TRIPOLI GERLACH Research Rocketry News

TRIPOLI PREFECTURE # 138

MAY 2012

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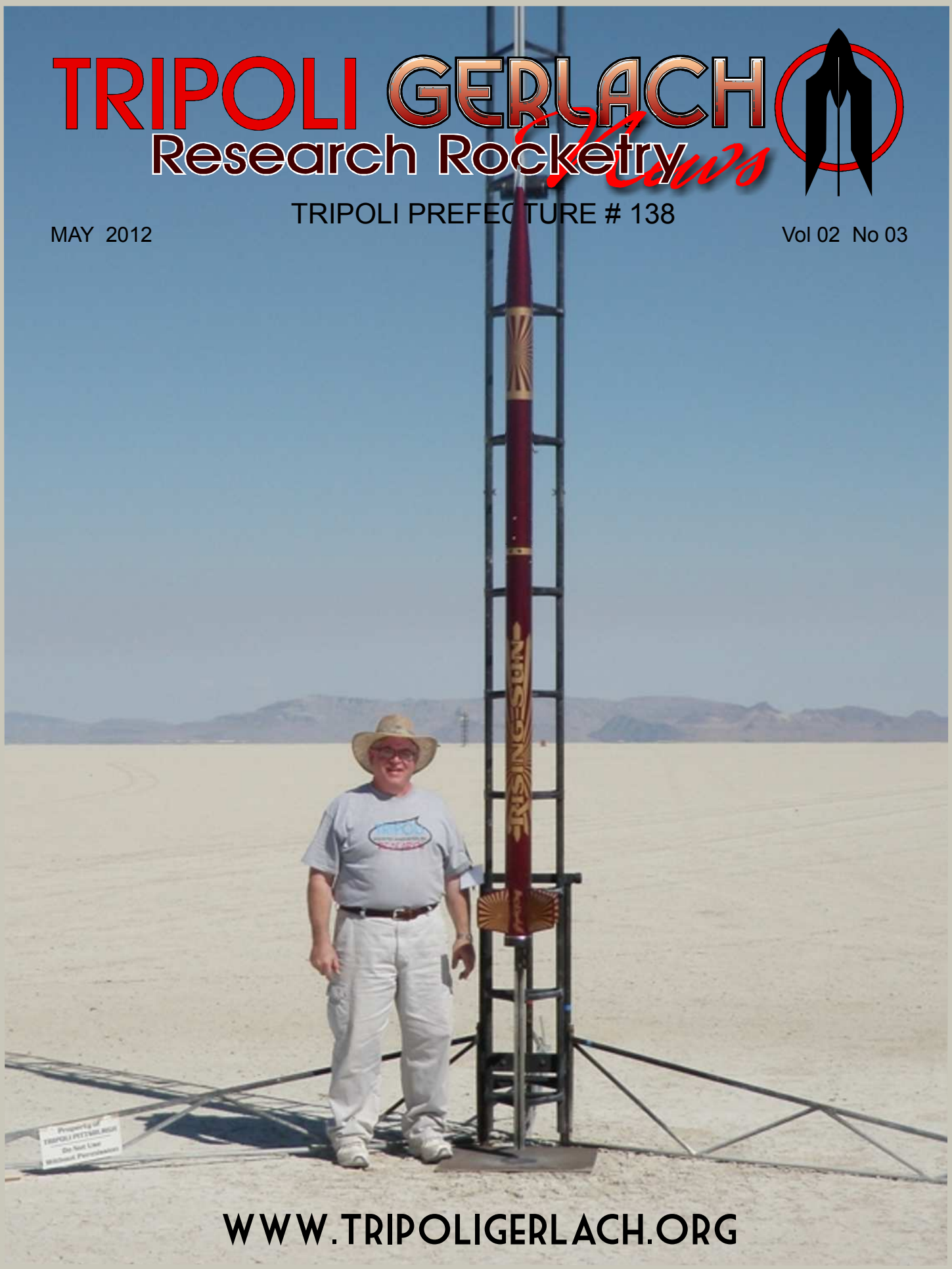

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PUBLISHED EXCLUSIVELY FOR
THE MEMBERS OF TRIPOLI GERLACH
AND ANYONE ELSE INTERESTED

Tripoli Gerlach was founded as a National Prefecture under the Tripoli Rocketry Association, Inc. Devoted to Research Rocketry and the Black Rock Desert area of Nevada, we welcome all qualified Tripoli Members having a Level 2 certification or higher.

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If you have anything to contribute in the way of information, articles, photos or whatever, please send them to Tripoli Gerlach Headquarters. Visit our WebSite on-line at;

WWW.TRIPOLIGERLACH.ORG

ON THE COVER

Dave Rose returned to Black Rock in 2011with his rebuilt RISING SUN. Time for something new in 2012?

Visit Dave's Shop on page 15.

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This is the third issue of *TRIPOLI GERLACH NEWS* for 2012 and our move to 16 pages seems to be doing OK. Response to the first two issue of 2012 are very nice. We're attracting more readers than we have members, in fact the number of people downloading is surprisingly rewarding. They know we're here.

We're still open to people submitting articles and always will be so if you have anything you'd like to share: a Project, a HowTo, Something neat you discovered or what ever please send your article too TOM.

Naturally Photos and Drawings are accepted !

LDRS 32 - 2013

Tripoli Gerlach's bid for LDRS 32, July 2013, at Black Rock is nearing completion. Range operation, lodging, banquet and other activities are coming together. LDRS 32 will not be a BALLS type event. Those who attend BALLS know its unique character created through a lot of work by member's of AHPRA. They make it look easy. While we will have their expertise running the Range we need to address a lot more and to this we need Tripoli Gerlach member's support and commitment to the event. Some members understandably will have commitments which we should honor but this still leaves us a large body of able people to commit assistance. Those with commitments are of the type that they will still assist where and when ever possible as this is their nature. So the rest is up to "us".

Mark & Robin are creating a Range Operation Outline. Robin will be the Event RSO. This is not BALLS so volunteers will be needed to help run the Range. Everyone in Tripoli Gerlach knows what has to be done running a Range and has done it so we have no reasons of inexperience. We need volunteers to assist Range operations and welcome anyone stepping forward.

On the non Range side of the line is a different story. We operational the day before the event opens. We need bodies for traffic control, assist vendors and resolve issues. We will need Volunteers to run Registration and the Banquet. Someone to interface with vendors and someone to assist BLM.

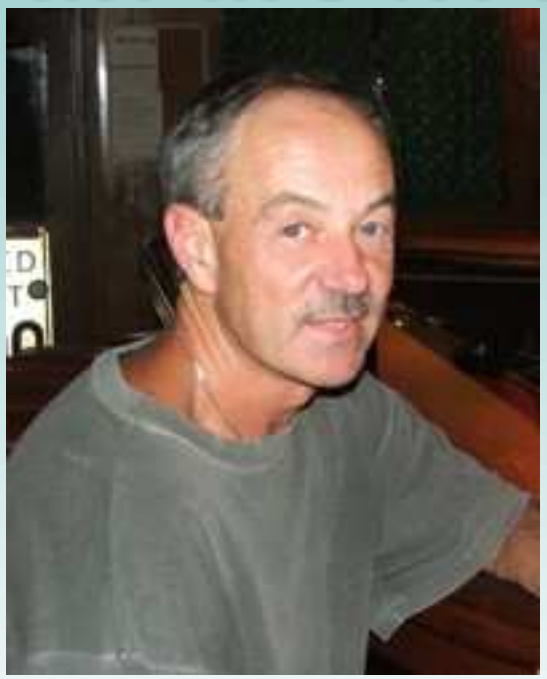
All members' volunteering will be placed on the Committee and updated regularly and/or given assignments as the event evolves. Those not volunteering are OK but expect to be "voluntold" in time.

LDRS Volunteers will be given adequate time for flying and line privileges. This will go for non Tripoli Gerlach members who step forward as well.

We ask now, way over a year till the event, for people to step into the Committee as core members so we have a working body and assignments can be passed out. A year goes by fast and to make an LDRS at Black Rock memorable we need it to run smoothly and seemingly open.

Contact TOM at your earliest convenience with your particular choice of position or just that you are available for "assignment".

CHUCK DUFFY



As you walk from Bruno's Motel to Bruno's Restaurant, or the "Casino", you pass Skeekie's house which has a wild assortment of geological samples, Gnomes, critters and the infamous tire with a rocket in it. As you walk further you pass a nice little tan colored home with a small neatly trimmed lawn and through the window you'll see stuffed animals. This is the domain of Chuck Duffy, friend of Tripoli Gerlach.

Chuck moved from Reno to Gerlach in 1997. His main reason was he loved the desert and hunting. He has worked at Bruno's ever since he arrived and enjoys his time off by not only hunting but exploring all areas of Black Rock.

Chuck is a real no nonsense sort of guy, quick and to the point but a little time spent with him soon reveals his easy going laid back approach to life.

His house is a virtual Wild Life Museum and Artifact display. He has so many wall mounts of his hunting adventures. Deer, Antelope, Chukkers, Geese are displayed everywhere. There is even a Bobcat mounted in attack.

In addition to his love of the hunt he spends a lot of time just out exploring. Proof of this is his very extensive collection of Indian arrow and spear heads and early Indian tools and artifacts.

He has led several groups of locals out arrowhead hunting as well as members of Tripoli Gerlach.

Chuck is very knowledgeable about the Black Rock area and is quick with advice and direction to those in search of a Black Rock experience.

He also opens his home to any seriously interested persons. A visit to his place is most rewarding. Not only to see the fantastic Indian displays and wild life but listening to him tell true tales of his experiences in Black Rock make time pass quickly.

Just two of several display tables that Chuck has built to store his massive collection of Indian artifacts he has obtained by just walking Black Rock.

CHUCK DUFFY

COLLECTOR

Above: Just two walls of prize trophys.
Right: One of many many skulls collected.
Below: Chuck with his 2007 Desert Bighorn (L) and his 2011 California Bighorn (R).

TREKKING THE WILDERNESS

In 2000, ten Wilderness Areas and a National Conservation Area were designated in northwestern Nevada to protect a unique portion of the Northern Great Basin and its associated wildlife, plant life, cultural resources, and the virtually untouched landscape..

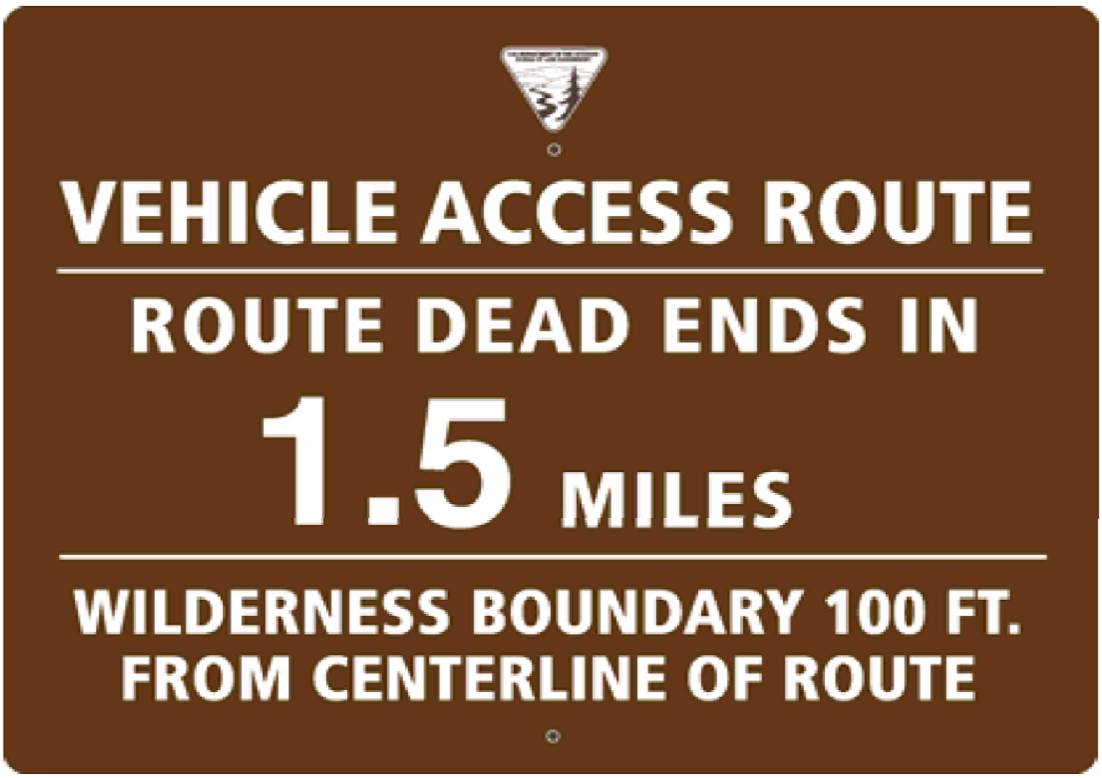
Despite the vastness of the Black Rock Playa, many times we find the need to search for rockets off the lake bed. A lot of this area is considered Wilderness Area and rules must be observed. Know your signs.

Allowable Uses of Wilderness
Wilderness Areas provide for numerous recreation opportunities including: hiking, backpacking, nature study, horsepacking, hunting, rock climbing, rockhounding, cross-country skiing, primitive camping, photography, or just enjoying the views and the solitude. Activities that impact the wilderness characteristics of naturalness, opportunities for solitude or primitive recreation are not permitted; these include: using motorized or mechanical transport, motorized equipment, landing of aircraft, or constructing permanent structures. Mountain bikes and game carriers are considered to be forms of mechanical transport and are not permitted in wilderness. Wheel chairs are permitted in wilderness.

Motorized Access
Over 800 miles of roads remain open to motorized use in the Black Rock Desert High Rock Canyon Emigrant Trails National Conservation Area. Many of these roads form the boundaries for the ten Wilderness Areas. Besides the boundary roads, 33 "vehicle access routes" were designated that provide access to areas within the wilderness. These "**Vehicle Access Routes**" are identified with signs, like the one below.

The **Wilderness Boundaries** and routes closed to motorized use within the boundaries are identified with a wilderness boundary post, like the one to the right.

BLM strives to maintain the boundary signing along the Wilderness Areas, but it is the visitor's responsibility to know where the boundaries are.



BETTER SMOKE GRAINS

Text & Photos by
Chris Pearson

One of the problems with many larger high-power rocket motors and almost all Research motors in general is the lack of visible tracking smoke after burnout. Even if you are flying a propellant that produces lots of smoke, after burnout at high altitudes the rocket can disappear, especially if you are flying a high-rate propellant in a minimum diameter rocket.

Smaller motors from the commercial motor manufacturers have delay columns for the ignition of a black powder charge for deployment of a recovery system. In almost all the cases though, the delay column is small and doesn't produce much smoke.

In many cases, the manufacturers of larger commercial high-power rocket motors don't have smoke grains in the motors at all and the end-closure is a simple plug. One reason they do this is to maximize the propellant loading of the motor case, something that many Research motor makers also strive for. Another is the assumption that electronics are going to be used for recovery system dual deployment.

Several aftermarket companies will manufacture you a custom end-closure capable of holding a large diameter smoke grain, but these will protrude past the forward end of the motor case and you'll lose your recovery system hard attachment point on the motor case. The only method to include a smoke grain in many motors without resorting to expensive custom machining is to sacrifice propellant length for a full column smoke grain. Several motor manufacturers such as Kosdon and AMW have, in the past produced full-column width smoke grains for some of their motors, but they were expensive and if you wanted to use them in any other motor, it required you to trim the top propellant grain.

The biggest problem with full-column smoke grains is heat: that is the heat produced when the smoke producing compound is burning. It's not as hot as the burning propellant, but the duration of the burn is the problem (think 10-30 seconds). Having a hot, slowly burning smoke grain with only about a 0.060" thickness of paper separating it from your expensive aluminum motor case is a recipe for disaster. I've seen cases discolored or damaged from the heat of these smoke charges.

The way many people solve this problem is to insulate the smoke grain from the motor case with o-rings or thicker tubes (up to 1/4" in the case of 98mm motors)

. The method described here is a way to use large, but not full diameter smoke grains without risking damage to your motor case. It is not unique; in fact I came up with the idea after looking at the delay in the end closure in a CTI motor. Those motors use a delay column potted in what looks like a silicone compound. This is actually a brilliant idea as it eliminates all of the causes of premature ejection charge firing caused by high-pressure gas blow-by during the motor burn. Other companies try to insulate the delay column and seal the gap between the combustion chamber and the ejection charge container with paper or plastic tubes and/or rubber o-rings. Sometimes these methods work, other times they don't. When they don't the result is a premature ejection of the recovery system during boost resulting is some spectacular and expensive rocket skywriting and damage to the vehicle.

This method uses the same HTPB used for propellant binder as an insulator between the smoke grain and motor case, eliminating potential case damage caused by the burning smoke grain.

There are many formulas for smoke compound available on the web, and everybody has their favorite. However, the diameter of the smoke grain will be smaller than the diameter of the motor. The easiest thing to do is use the next smaller diameter propellant casting tube for your smoke mixture,

and pot that grain in a piece of casting tube the same diameter as the propellant grain you're using. So a 98mm motor will use a 75mm smoke grain, a 75mm motor will have a 54mm smoke grain, a 54mm motor will have a 38mm smoke grain, and a 38mm motor will have a 29 or 24mm smoke grain (use a 29 or 24mm motor tube). You can cast the tubes as long a length as you wish, as the longer the smoke grain, the longer it will burn. All smoke compounds burn at different rates, so you'll have to experiment to see the optimum length for the motors you plan on using. You want the smoke charge to burn at least until the rocket is under canopy, but not so long as to have it still burning when the rocket touches the ground.

For the purpose of this article, I am casting a 54mm smoke grain of 1" length in a 75mm casting tube. I am using the a Tru-Core casting cap for making the smoke grains. (Photo 1)

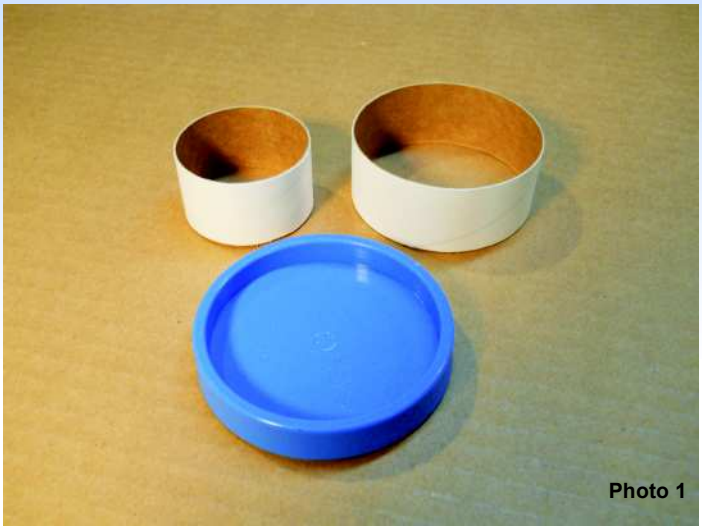


Photo 1

1. Apply mold release on the 75mm casting cap in the usual fashion. It may be necessary to plug a hole in the cap if it was used with mandrels. (Photo 2) Tru-Core will make you casting caps without holes for this purpose.


Photo 2

2. Place the length of 75mm casting tube in the cap. Use tape if necessary to insure a tight fit or HTPB might leak out. (Photo 3)


Photo 3

3. Mix up a small amount of HTPB and pour about a 1/8" deep layer in the cap. (Photo 4)


Photo 4

4. Once this has self-leveled, center the smaller 54mm smoke column casting tube inside the 75mm tube. (Photo 5) Allow the HTPB to cure overnight.


Photo 5

5. Now you can mix up another batch of HTPB and pour it into the gap between the two casting tubes. You can degas

the HTPB if you want to get all the bubbles out. I also add a small amount of lampblack to this HTPB for cosmetic reasons. (Photo 6)

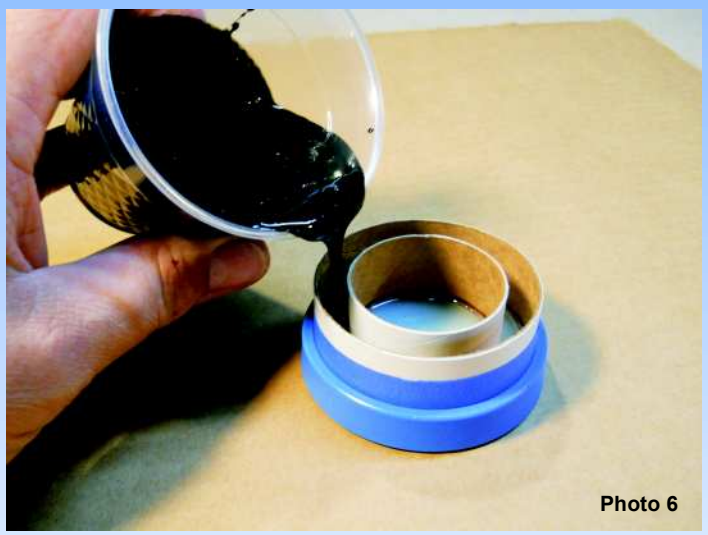


Photo 6

6. You don't have to wait for that to cure before mixing up whatever smoke mixture you are using and pouring it into the smaller 54mm casting tube. Allow both to cure overnight. (Photo 7)


Photo 7

7. Once both mixtures have cured the completed smoke grain can be removed from the casting cap. Level the exposed end of the smoke grain using sandpaper in the customary method for preparing propellant grains. (Photo 8)


Photo 9

8.The HTPB layer at the bottom of the smoke acts as an inhibitor and will protect your forward end closure from heat damage. (Photo 9)


Photo 9

Another method is to cast the smoke grain in long tubes and then cut them to length as needed so you don't have to cast smoke compound for each launch. (Photo 10) This requires a modification of the assembly method described in Step 3. You will pour the initial HTPB layer and let it cure before inserting and potting the smoke grain. You'll have to adjust the length of either the delay grain or the insulator tube length to compensate for the thickness of the HTPB layer


Photo 10

The tracking smoke grain will then be installed in the case liner tube on the top of the propellant stack with the inhibited end facing the forward end closure.

Coming In The Next Issue

VACUUM LID FOR PROPELLANT MIXER BOWL

EJECTION CHARGE SIZING

To many of us Ejection Charges are secondary based on past experience. And while we assume to estimate properly it can be proven in many cases, many people assume wrong. It is always good practice to ground test your ejection system before launch. This is a simple proceedure accomplished with a little forethought and safety. Equations are provided here to estimate required charge sizes. A little math will provide you with a charge size that should be sufficient however a ground test may show different, based on actual vehicle configuration.

As a starting point for the ground test use the chart present near the end of this document to estimate how many grams of black powder are likely to be needed. This is just an estimate! The table assumes 15 psi for body tubes 5.38 inches or less in diameter. It assumes 350 pounds of separation force for body tubes larger than 5.38 inches. Remember this table is for generating an initial estimate. And, while it can be used as is keep in mind many factors will influence the situation. Ground test it!

NOTE:
Ground tests should be conducted with a completed assembly. Recovery components should be stored as if in actual launch.

DERIVIATION OF TABLE FOR ESTIMATING EJECTION CHARGE SIZE

First we assume the entire mass of the ejection charge is burned and converted to a gas. Next from basic chemistry we use the ideal gas law equation:

$$PV = NRT$$

The constants for 4F black powder are:

P = pressure in psi
V = volume in cubic inches = pi*(D/2)2L

N = mass in pounds. (Note: 454 gm/lb)
R = 266 in-lbf/lbm
T = 3307 degrees R (combustion temp)

A good rule-of-thumb is to generally design for 15 psi pressure. If this is used as the design goal, then the ideal gas equation reduces to:

$$N = 0.006*D^2L \text{ (grams)}$$

where **D** is the diameter in inches and L is the length in inches of the compartment in the rocket that is to be pressurized. **N** is the size of the ejection charge in grams. However, on large diameter rockets, 15 psi will probably generate too much force!

For example, a 7.5-inch diameter rocket has 44 square inches of area on the end of it so 15 psi would produce over 15*44 = 660 pounds of force!! The amount of force needed for a large rocket is going to depend on a great many factors, but a reasonable limit is probably some where around 300-350 pounds. This is the same amount of force generated in a 5.5-inch rocket at 15 psi. We can refine our equations for large rockets by adding a limit on the force that is to be generated. The force F (in pounds) is given by:

$$F = PA$$

where **P** is the pressure in psi and **A** is the area in square inches. Since $A = \pi*(D/2)^2$ we can combine this equation with the ideal gas law equation to get:

$$N = 0.00052*FL \text{ (grams)}$$

This last equation tells us how many grams **N** of ejection charge to use to generate a specified force **F** in pounds for a given length **L** of pressurized compartment. What is interesting about this equation is that the diameter **D** is not present. It means that for large rockets the ejection charge size does not need to increase with body tube diameter.

Using these equations here is a handy reference table for various body tube diameters

.

REMEMBER NOTHING REPLACES GROUND TESTING

BODY TUBE ISIDE DIAMETER	ESTIMATED EJECTION CHARGE SIZE
1.53 in	0.5 grams per 36 inches of length
2.15 in	1 gram per 36 inches of length
2.56 in	1 gram per 25 inches of length
3.00 in	1 gram per 18 inches of length
3.90 in	1 gram per 11 inches of length
5.38 in	1 gram per 6 inches of length
6.00 in	1 gram per 6 inches of length
7.51 in+	1 gram per 6 inches of length

PROPELLANT VACUUM CASTING

LES DERKOVITZ

Les is a member of NASSA (Nevada AeroSpace Science Associates) who have been researching motor technologies since the early 90s. The group has developed serveral propellants and can be found on-line at: www.nassarocketry.com

One of the main problems most of us have making motors is eliminating air bubbles which can cause a motor to over pressurize and create havoc. This is especially true in large diameter motors where propellant is placed in pieces at a time to fill a casting tube. Despite rumor, motor propellant is not poured it is mostly "placed". This process can create voids in the propellant despite the best efforts to evacuate the propellant before casting it.

A discussion of NASSA members took place at a BALLS launch to figure out a better way to cast larger 6" diameter grains. Present at the discussion was John Rakonnan, long time Amateur Rocket person and former Thiokol Propellant Master. He told us of a way to cast propellant under vacuum and assured us that this technique was proven and worth the effort. Under such a recommendation NASSA members began the development of a true Vacuum Casting System.

A complete working Vacuum Casting Machine capable of filling a 6" diameter Casting Tube is simple and workable.

Les Derkovitz head up the development team, we should say "was" the development team. With assistance from Jerry McKinlay and Oliver Schubert an apparatus was designed and fabricated that, with minor technical adjustments, became a working Vacuum Casting Machine.

Developing vacuum casting in NASSA, both the hardware and the production techniques, was sort of a natural. NASSA had thought and talked about it for a long time, and after we had a couple of disappointing casting sessions pouring a motor for BALLS when voids were coming up on the surfaces against both the mandrel and the casting base, the time was right to pursue vacuum casting. Because NASSA pours motors in many different sizes and configurations, the challenge was to develop a casting chamber that could accommodate all the sizes we deal with in a convenient “one motor at a time” production session.

The concept is to have a chamber that contains the casting tube, is sealed and can be drawn down to a vacuum with our pump. Into that chamber the propellant has to be drawn in and injected into the casting tube. The "tube" of the chamber is a 30" inch long piece of the tube that we can make 6 inch motor grains with. NASSA went with 30 inches because it is doubtful that they will cast a single grain any longer than 25 inches. The remaining 5 inches is needed to align the "spigot" from the ball valve to the casting tube via use of a hose.

A base plate was fashioned from MDF and plexiglass. In the photo above you see how the plexiglass sheet is sandwiched between the two pieces of MDF. A slot was routed out in the plexiglass to allow for the silicon gasket that would seal the bottom of the chamber. A set of 4 bolts pulls the vacuum chamber tube down against the gasket to preload it so that the chamber can pull a vacuum. The air board sander is attached to the base to vibrate the unit and settle propellant.

The top of the chamber is another plexiglass vacuum plate with a silicon gasket and holds the mechanism to attach the vacuum pump plus introduce the propellant into the casting chamber and into the motor casting tube itself. These are made up of brass fittings allowing the connection of the vacuum pump, along with a vacuum gauge to monitor the degree of vacuum, plus a small ball valve to seal off the chamber if the pump is disconnected. This allows for the vacuum hose to be disconnected from the chamber and still maintain a vacuum inside. The idea here is to be able to use only one pump to degas the propellant in the usual way and use the same pump to draw the vacuum on the chamber. It

saves time not having to draw a vacuum from scratch in the chamber when the pump is changed from the mixing bowl to the chamber. The gauge can show if any vacuum was lost.

The main challenge was developing a system that could introduce the propellant to the inside of the chamber without losing the vacuum. It was decided to go with a one inch brass ball valve having an aluminum funnel, used as a loading hopper, attached to the top. The theory being that the chamber could be drawn down with the ball valve closed and then the propellant could be added to the hopper. Once the funnel is full of propellant and the valve is opened, the propellant provides the seal as it is being drawn down into the chamber. Before all the propellant has been drawn out of the hopper, the valve is closed again and more propellant added to the hopper and the process repeated again till the grain is full of propellant.

A piece of flexible tubing is attached to the chamber side of the ball valve fitting and is used to guide the propellant to the casting tube inside the chamber. A special "Do-Dad" was designed to break up the propellant while introducing it into the

casting tube. The tube can be manipulated, to a point, for targeting various size grains.

Last item is that air board sander attached to the base of the unit. While casting propellant the air sander is turned on and the vibration shakes the unit to help settle propellant as it is dumped into the casting tube. A little extra something to

Wooden base with the 6" aluminum chamber (not shown in position) and an air board sander explained in the text.

assure any possible trapped air is released. Under vacuum this possible trapped air is virtually non-existent.

After reformulating the NASSA propellants to be more “pourable”, and casting up a couple of motors using the newly developed hardware, some problems were exposed and corrected that the original engineering did not foresee.

The Do-Dad is designed in two pieces for cleaning purposes and possible future mod-ifications.

The Do-Dad assembled. Note the "flange" on the end to help hold it inside the flexible tube.

The "Do-Dad" piece is attached to the end of the flexible tubing. A hose clamp (not shown) assures it staying on during vacuum.

After the refinements were in place, casting under vacuum can be done with relative ease however, clean up of all the additional hardware that comes in contact with propellant takes quite a bit longer. Also, even though the propellants are now more "pourable", one must work as fast as possible because it takes a long time to draw all the propellant through the one inch ball valve and any delays will give the curative time to "kick" off the propellant enough to make it almost impossible to be drawn into the chamber. NASSA did go with a room temperature curative that gives as long of a working time as possible.

As expected, grains cast under vacuum show no voids at all. When inspecting grains that have burned part way through and then extinguished, they show a very smooth burn surface. The surface does not look like that of the moon with the craters we are all used to seeing from motors not cast under vacuum. Now that the bugs have been worked out of the production techniques and the chamber has proven it's worth, we expect to cast most of our large NASSA motors under vacuum.

The heart of the whole operation is the top plate. Just about self explanatory it resembles a large standard Vacuum Plate with a big funnel attached.

BAND SAW CIRCLE CUTTER

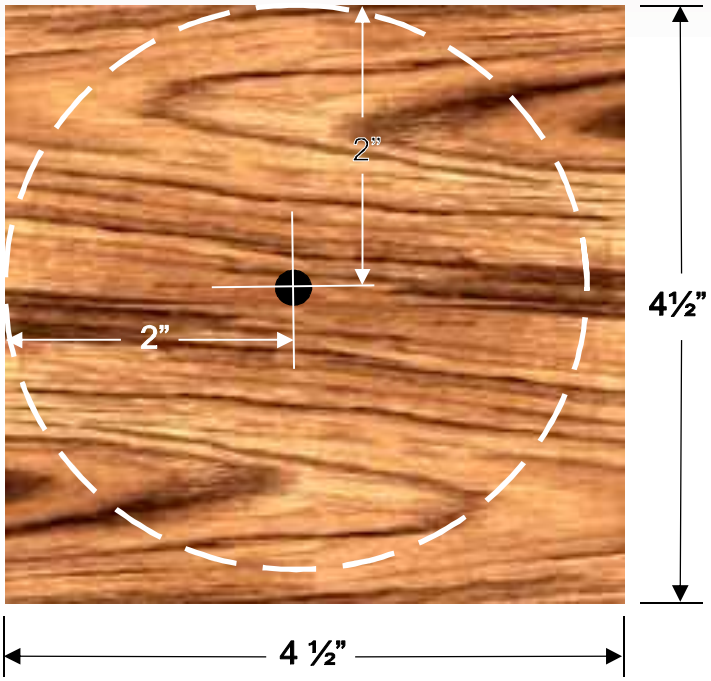
Making Circles Out Of Squares

It is easy to build this traditional and handy circle cutter using your basic Band Saw. It is used mainly for cutting solid bulkhead disks in wood, fiberglass or even metal, using the proper blade.

Do not expect to cut centering rings this way, only bulkheads! It is a work platform designed to fit on the deck of your bandsaw. Through the center is a channel fitted with a sliding tongue with a ¼" pin placed in the center as shown. The tongue can slide, positioning the pin at various distances from the band saw blade. This distance is your radius.

Image 1 & 2 to the right show how it operates.

As an example if you wanted a 4" diameter bulkhead you would cut a square of wood ¼" oversize so you would have a square 4¼" x 4¼". Measure in from one edge 2" and then from another edge 2" (this is the radius of the circle you want to cut) and draw a center X as shown in the diagram.



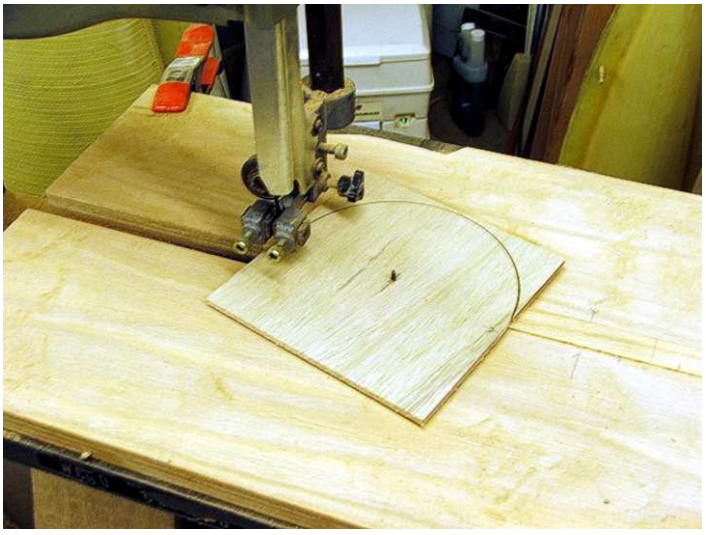
Note: The peice of material is slightly larger than the circle desired.

Drill a ¼" center hole on the center X.

Now adjust the sliding tongue so the center of the pin is 2" from the blade, This 2" is the radius of your 4" circle. Lock or clamp the slider in position so it will not move. Place the wood square, or even a stack of them, on the pin so the blade is positioned flat against the starting point of the desired circle.

Top shows the slide pin in a close position while the bottom photo shows it moved out.

Turn on the saw and spin the wooden square while it is held centered by the positioning pin as shown below. - Simple and clean.



LET'S VISIT DAVE ROSE

Dave Rose, co-owner of Graphix & Stuff and partner in DT Research Rocketry, works out of two rooms in his basement. Like just about everyone else the work areas are cramped and organized storage is an art.

The front room is the main work area. Rocket construction and motor making takes place here where all of Dave's tools are located. And, like most others, stuff is on wheels to be shifted around when space is needed.

Large rocket projects are capable here as seen by Dave's 2012 "THE RING MASTER", which gets moved around quite a bit!

The front room is the main work area with all equipment mounted on wheels for easy move abouts.

All fiberglass work and fabrication, motor making and "bodywork" is done in this rather close area.

The two photos at the bottom show the back room. This is Dave's "Clean Room" where electronics and motor assembly is preformed. It is also the storage area for his completed rockets.

The back room also stores Dave's huge collection of miscellaneous and specialty tools, and he's got a ton of them.

While Dave's "shop" is confined, its organization is outstanding.

The clean room holds most of the stored pieces and parts as well as small specialty items.

THE ULTIMATE ROCKET PAYLOAD