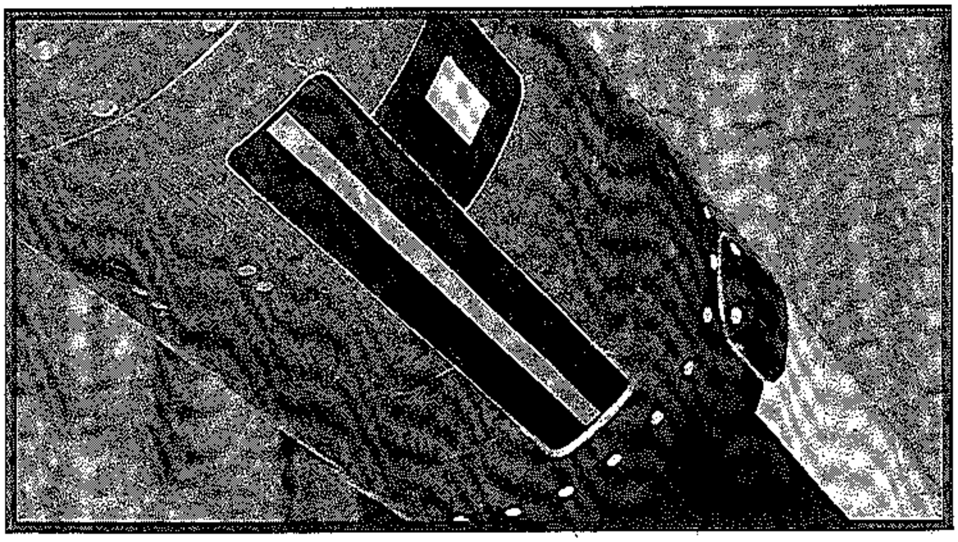
# PATRIOT DETAILS



Left:

Tail Section Details

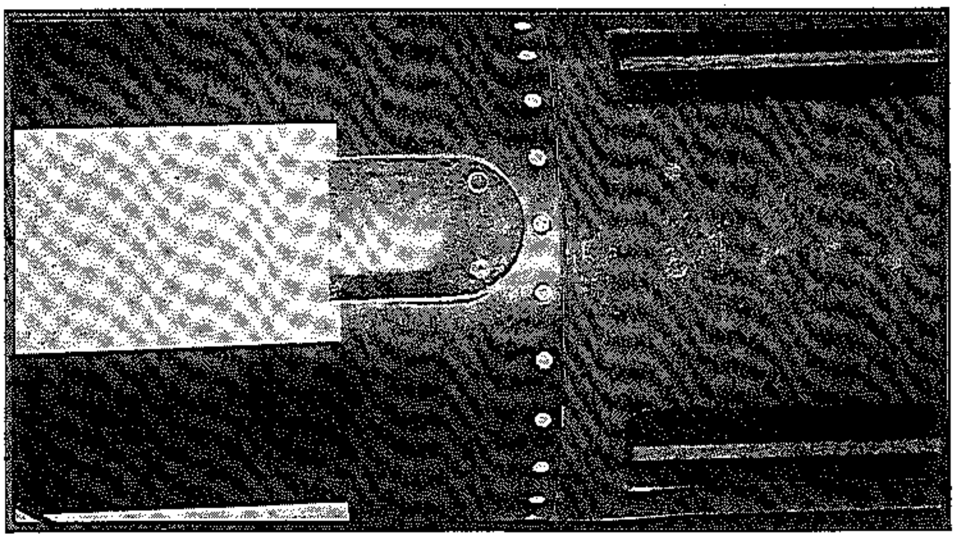
(Matt Steele photo)



Right:

Warhead Section Detail

(Matt Steele photo)



Left:

Motor/ Warhead Section Assembly Joint Detail

(Matt Steele photo)

Back Cover:

A Patriot takes out a target drone during operational testing.

(US Army photo)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Hasten!