TRIPOLI Report

JOURNAL OF THE TRIPOLI ROCKETRY ASSOCIATION, INC.
Volume 29 Number 2 - Spring 2018

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Cover photo: What can we say. Sometimes things just fall apart! *Photo by Gerald Meux Jr.*

Photo to Left: Jim Cornwell of Arizona built a giant Mosquito and successfully flew it at BALLS in Nevada. *Photo by Dave Rose*

Tripoli Private Discussion Forums

The Tripoli Rocketry Association supports on-line forums for TRA members, hosted on the TRA website

Along with other features and information available only to members at **www.tripoli.org**, the forums provide an opportunity to interact with TRA members around the globe.

To access the TRA forums, log on to the tripoli.org website, using your 5 digit member number and your password (*note - when accessing the website for the first time, select 'Reset Password' and follow the instructions to set your initial password*). Once logged on select "Forums" at the top of the screen.

For assistance with the website or online forums, please contact **bvb@tripoli.org**

TRIPOLI ROCKETRY ASSOCIATION, INC.

The *TRIPOLI REPORT is* the business and communications publication of the Tripoli Rocketry Association Inc.

Submissions to this publication, in the form of articles, opinions, and photos, are accepted. The *TRIPOLI REPORT* reserves the right to reject or edit any material submitted.

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FROM THE PRESIDENT

by Steve Shanon

To be honest, it's distressing that I have to write this column. Especially now, when launch sites are so easy to lose and so difficult to get. This is a biased account of an actual recent series of incidents as related by some local launch organizers to me. Deb Koloms and I are also gathering information from the other parties to this story and the Board and I are discussing what to do about it.

Recently, a small team of experienced flyers brought a large rocket to a launch. The launch was a two day launch suitable for their project. It was a large, expensive project and they incurred great expense traveling to the launch site. They understandably wanted to see it fly. Unfortunately, the rocket wasn't ready to launch on the first day. We all know how that goes: just a "few minutes" worth of problem solving that eats up a bunch of time. They stayed up nearly the entire night working on the project and then went to the launch site early on the second day. The team didn't attend the flyers' meeting either day of the launch, instead focusing on the rocket and preparing the launch pad they had borrowed.

One of the specific things covered during the flyers' meeting was landowner restrictions for access to the field. The landowner required the use of a service road and prohibited driving across the field. Unfortunately, when the team brought the rocket and pad to the field, *they drove across the field*. **That's precisely the kind of behavior that can cost a club its launch site.**

Once the rocket and pad were ready, enough clouds had gathered that the launch organizers put off launching the rocket, choosing instead to wait to see if the cloud cover would improve. One of the local people who was helping as RSO for the launch even contacted me to see wondering if a loophole existed. I sent him a link to FAR 101, the Federal Aviation Regulations that govern our rocket flights. Here are the relevant requirements, but I don't know of any loopholes:

§101.25 Operating limitations for Class 2-High Power Rockets and Class 3-Advanced High Power Rockets.

When operating Class 2-High Power Rockets or Class 3-Advanced High Power Rockets, you must comply with the General Operating Limitations of §101.23. In addition, you must not operate Class 2 High Power Rockets or Class 3-Advanced High Power Rockets—

(a) At any altitude where clouds or obscuring phenomena of more than five-tenths coverage prevails;

(b) At any altitude where the horizontal visibility is less than five miles;

(c) Into any cloud;

The launch team and the launch organizers disagreed whether the amount of cloud cover was sufficient to prevent launching the project. Things got tense and one of the members of the team had his first argument with the launch organizers. I absolutely understand that it's extremely frustrating to have a large project on a rail and be told to stand down. The rule requires that cloud cover be no more than 50%. **Whether the cloud cover is excessive or the chance of launching into a cloud is too high is strictly up to launch organizers, specifically the Launch Director, RSO, and LCO. No flyer can ever overrule them and arguing with them will only make things worse.**

Because the project team would not be allowed to fly the rocket, they had to remove it from the pad. NFPA 1127, requirement 4.13.8 very clearly requires that energetic materials be disarmed before lowering a rocket from vertical. I've included it below:

NFPA 1127, 2018 Revision, Requirement 4.13.8: *The function of firing circuits and onboard energetics shall be inhibited prior to removing the high power rocket from the launching position.*

Here's where things got really heated. Instead of a switch, the project team had twisted the wires together and then inserted them completely into the hole. I suspect everyone reading this knows of this method. It's called "twist and tuck." Here's where perception and the ability to step back and let things cool down are

so important. The person who had argued before felt that the launch organizers were being critical of his switching method and became defensive. His justification for using that method came across as condescending to the launch organizers. He argued that he used "twist and tuck" because he's a BALLS flyer with experience flying rockets at Mach 4 velocities and that "twist and tuck" is the only method reliable enough for such flights.

As far as the rules go, it's simple. If you want to use "twist and tuck", be sure you have a way to extract and separate the wires. In this case, I was told they ended up drilling a larger hole in the airframe so they could fish out the wires. The only people I know who twist wires use "Twist and Tape" where a portion of the wire remains taped onto the exterior airframe such that it can be used to retrieve the twisted wire to disconnect the power to the electronics. Will that withstand Mach 4? I don't know, never having flown a rocket that fast, but I do know that there are switches that would work.

Finally, according to the launch organizers, when the project team left, they deliberately drove over the field again.

Whether a launch is large or small, the organizers of a launch work very hard to make sure that everything is done safely and within the rules. They must obey FAR 101, the special conditions of their Certificate of Authorization (COA or waiver), NFPA 1127 – which is the foundation of the Tripoli Safety Codes, the Tripoli High Power Safety Code, the Tripoli Research Safety Code, all local or state rules and regulations, and landowner restrictions. Failure to adhere to any one of these could cost a local club their launch site. They are also working very hard to make sure that flyers and spectators have a good and safe experience. Launch organizers don't make up rules; instead they are faced with the delicate task of following the many rules that are presented to them. In fact they frequently bend over backwards to try and make it possible for people to fly. The phone call I received asking for a clarification of the rules on cloud cover was an example of this.

If the launch organizers say "No", "No" is the answer! If they say "Cover all metal parts", cover the metal parts. If they say "only pink fins", paint your fins pink. Neither I nor anybody on the board will override a local requirement intended to satisfy a landowner or comply with NFPA or FAR requirements.

Arguing with the folks who go to the trouble to develop a launch site, obtain a waiver, and put on a launch is also self-defeating and reflects very poorly on the person doing the arguing. The quickest way to be barred from a launch site is to argue with the launch organizers. The board will back the organizers in that also. Every time.

On the other hand it's easy to establish a good relationship with launch organizers. Show up early, help set up the range. Attend the flyers' meetings (all of them; conditions change), and follow the local rules; if you don't know, ask! Stay late and help the organizers break down the range.

FROM THE EDITOR

by Ken Good

About Facebook

Many of us spend some amount of our time looking through Facebook, perusing postings, getting annoyed, adding comments, etc. I treat it these days almost as an intellectual curiosity. Some who know me may recall that my professional credentials include some expertise in Information Science. When viewed through that lens, Facebook may be considered an information age train wreck. But so often like such an accident, it's one we watch with a sense of morbid curiosity.

Without getting into any discussion about the current controversies of how Facebook has apparently not been well-devoted to protecting user information or guarding against propagandistic abuses of the platform, the main objection I have to much of what I see therein is the incessant tribal/political attack and counter-attack. Also, there is a careless tendency of many posters to offer unreliable, uncorroborated information, merely to bolster a position or attack another. It truly gets depressing.

But there is a more positive side, and it is often linked to special interest groups. The Tripoli Rocketry Association and other rocketry groups have Facebook presences, and these seem to me to be welcome oases of people truly being helpful, open, and factual with each other. I have seen many postings from rocketeers, often newbies, looking for help, information and advice. Responses tend to reflect how we treat each other out at actual rocket launches - helpful, insightful, and unselfish. We seem to be very willing to recognize our common interest and common goals - to see our fellow rocket enthusiasts grow their skills and achieve their goals. As we find ourselves in this context, we demonstrate a willingness to put aside rancor and connect as brothers and sisters.

I have never seen anyone offer bogus, unreliable advice that they found on some questionable website in order to "make a point" when it comes to helping one of our fellow rocketeers. I haven't seen name-calling and posturing in this context either. I have seen healthy debate about the best way to achieve a flyer certification, or what electronics to use, or what parachute may be best for a certain flight profile. The debate and disagreement seem to be positive, and helpful in offering different valuable perspectives. You know, the way healthy debate should actually be conducted!

I also really enjoy photos and reports of rocketry projects and results that are posted. You will see one such short posting - with an amazing photo - reproduced in this issue of the Tripoli Report (see "Vapor Cones"). This kind of content offers a fine opportunity for our rocketry community to share our triumphs (and tragedies too) among ourselves and other interested parties. And again, this information tends to be reliable, factual, and real. A refreshing departure from standard Facebook nastiness.

I would like to think it would be possible for the ethics and courtesy discussed above to be more contagious to other Facebook content, but it's doubtful such will be the case. For those among my rocketry colleagues who tend to get a bit harsh in other non-rocketry postings, I would hope we could all look a little more into the better angels of our nature, and try to apply the same sort of respect we offer when discussing our rocket activities.

Whether that happens or not, I applaud the positive way we seem to be showing the Facebook audience the activity we love. We are far from the early days of Tripoli when many of us were nervous about too many people knowing about the powerful rockets we were building and flying, often in less than ideal circumstances. We are visible to all now, through the many forms of media that exist in the current state of the Information Age. Facebook may not be the perfect example, but let's continue to leverage it in a productive, ethical, and factual manner, ensuring that Tripoli Rocketry puts its best face forward.

TRIPOLI ROCKETRY ASSOCIATION, INC.

BoD ACTIVITIES

Boar of Directors Meeting

Date: January 19th, 2018

Time: 21:00 EST

Location: Teleconference

Present: Steve Shannon
Debra Koloms
David Wilkins
Dave Rose
Burl Finkelstein
Gary Rosenfield
Gerald Meux
Tom Blazanin
Dick Embry

Apologies: none

Proxies: none

LDRS Update

Dave Rose has received Hotel arrival times from all Directors attending LDRS 37.

FAA/BLM Update

FAA has been quiet until the end of the month; suspect they are waiting.

BLM Permit to cost $110 for Black Rock this year.

Dick Embry will be following up with other launches on Black Rock that make sure they have paid their BLM fees. Those who don't may not be allowed to launch there again.

Kent Newman is working on the BALLS Certificate of Authorization (CO)A.

Aeropac and Tripoli Central California are taking care of their own.

Class 3 Committee

Kent Newman, Ken Overton, Chuck Rogers, Kevin Trojanowski and Greg Deputy had a teleconference with Steve to discuss the change of committee leadership.

Greg and Kevin had all their questions answered, and both are looking positive to acting as Co-Chairs.

Ken Overton will remain as an analyst.

Joe Bevier has agreed to be an analyst.

Dick Embry has agreed to support the committee on FAA issues.

A few years ago Tripoli purchased a license for ASTOS (Analysis, Simulation and Trajectory Optimization Software for Space Applications) for use by the Class 3 Review Committee. At that time ASTOS was installed on a commercial application server (AWS), but the cost was too high. Greg is setting up a server which he will be hosting to provide remote sessions for analysts. We hope the new setup will help expedite its use as a tool for the C3RC analysts, but they will not rely on it for analyses this coming season until they feel proficient with it.

Dick will discuss the possibility of training assistance with the ASTOS publishers.

Spaceport America Cup

Andy Berger asked about a Class 3 COA for any Spaceport America (formerly known as IREC) teams flying Class 3 rockets (containing more than 40,960 N-s); should they contact FAA about a COA straight away?

Steve Shannon suggested that they should join Tripoli and avail themselves of the Class 3 Review Committee. We won't process Class 3 requests for non-members/groups because access to the Class 3 committee and its expertise is a privilege of membership, but we need to support University/Colleges in their research activities by providing Safe Practices. We can distance ourselves from people who go “rogue” and ignore the standard we set.

Our reputation with FAA Class 3 processing is a major advantage. Our success ratio with Class 3 projects is higher.

Manufacturers' Committee

No progress to date; Gary Rosenfield is still formulating the scope of the committee and will discuss further with Steve before making a formal proposal to the Board.

HPR Rights

Tom Blazanin has spoken with Bruce Kelly and has agreed on a one-time fee of $1500 for all rights to HPR Magazine content. We pay shipping for all the content he has.

The BoD are inclined to approve this as long as it secures exclusive full rights to the content of HPR and

other Tripoli content, and the right to use/reproduce the content. It's important to secure it as it's part of our history. This is also seen as important in securing the content and bringing it back into Tripoli. It's important to receive the material before making payment.

Burl Finkelstein, Steve Shannon, and Tom to sort out the agreement details to protect Tripoli.

Tom raised storage of the material as an issue; Tom will find out from Bruce how much material there is.

We will look to digitize the content; we could crowd-source the work and supply a high quality scanner or two to members who are interested in processing the content into a digital archive that can be made available to members. The hard part will be curating the collection.

Frank De Brouwer

The Board noted with sadness the passing of Tripoli member Frank De Brouwer. Once his family has made an announcement we will reach out to them so we might put an entry into our memorial forum in recognition of Frank's participation in the hobby and as an active member and prefect of Tripoli.

Meeting adjourned: 22:07 EST

What's this election thing all about? I just want to fly rockets...

by Bill Riley, TRA Election Committee Chairman

Whether you've just recently joined Tripoli, or you are a long time member, you're likely well aware that we rely on volunteers for just about everything. While we all like building and flying, we also see that there's work to be done. Setting up the range on launch day, performing RSO and LCO duties, mentoring new members, administering certification exams, serving on the Technical Advisory Panel, and so on, are examples of ways that people volunteer their time and experience to support us and our hobby.

As an educational non-profit organization, there is also ongoing work to be done to ensure the safety and continuity of the hobby. Negotiating with insurance companies, keeping up to date with safety standards, working with local and national authorities, and testing commercial motors are examples of work done behind the scenes that also take considerable time. Tripoli relies on a nine person board of directors and supporting committees to shoulder much of this workload. Each year three directors are selected to serve on the board for three year terms.

Where do these directors come from? Yes, they too are volunteers. This is where you and I play a part. As members, we choose from the candidates who have volunteered to take on these important responsibilities.

Just as you no doubt lend a hand at local launches when you are able, I encourage you take a few minutes to review the candidates' resumes and select up to three to serve in this valuable role. Not only does this reinforce that we want the most qualified individuals, your vote also indicates that you are interested in the long term viability of our organization, and actively support the volunteer nature of our hobby.

The following is the candidate slate for Tripoli's 2018 Board of Directors Election for the three seats available. Of these candidates only one incumbent is running to keep their seat on the Board. Candidates presented here are shown as drawn from a random selection order. Please review all resumes before voting and vote for the three people you feel would do the best job in guiding your organization into the future.

2018 TRA BOARD OF DIRECTORS CANDIDATES

LOU POCCIA
TRA# 01255 - L1

I want to be on the Tripoli Board because I feel that I can bring a new outlook and enthusiasm to an "old hobby". This is done by thinking "out of the box" and finding ways to make our sport more fun and useful. It's not about just building larger rockets with more powerful motors. It's necessary to try to do something with our hobby by applying our rocket skills to achieve something different.

Did you know that high powered rocketeers can actually use their skills to build a large working model of a UFO? I am working on one for an amateur movie. You can too. How about modeling a working flying version of an aircraft or rocket plane? Or even experimenting with a hybrid flying craft that mixes various flight technologies, i.e. a jet with rocket propulsion. The Germans did this in World War II and so did Uncle Sam in the 40s, 50s, and 60s. The possibilities are endless and add so much more to your experience with high powered rocketry than just another big rocket. I learned this when I was studying to become a science teacher and wrote a model rocket lab manual to teach physics.

Now, I am working to develop commercial applications for high powered model rocketry. One of my projects was a 12 foot tall 96 sq. foot rocket lofted banner during the last presidential campaign. I also developed all the techniques necessary to successfully and safely fly this

banner repeatedly. Now, I am currently working on a larger project, a 480 sq. foot 30 foot tall "K" powered aerial banner for a commercial advertiser. These projects "push the envelope" so to speak.

In addition to my rocketry, I am an author and lecturer. My writing explains a variety of unexplained mysteries including lost civilizations and UFOs. My book, X-history, discusses World War II and various weapon systems that can be called UFOs. My book, Secrets of Lost Earth, discusses lost civilizations and even the possibility of an Earth – Mars connection. Both books are paperbacks that have been printed locally and make available at my public lectures.

Also, I entered politics this past year and ran for city council. If you are curious, you can look up my Facebook page: Lou Poccia Let's Work Together. The Facebook page also has a photos of my late brother Mario next to our 11 foot test model and a photo of me holding our 12 foot political banner.

If you wish to contact me please email me.
Thank you.

CHRISTOPHER SHORT
TRA 10247, L3 TAP
Prefect Central Alabama #38
tbonerocketeer@gmail.com

My name is Christopher Short, and I am running for the TRA Board of Directors. My reason for running is that I am in a unique position to represent the diverse interests of the composite of Tripoli membership from Level 1 flyers thru complex Class three rockets. You probably know me as Chris from Chris' Rocket Supplies.

I was born in California in 1984, but moved in early 1985 to Germany. I was raised in a military family, so I have lived all over the place. I became interested in rockets in elementary school in Sumter, SC when my neighbor flew one in the field on our road. I was unable to get into rockets though until we did them in middle school science class in Navarre, Fl. I have been involved ever since. I became the student lead for a TARC team my senior year of high school when the principal approached me to form a team because he knew of my interest in rockets. While doing TARC, I found SEARS in south Alabama and have been a member of their club since. I obtained my Level 1 cert in March of 2004 as a freshman in junior college, and my level 2 in September of the same year. After Junior college, I went to Auburn University as an Aerospace engineering major. My L3 cert came in January 2006, after which I joined Auburn's USLI team. I was a member of several USLI teams while I attended Auburn. Somewhere in the 2007-2008 time, I was nominated and added as a TAP. I did not finish my degree at Auburn, but I am continuing my education at Middle Georgia State in Information Technology. I am the founder and owner of Chris' Rocket Supplies, LLC, and continue to be very active in the hobby on both the commercial and research side. I attend launches across the country on a regular basis.

My reasons for running for the board are to give back to the very hobby that provides so much for me. I truly love this hobby and want to see it continue to grow. Tripoli members and the rocketry community are who I spend most of my waking hours talking to. I would like to work with the board to help progress the website and help the organization continue to grow while representing the overall flyer, not just the small groups of flyers that some members feel the board represent. I regularly attend launches across the country, where I meet and talk to all the different people that make up Tripoli membership. I believe that my knowledge of the hobby and listening to TRA membership makes me able to represent the membership's voice in board decisions. Thank you for your consideration, and if you have any questions, please email or call me and I will be happy to answer them. I appreciate your vote.

ART APPLEWHITE
TRA #09409-L2, NAR #80632-L2
Secretary, Texas Hill Country Tripoli #089

Senior Advisor, Alamo Rocketeers, NAR#661
Senior Advisor, Hill Country Rocketeers, NAR#671
Master Sergeant(Retired) U.S. Air Force 1971- 1991
Bachelor of Science degree in Computer Science from the University of Maryland

I was born in Fort Worth, Texas on February 3, 1951. I flew my first rocket when I was 9 years old. It was an Estes Scout. Since that time, I have never lost my interest in rocketry, although, at times, my career and location have prevented me from pursuing it. I joined the U.S. Air Force in 1971 and served on active duty in Texas, Mississippi, Illinois, Oklahoma, Germany, Japan, Turkey & Spain. After I retired from active duty with the Air Force, I worked as an Air Force contract employee from 1991 to 2001 in England, Korea and Turkey. I retired from Government service in 2001. I relocated to San Antonio, Texas where I officially became a BAR (Born Again Rocketeer).

Soon thereafter, I started my own small business, Art Applewhite Rockets, so I could design, produce and sell my own unique rocket kits. I use the profits to support local rocket clubs and to provide low-cost rocket kits and launch equipment to schools, scouts, and other educational organizations. I have been a mentor for the Team America Rocketry Challenge (TARC) every year since its inception.

I founded the Alamo Rocketeers, NAR#661 in San Antonio, Texas in 2002. After moving to Kerrville, Texas in 2004, I founded the Hill Country Rocketeers, NAR#671 and shortly thereafter, Texas Hill Country Tripoli #089. I served as its Prefect for several years. I am a co-founder of the South Texas Aerospace Club, STAC, NAR#739, in Beeville, Texas.

Free of charge, I created, hosted and maintained Internet web sites, Yahoo groups and Facebook pages for these rocketry organizations:

Texas Hill Country Tripoli#089
http://www.artapplewhite.com/089

Heart of Texas Rocket Club(HOTROC), TRA#012
http://www.artapplewhite.com/hotroc

Alamo Rocketeers, NAR#661
http://www.artapplewhite.com/661

Hill Country Rocketeers, NAR#671
http://www. artapplewhite.com/671

I host and maintain the "Texas Rocket Launches and Events" web page at:
http://www. artapplewhite.com/launches.html
to keep folks informed about all Texas and national rocket launches and events.

My goal is to make rocketry as safe as possible for as many people as possible. To further this goal, I serve as RSO at most of the launches I attend and I am active in community outreach programs. I believe that, to be truly effective, safety codes and certification procedures should be as simple and objective as possible. Above all, personal bias should be avoided and common sense should prevail. I believe that there is always something new to learn and the amateur rocketry community should be open to innovative and creative ideas. I appreciate your support.

GARY DICKINSON
TRA #05520 - L3 – TAP Member
Prefect - Tripoli Mid-Ohio #31
Member: Tripoli Gerlach; Tripoli Quad Cities

Fellow TRA members, my name is Gary Dickinson and I am running for the TRA Board of Directors. The 2017 election added some excellent folks to the TRA board and I hope to join them this time around. Not a lot has changed since this time last year, but I do have a couple of updates.

I retired from Procter and Gamble in 2014 after ten years as a direct employee. My career with them started in 1981 as a contact design engineer, working on updates to the Pampers QI diaper converters and progressed across numerous business units. I worked process/equipment R&D and led many successful capital projects in a lead design role, responsible for concept through start-up in North American and Europe.

I returned to work full time in July 2017 as a contractor, in the role of Global Design Manager for Procter and Gamble's Feminine Care Business. I have come full circle! My wife refers to this as "flunking retirement".

In 2017, I had the opportunity to work with The Ohio State University's Buckeye Space Launch Initiative earlier this year, developing Research motors for the 30K launch in 2017 at Spaceport. I am once again on the team in 2018 and will be working with the students to assist in developing motors for two of their projects.

Born in New Brunswick New Jersey in 1953 we moved to Ohio in 1954. I was a child of the 'space age', watching and listening to the daring exploits of the early pioneers in space travel. I had hopes and dreams to be one of them someday, but that did not work out.

I had my first exposure to hobby rocketry when my best friend in junior high school came into home room one day with an Estes catalog exclaiming: "Look what I have!" I ordered a WAC Corporal kit and several engines and the journey began. I gave up model rocketry for girls, cars, and college, marriage, and kids.

I re-entered model rocketry in 1991 with my young son Mike. We built and flew rockets together at the neighborhood school yard and had a blast; pun intended. I always knew that there had to be bigger rockets out there somewhere and found out where they were when I was in the Pit Row Hobby Shop in Kenwood on my lunch break in November of 1995. In the magazine rack was a stack of the now defunct "High Power Rocketry" magazines and on the cover was an inset picture of Bob Strauss' ODESSEY at the ICBM launch. Now THAT'S what I wanted to do! I made a trip to Ross Dunton's Magnum Inc. store in Mechanicsburg Ohio on New Year's Eve Day that year and purchased an Aerotech Mustang. The rest is, as they say, history.

Tripoli Mid Oho #31 was founded by Ross Dunton in the 1980s and has gone through a few prefects and numerous changes since its inception. As only the fourth prefect, I have taken the club through a short phase of "indy" operations and back to a regular prefecture flying under TRA Research rules. We are slowly growing and have a loyal following here in Ohio and the surrounding states, reaching out to students from local high schools as well as the University of Cincinnati, University of Dayton, and The Ohio State University. We are on solid financial footing and are updating our launch infrastructure to better serve our fliers. A number of years ago we purchased a Wilson F/X launch system and upgraded several of our launch pads this past year.

I am also a member of Tripoli Gerlach and was closely involved in running BALLS 2016 and 2017. I proposed that Tripoli Mid-Ohio offer the use of our Wilson F/X

launch system for the event. Along with the BALLS event staff we expanded the Wilson system for BALLS 2017 and beyond.

My passion for this hobby continues to grow, especially around research motor making. While I am not an expert by any means, I am mentoring several fliers on the motor making process and I am seeing positive results at our local launches and at the BALLS 2016 launch.

I have had several people ask me why I want to run for a position on the TRA board and my response is simple: I want to give back to a hobby that has given so much to me. Within both my original career and my "retirement career", there exists a "flow to the work" mentality. Go where you are needed and do what needs to be done. If I am elected, I will bring that same philosophy with me. As previously stated, I have a deep passion for research motor making and I am also a strong proponent of safety and education in this hobby. I am a "rules person" but believe that education is the basis for safe and successful events.

I would welcome the opportunity to serve you and this great organization in any capacity and ask for your vote in this election.

DEBRA KOLOMS
TRA #09021 – L3
Tripoli Vice President

Fellow Tripoli members, my name is Debra Koloms and I am running for my fourth term on the Tripoli Board of Directors.

For those of you who don't know me, I'll start with some background information.

I was born in 1958 in the Chicago area. I got involved in rocketry like so many others of us by first flying rockets as a child, I think I built almost every rocket Estes made back then, and can still remember the fun I had. As high school came along and then college, rocketry took a back seat, while more pressing things such as getting a degree, starting a career and family took a priority.

I attended Washington University in St. Louis where I received a BS in electrical engineering in 1980. I then worked at Motorola as a RF design engineer for about a

year before attending medical school. I received my M.D. from the Loyola Stritch School of Medicine (located in the Chicago area) in 1985. After medical school I did a one year transitional internship, and then a 3 year Ophthalmology residency again at Loyola, finishing in 1989. I started practicing ophthalmology in the Chicago area and stayed there until 1997 when I decided to relocate to the Northern New York town of Watertown where I currently practice and live.

In the mid 90's I played around a little with rocketry by building a few Estes kits and flying them with my children and sometimes with their school's classes, but I did not seriously get back into rocketry. Around 2000 I caught the rocketry bug again after seeing a web page featuring high power rockets, I became a "Born Again Rocketeer", and have not looked back since. I bought my first high power kit a LOC IROC and built and flew it for my L1 and L2 certifications in 2001. In 2002 I flew my L3 flight on a large tetrahedral rocket.

I have been a TAP member since 2004 and have served a stint as TAP chair.

I have served on the Board of Director for nine years and have served as president as well as vice president. I currently chair the insurance committee and will be launch director for BALLS this September. The last decade has seen much change. When I originally ran for the BoD one of my major goals to accomplish was to integrate research and commercial flying. I am happy to report that we have accomplished this. The last step accomplished a few years ago was to allow other rocketry organizations members to fly commercial motors at TRA research events, thus giving all TRA members the freedom to fly!

While I have accomplished one of my major goals, I think there is still much to do.

I still think we need to find a way to better communicate with the membership and be able to listen to their concerns.

We need to expand our educational outreach. TRA is in the perfect position to partner with universities. We have done much of this with university projects, but there is still much opportunity there.

We also need to grow our membership, and get younger members involved with leadership on both the local and national levels.

I love this hobby and have found serving on the BoD these last nine years a very rewarding experience. I am very proud of what TRA and its members have accomplished.

I feel I have a lot to contribute and would love to continue to serve on the BoD if re-elected.

If anyone has any questions please do not hesitate to contact me

Respectfully,
Debra Koloms

NEIL BAKER
TRA #06620 – L3

To the members of Tripoli Rocketry Association, I would like to offer my services to the organization as a board member. I believe that my years of involvement in the rocketry community as well as my professional and technical skills would prove beneficial to the organization.

Building and flying rockets is a huge part of the hobby that I love, but it's not the only part. I find that much of the interest and enjoyment I get from this hobby is from the planning, coordination and preparation of anything from a single flight to hosting a launch event.

Personal

I'm 50 something years old, and happily married with three grown children. Over the years my family has enjoyed (endured) the rocketry hobby with me. We have lived in West Jordan, Utah for as long as I can remember. My wife and I are at the point in life where our children have moved on to their own lives or are doing so quickly. I'm very proud of my family and very much enjoy the relationships we all have with each other.

When we aren't doing rocket stuff, my wife Michelle and I like to overland, camp, and travel. My childhood was spent in the deserts of northern Utah riding motorcycles, launching model rockets and enjoying the stark beauty of the desert landscape.

History

I attended my first launch competition in 1976 and with a few exceptions have continued to keep my eyes pointed up ever since. During both junior high and high school, I promoted the hobby of rocketry and held demonstration launches for the science classes at the request of the teachers.

I attended Utah State University (Aerospace Technology with an emphasis on Computers). During my time at USU, I was the secretary of the local chapter of the American Institute of Aeronautics and Astronautics (AIAA) and initiated the group's first of many rocketry competitions. I also provided demonstrations and talks to many schools in the area.

After returning to Salt Lake City, I continued my exploration of the rocketry hobby and became a member of the Utah Rocket Club (UROC) in 1996. I quickly became involved with the organization's inner workings and volunteered my services.

I have continuously held a position within UROC over the years such as Equipment Manager, Webmaster and Treasurer. I have been fortunate to hold the position of president of UROC more times than any other member.

In 1998 Tripoli Utah (UROC) was chosen to host LDRS 17 on the Bonneville Salt Flats. This was by far the largest launch that any of our club members had participated in. I was part of the team that planned and executed the event. We needed to build much of the equipment and infrastructure required for the event. In the end, we felt the event was a success for the attendees. All of us that were involved learned a lot about holding a large-scale event, we made a lot of mistakes but learned a lot that would prove beneficial for many years to come.

During my time with the Utah Rocket Club, I'm proud to have been involved with these accomplishments:

- Held a successful LDRS event on the Bonneville Salt Flats (LDRS 17)
- Have consistently held HellFire – a large high-power launch for the past 23 years on the salt flats. (One year was flooded out)
- Lead the initiative to incorporate the club and become a 503c not for profit entity.
- Engaged many of the K-12 (private and public) schools in Utah and have provided talks and demonstrations for the students.
- Developed UROC's first website in 1996 (one of the first rocketry club websites) and the site has remained up uninterrupted since then. This includes online registration and ticketing for our events.
- Hosted demonstration launches for the NASA Space Grant Consortium
- Hosted the NASA University Student Launch Initiative (USLI) multiple times
- Provided talks, demonstrations and displays at various events such as the state fair, fund raisers for our local planetarium, etc.
- Provided the launch system used at LDRS 24 in Lethbridge, Alberta Canada.

Real Life

In my real life I am the Director of I.T. Services for VLCM, a VAR based in Salt Lake City, Utah. My role includes the day to day management of a team of 25 computer engineers and administrators. Our company provides I.T. support in the SMB and Enterprise markets in Utah, New Mexico, Colorado and Idaho. Over the past 25 years I have been involved in hundreds of successful implementations and solutions.

Before joining my current employer, I worked as the I.T. Manager for Advanced Brain Technologies located in Ogden, Utah where I maintained the I.T. Infrastructure and developed testing procedures and deployment processes for our products.

As a Systems Analyst at Fidelity National Financial Information Services (FNFIS), I was part of a team responsible for the development and execution of a data migration process involving over 500 credit union's core systems around the world.

During my time at Capital Associates Technology Group/MBS Connecting Point as the Manager of Engineering, I and my team were integral to the development and implementation of solutions such as one of the first remote banking/conferencing kiosk systems in the United States.

Vision

We are at a key point in history right now, not since the 60s has there been as much enthusiasm about rocketry and space exploration as there is right now. Tripoli can and should be an even more relevant resource for today's and tomorrow's advanced rocketeers. Today, there is far more information available to interested people via social media and the internet than ever before, this explosion in communication and information has changed the way people/groups interact. I believe that without direction from an experienced organization such as Tripoli, the enthusiasm seen today by many of the young people entering the hobby will be short lived and transitive. I believe, Tripoli has an excellent opportunity to make new life-long members.

Tripoli should ride this wave to increase membership and exposure as much as possible. The interest is there, but the methods of discussion and participation have changed, we need to address these changes to continue our relevance in the years to come.

Millennials, are our new audience, while we, as current members, enjoy the friendship, comradery, and relationships that we have all built in this hobby, we must do more to foster interest and support for the hobby and Tripoli itself with the next generations. I believe this is best achieved by communicating and reaching out to new, current, and prospective members through methods of communication that are comfortable and familiar to this new generation.

Thank you for considering me for a position on the board. Please know that regardless of the outcome, I am more than happy to assist Tripoli and its members in any way that I can.

Thank you for your time and consideration

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Respectfully,
Neal Baker

CALL FOR ARTICLES

The *TRIPOLI REPORT* is looking for articles that may be of interest to the members of the Tripoli Rocketry Association. These can be in the form of technical papers in topics relevant to rocketry or supporting activities, such as photography, propellants, software, workshop tools, etc.

Contributions must be original material; if submissions contain information, photos, graphics, etc. that are obtained through other sources, they must be free domain or permitted to be reproduced. Please ensure such sources are identified with your submission.

MS Word documents are requested along with photos and/or drawings. Photos must be at least 300dpi in JPG or PNG format. Please submit your material to:

KEN GOOD, Editor
ken.good@tripoli.org

FREE ADVERTISING

Free ads are available to manufacturers and/or vendors of High Power & Research Rocketry product Ads are available on a space available schedule. Ads must be size adjustable. Our design service is available.

For complete information on Tripoli's free ad service contact:

TOM BLAZANIN, Production
justtom@rimworld.com

COMING IN THE NEXT ISSUE . . .

ELECTION RESULTS
AP COMPOSITE BASICS
USING CALIPERS
BAND SAW CIRCLE CUTTER
and MORE

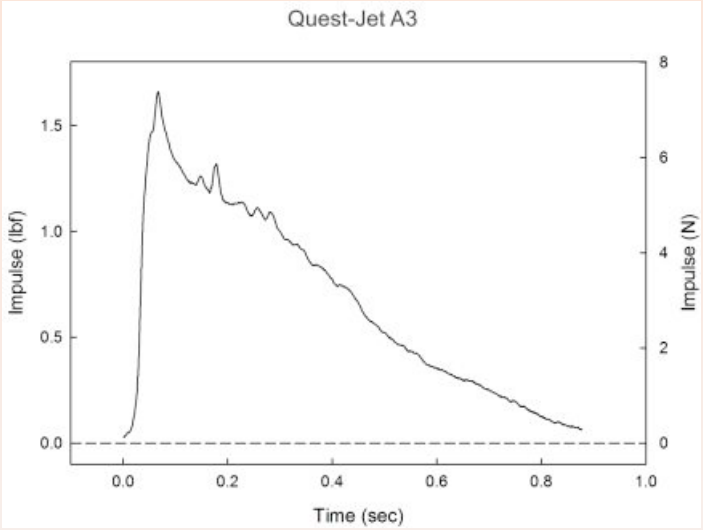
TMT REPORT

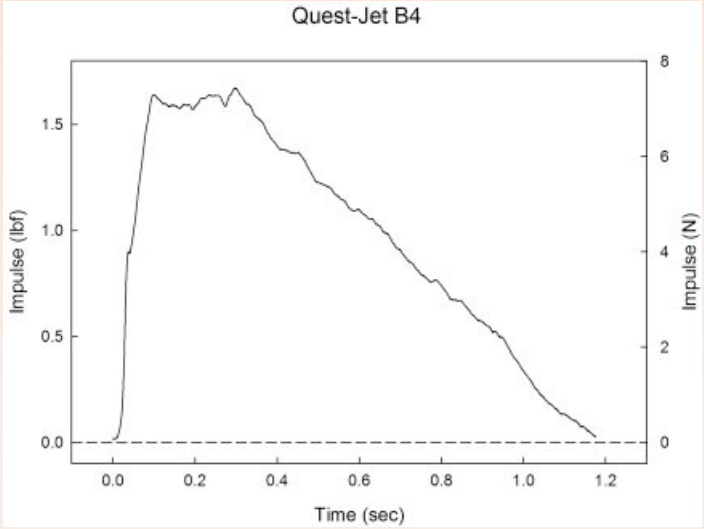
by Alan Whitmore

The only thing going on in the last 3 months has been the certification of 2 new Quest motors, the A3 and B4. The test photos were from a day when it was raining hard and in heavy fog. The APCP motors made huge clouds of smoke/water condensation. The nice thing about testing A and B motors is that you can do it in your driveway and the neighbors don't even know.

Left: A small B Motor is fired.

Below: Alan performs one-man motor testing of these small motors.





The following are the average figures for the two motors tested. Test altitude was 427' above sea level.

MOTOR	BURN TIME (sec)	I Total (N.s)	I Avg (N)	Delay (sec)
A3-4	0.772	2.50	3.24	4.05
A3-6	9.772	2.50	3.24	6.26
A4-4	1.097	4.85	4.41	3.778
A4-6	1.907	4.85	4.41	6.25

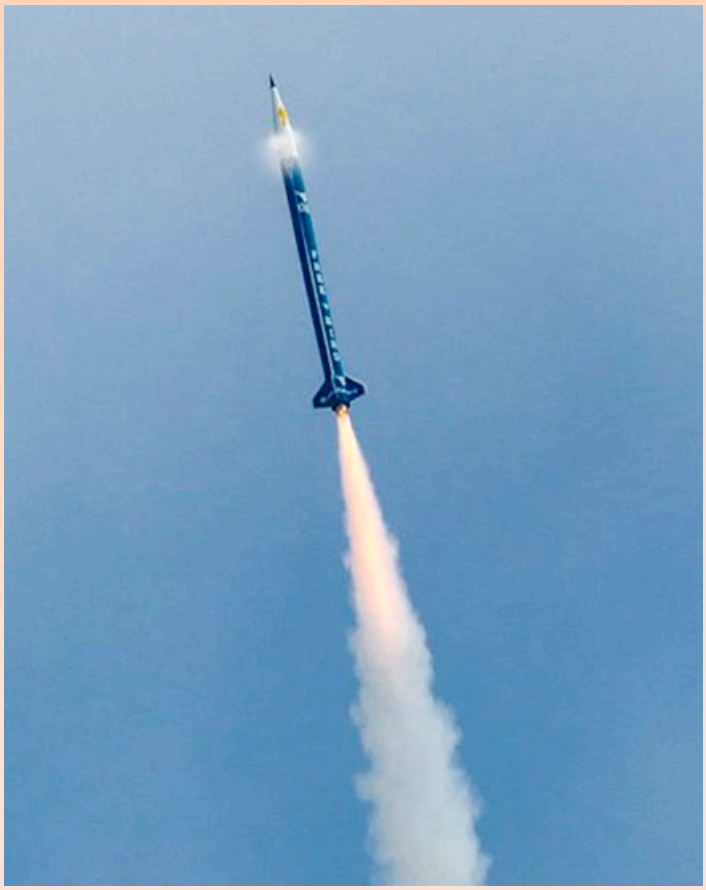
VAPOR CONES

A Vapor Cone, also known as shock collar or shock egg, is a visible cloud of condensed water which can sometimes form around an object moving at high speed through moist air, for example an aircraft flying at transonic speeds. In aeronautics, transonic refers to the condition of flight in which a range of velocities of airflow exist surrounding and flowing past an air vehicle or an airfoil that are concurrently below, at, and above the speed of sound in the range of Mach 0.8 to 1.0, (600–768 mph) at sea level. When the localized air pressure around the object drops, so does the air temperature.

Most of us have seen photos of sleek aircraft traveling at transonic speed with a vapor cone formed. We doubt anyone has captured a non-commercial hobby rocket at transonic speed forming a vapor cone. Students at West Virginia University have captured the moment.

The photo shows “Freebird” in flight as it goes transonic and you can see water vapor condensing on the shock wave as it forms around the nose cone.

The "Freebird" rocket was built by the West Virginia University Experimental Rocketry team. It was powered by a 152mm, 37,000 Newton second 'O' motor using NASSA Yellow Propellant. Their Tripoli Mentor was Joe Pscolka of Pittsburgh, PA. The entire motor



was machined and the propellant mixed and cast in-house.

It was flown at the Kloudbusters launch site in Argonia, KS on March 11, 2018.

PREFECTURE IMPROVEMENT PLAN

The Tripoli Board of Directors is once again pleased to announce the 2018 Prefecture Improvement Plan (PIP). Tripoli wants to potentially reward your Prefecture for your financial support over the years via the Annual Prefecture Dues. We are able to offer the PIP for an amount of up to $250 per Prefecture.

This is a grant program your prefecture can use to improve the flying environment for Tripoli Rocketry Association members. We want to enable your Prefecture to purchase equipment and supplies, perform outreach, and conduct marketing that will enhance your Prefecture, environment and flying field.

Please go to our website and download the two PDF documents available. The first is basically what we’re saying here and the second is a PDF form you will use to apply for your Prefecture’s PIP grant. Read over the letter, fill out the form and mail it into Dave Rose, Tripoli’s Treasurer.

Please act quickly since the program is limited to a maximum payout of $10,000, the total set aside for all Prefectures in the 2018 fiscal year. Letters will be sent to all Prefects with this information as well. Act now - first come, first to grab $250. It’s not hard to envision how this can help your Prefecture.

There is one caveat: the Association would like to know how you use these grants, so it would be nice to send in a report describing the use of the funds. With cooperation we can continue this program next year as well.

TRIPOLI ROCKETRY ASSOCIATION, INC.

CLASS 3 COMMITTEE UPDATE

Ken Overton has stepped down as Chairman of TRA's Class 3 Committee, an important committee servicing our high altitude flyers. Prior to Ken's tenure, Kent Newman served with great dedication for several years; These 'retirements' caused a major search for a replacement. After much discussion among the C3 committee members, a good outcome has been reached.

Two long time C3 members have stepped forward to co-chair the committee. Greg Deputy from Bonney Lake,Washington, Internet enterpenuer and creator of BurnSim, will co-chair with Kevin Trojanowski of Bellevue, Nebraska to head the committee and share responsibilities.

Both are veteran C3 members and will ensure the transition is totally un-noticable to our members in need of this Tripoli service.

Former chairs Ken Overton and Kent Newman will remain on as committee analysts, along with Chuck Rogers.

Joining the committee as an analyst for 2018 is Joe Bevier of Portland, Oregon. Dick Embry has agreed to support the committee on FAA issues.

As Co-Chairpersons, Greg and Kevin will receive Class 3 Forms and distribute them among the various analysts for review. Those found in need of Certificates of Authorization (COAs) will be passed onto the FAA & AST for approval and grant.

Greg Deputy

Kevin Trojanowski

WHAT IS A CLASS 3 ROCKET?

There are three classes of non-professional rockets. The first, Class 1, are model rockets using motors ranging from ¼A up through G (160 Ns). Class 1 rockets do not require an FAA Certificate of Authorization (COA).

The second group is known as Class 2. These are rockets using motors ranging from H, 320 Newton seconds through O, up to 40,960 Newton seconds. Class 2 rockets can be flown under a normal FAA COA for a typical rocket launch and require no additional paperwork.

A Class 3 rocket is one that contains more than 40,960 Newton seconds of total installed impulse (a full O-class motor). This is the threshold for those who are required to submit a Class 3 form to the TRA Class 3 Committee. Simply do the math. Add up the total impulse of all the installed motors and compare the sum to 40,960 Newton seconds. If it's more, it's Class 3 and a Class 3 form must be submitted to the TRA Class 3 Committee. It is mathematically impossible to have two O motors in the same rocket without it being Class 3. Or an O and two N motors. For that matter, if you have a 100% O motor in the rocket, even an additional 'A' motor would force it into the Class 3 realm. A baby P motor which is a Newton second over 40,960 is Class 3, and a Class 3 Form is required.

Tripoli adds an altitude-based requirement for rockets being covered by our insurance - fliers of any rocket (single or multi-stage) which will exceed 50,000 feet must submit a Class 3 Form to the committee, even if its total installed impulse does not exceed 40960 Newton seconds.

This latter example is required by the Tripoli Rocketry Association as part of our self-governing programs. Although not required by government agencies, it goes a long way toward demonstrating our consistent commitment to safety to the powers in authority.

MANUFACTURER'S COMMITTEE

The Tripoli Board of Directors has created a Manufacturer's Committee with Board Member Gary Rosenfield seated as Chairperson. The Committee is looking for members to participate and assist with Committee goals. While mostly dealing with motor issues the Committee needs members who not only manufacture motors but vendors who sell such motors. Even parties who do not sell motors are welcome.

The following is the Committee's initial outline:

Purpose:
To assist motor manufacturers and dealers in industry-specific matters including local, state, National Fire Protection Association (NFPA), federal and international regulatory compliance.

Scope:
Interface with manufacturers and dealers on the following:

- Safety and accident prevention
- NAR & TRA certification requirements and issues
- Department of Transportation (DOT) approval requirements and other regulatory compliance
- How to become a party to the DOT special permits 10996 and 7887
- Form a discussion group with on-site dealers to address the industry-wide problem of transporting inventory to launch sites contrary to existing regulations. This may include an effort moving forward of petitioning the DOT for a special permit for onsite dealers to transport inventory in alternative packaging and with alternative methods.
- How to submit an NFPA proposal or Tentative Interim Amendment (TIA)
- How to become a member of an NFPA committee
- Potential Consumer Product Safety Commission (CPSC) issues (re: banned hazardous substances act compliance)
- Department of Homeland Security (DHS) compliance (AP and powdered metals storage security)
- Bureau of Alcohol, Tabacco and Explosives (ATF) issues and compliance re: black powder, igniters and non-APCP propellants
- Storage and disposal of propellant waste/scraps, and other Environmental Protection Agency (EPA) -related matters
- Occupational Safety and Health Agency (OSHA) regulations and compliance
- Certified Europe (CE) requirements, compliance and costs

Any suggestions are appreciated and anyone interested, be they manufacturer, vendor or concerned Tripoli Member should contact Gary at:

garoq@scinternet.net

PARTICLE SIZES EXPLAINED

by Joe Pscolka

You will often see chemicals in fireworks and propellant formulas that look like these:

Aluminum, atomized, 22 micron
Aluminum, -325 mesh
Aluminum, -325 mesh, spherical, 22 micron

Do you really know what those particle sizes mean? What is actually being described? When they say "-325 mesh" and "22 micron", what's the difference? And why does it matter to you?

Well, it can definitely help you to know how the particle "size" ratings get assigned to metal powders. Most of the size ratings come directly from the wholesaler or manufacturer. But every so often we buy surplus materials which may not come with any additional information about the manufacturer, the size or shape of the powder.

The first step in the identification process is a visual inspection. You may be surprised how much you can tell about a sample just by looking at it. By observing the flow characteristics of a powder, and how it feels between your fingers, you can approximate particle size and shape. If you have experience with metal powders, for instance, you can often tell if a sample is granular (rough feeling), or atomized (round particles, feels smooth, pours and flows quickly and smoothly). If you cannot feel any particles between your fingers, you can assume the powder is probably finer than 200 mesh, or even less than 325 mesh (written as "-325 mesh.")

The next step is to verify those assumptions through quantitative and qualitative testing.

To determine if a material is appropriate to be used in a given formula you'll need to know the particle's shape (morphology), size, and distribution (granulometry). Shape, as shown below, is easily determined under a microscope and classified as atomized (spherical or spheroidal), granular, or flake.

Particle size is reported in one of two ways: either by mesh size (large and medium particles, generally larger than 325 mesh) or by microns (very small particles).

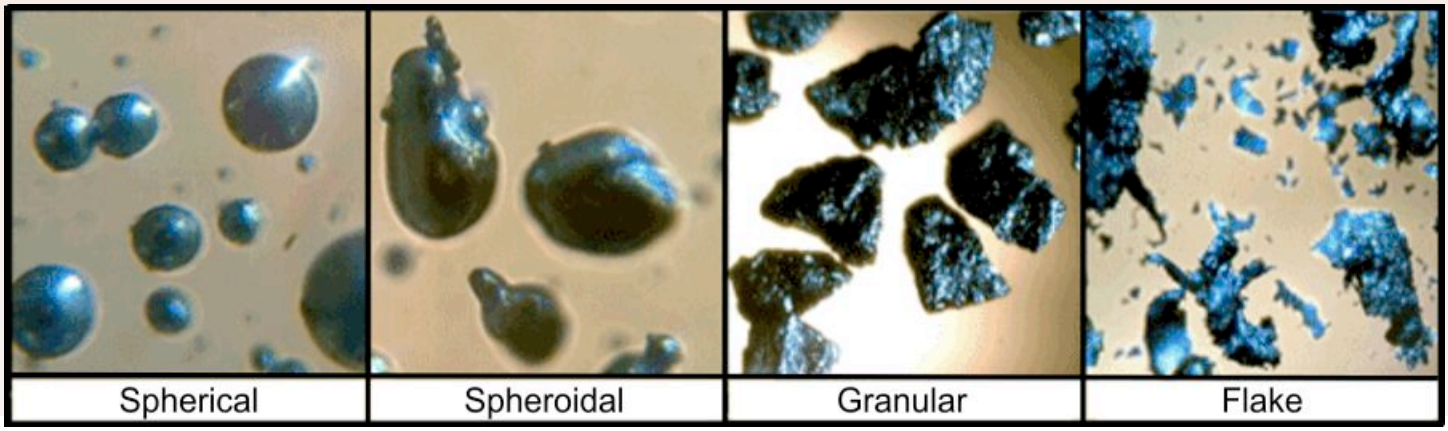
Why use two measurements?

US mesh size describes the number of openings per inch in a screen. So if a material is listed as -60 mesh it will all pass though a 60 mesh screen (the minus sign in front of the 60 means that all particles are smaller than 60 mesh). Conversely, if the material is described as +60 mesh, it would mean that all particles would be retained on a 60 mesh screen and are therefore larger than 60 mesh.

But mesh sizes can only go so far. After a point the individual wires that make up the screen are so close together it is no longer practical to measure using screens. In practice, particles smaller than 325 mesh are usually described in microns. A micron is one thousandth of a millimeter, or one millionth of a meter. The unaided human eye can see particles of about 40 microns. Smaller than that, you need magnification.

There is no truly accurate conversion from mesh size to microns, because the wire thickness in screens vary all over the place. But approximate conversion tables are commonly used anyway. (In the table on the next page, screen sizes of smaller than 600 mesh are shown, even though they don't exist in practice.)

“Mass Fraction Analysis" is used to determine large-to-medium size particle distribution in a sample. The powder is sifted through a set of nesting screens, each



with progressively smaller openings (higher mesh numbers). By measuring the percent of material that remains on each screen, we can classify a material by its size distribution.

US MESH	MICRONS
10	2000
20	841
40	400
60	250
80	177
100	149
200	74
325	44
400	37
625	20
1250	10
2500	5

If you were to sift a Magnesium-Aluminum product (described as 180-325 mesh) through a stack of 180 mesh, 200 mesh, and 325 mesh screens, a mass fraction analysis might yield a particle size range that looks like this:

+180 Mesh	26%
180-200 Mesh	31%
200-325 Mesh	21%
-325 Mesh	22%

If the 180 mesh size was critical to your formula, you can interpret this to mean that 26% would remain on the 180 mesh screen (larger then 180 mesh) and 74% would pass through it (be smaller than 180 mesh).

Mass fraction by sieve analysis is a very helpful method of classifying coarse-to-medium particles, but what about the really small stuff?

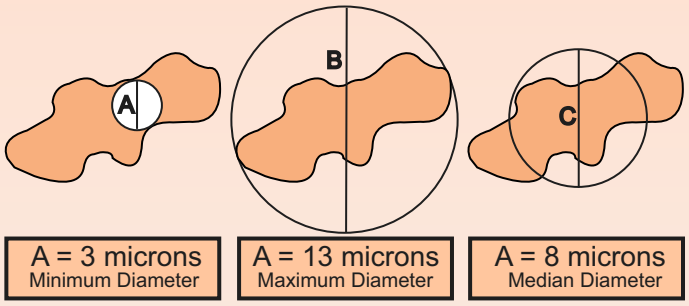
When the average particle size is around 50 microns, sieve analysis is no longer practical, and doesn't adequately describe the particle sizes. Several methods are commonly used to measure really fine stuff: Gravitational Sedimentation, Laser Light Diffraction, Optical Light Microscopes, Scanning Electron Microscopes (SEM) and Transmission Electron Microscopes (TEM). The most accessible method to an amateur is an Optical Light Microscope.

So how is a particle measured with a microscope? Do you need some kind of tiny ruler? As funny as that might sound, that's exactly how it's done. The microscope can be fitted with a gizmo called a Reticule Micrometer. After it is calibrated, it can be used to measure the size of individual particles in a powder sample right down to 1 micron. But just because you can measure it, that doesn't mean it's a simple task.

Sure, measuring spherical material is fairly straightforward. After all, you're really just measuring the diameter of little balls. But what about flake, granular, and spheroidal samples? Digital imaging and software can drastically decrease the time needed to perform measurements and reduce error rates. But it appears that most if not all of the automated equipment measures any particle shape as if it is spherical. Because of this, there is not really a standard method for assigning a particle size.

Selecting the method seems to be based mostly on what you'd like your results to state. Below is an imaginary particle and three circles representing different measurement methodologies.

In the first example the measurement is across the smallest dimension of the particle. This method might be used to describe the particle in terms of its reactivity by describing the particle in the smallest possible size. Method B might be used conversely, to describe the particle's largest dimension. Arguably the most accurate methodology would be using example C, where an average size is calculated



No matter what method is used, the results would normally be presented to you, the end user, as an average size (3 micron), a particle range (3 to 15 micron) or a frequency distribution (30% <5 micron, 10% 5-10 micron, 60% 10-15 micron), or some variation thereof.

So why does particle size or shape matter? The shape and size of a particle has a huge impact on its reactivity. Flake particles have a larger surface area that can be in contact with an oxidizer when compared with a spherical particle. Granular particles often have sharp edges that can ignite more easily than the smooth, round edges of an atomized powder.

Selecting powder with a different particle size or shape can create a wide variety of changes in motor performance, such as burn time, specific impulse, chamber pressure, etc.

Motor makers: Right now, as you look at the aluminum powder options from a chemicals suppliers list, you are

probably asking yourself: "what is the difference between spherical and spheroidal aluminum?" Or, for that matter, "what does it matter that a particle shape is granular, or flake, or atomized?"

Funny you should ask - I was just about to tell you. Herewith follows:

Particle Shapes 101:
Before you embark on this area keep in mind that particle shape is not the only factor influencing how a metal powder will perform in a motor composition. The size of a particle of metal, whether it is coated or not, and other factors are just as important as particle shape.

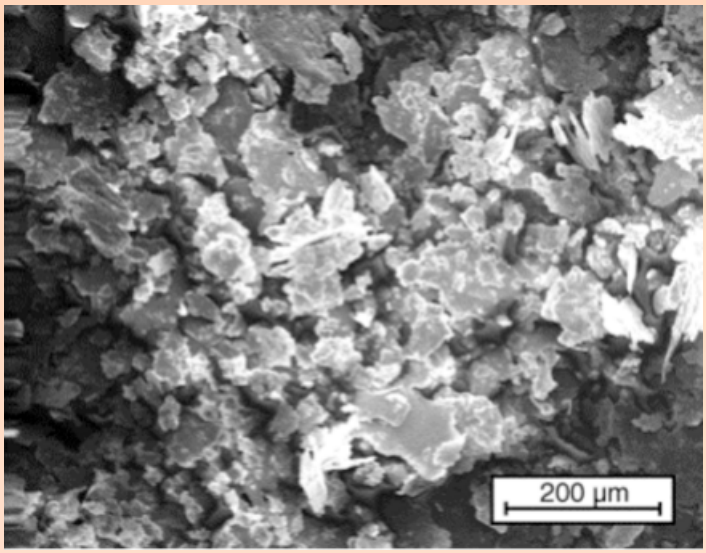
Particle shape matters mostly because of its impact on pyrotechnic composition reactivity. Think about it. Which is easier to light, a 3 x 3 inch piece of paper or a 3 x 3 inch piece of plywood? Chemically they're almost the same thing. But the little, bitty edge of the paper is a lot easier and faster to light than the edge of the plywood. And that's what separates the flakes from the atomized - ease of ignition.

Whether you are trying to make a rocket propellant, a flash device, a glitter fountain, a flitter star, or a long-tailed comet (I know, those are fireworks), your success will depend in part on using the right particle shape. So pay careful attention to the type of aluminum (or other metal powder) prescribed in your motor composition. If particle size or shape is not specified, and you are new to making motors, then it's a good idea to ask someone knowledgeable. Using the wrong one might be a waste of time and money, or could even be dangerous.

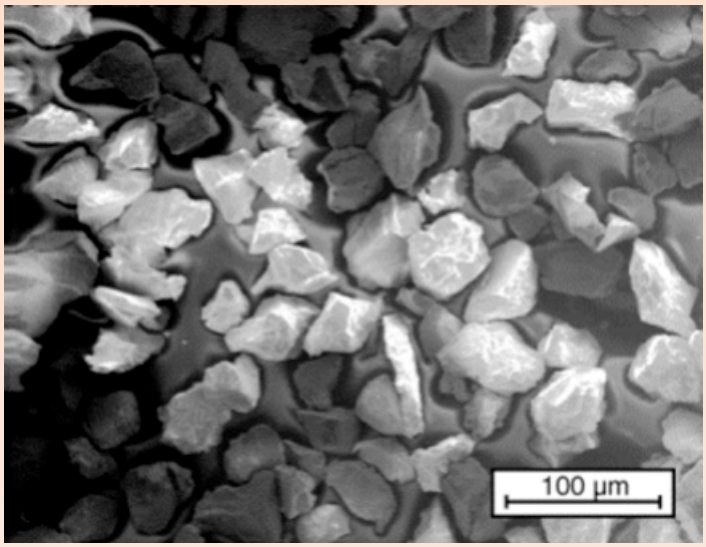
The photographs on this page show the most common particle shapes used in making fireworks. The scale on the bottom of each photograph shows a 200-micron long scale for your reference (that means 200 millionths of a meter, or a little bigger than a grain of fine, pesky, popcorn salt for all you who insist on watching television and munching popcorn in bed).

In the top photo notice how "edgy" the aluminum flakes are. These thin edges heat up and ignite faster than the rest of the particles. Flakes, because of this edginess and the fact they offer the greatest surface area, are generally the most reactive particle shape when used in pyrotechnic compositions.

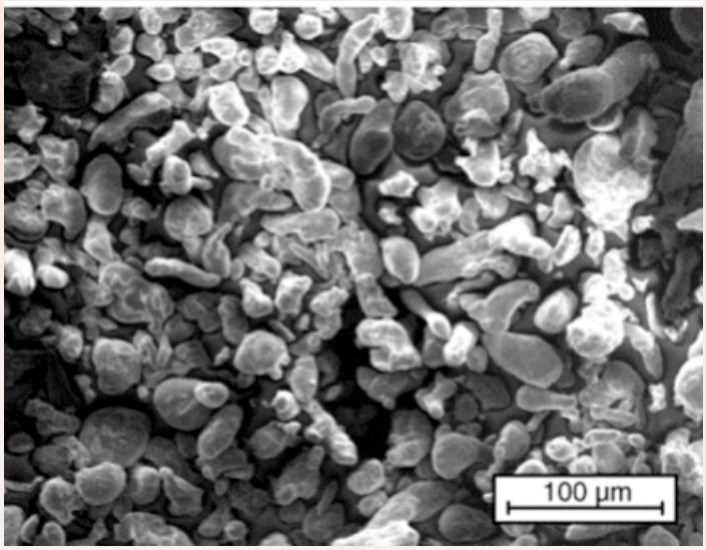
Granular (ground) metal particles, as shown in the second photo down, have a characteristic, gravel-like shape. Like flakes, they have a lot of sharp edges, too. But they do not offer as much surface area, and so will not be quite as reactive as flake powders.



Flake-Shaped Aluminum Particles
(Magnified 100times)

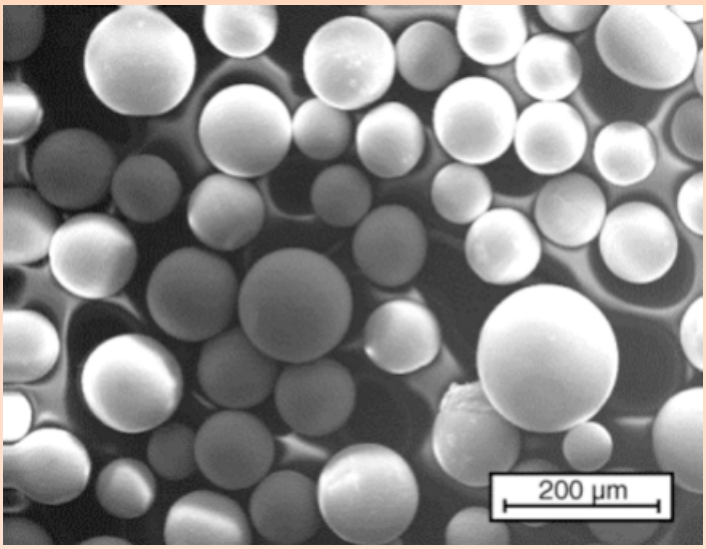


Granular-shaped ferro-aluminum particles
(magnified 100 times)



Atomized, spheroidal aluminum particles
(magnified 200 times)

Atomized particles come in two basic shapes: those that have irregular, rounded shapes, called spheroidal, (bottom photo, previous page) and those that are almost perfectly round called spherical, as shown below.

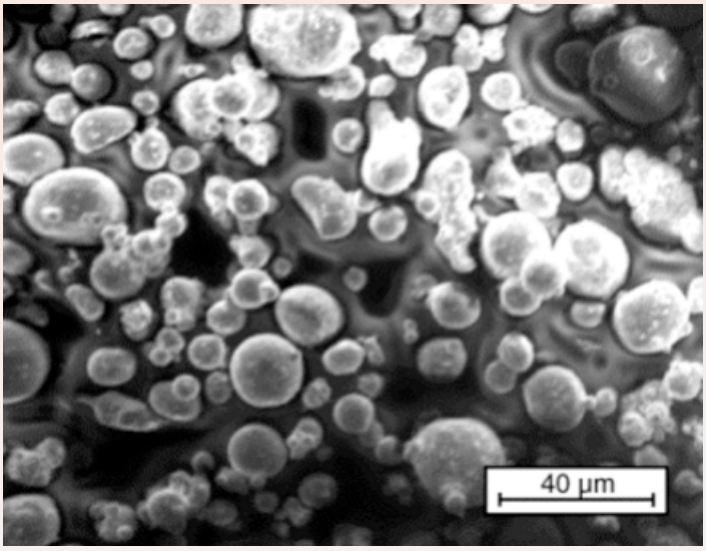


Atomized, spherical titanium
(magnified 100 times)

Notice that the spheroidal particles on the previous page also have "edges", those irregularly shaped extensions you see in the aluminum shown. But because they are rounded, they are not as reactive as the flake and granular material.

Spherical-shaped particles range from being perfectly round, shown in the titanium photo above to almost-round, as shown with the aluminum particles below. These are the least reactive particle shapes of all, with very few, if any edges to take fire.

So, the bottom line is that all metal powders are not created equal. Whenever you are creating a new composite propellant composition, choosing the right metal particle shape is critical. Spherical shapes are the predominant metals used in composite compositions. However, some have had success with other shapes. Again, if in doubt, ask someone knowledgeable.



Atomized, spherical aluminum
(magnified 500 times)

US MESH	INCHES	MICRONS	MM
3	0.2650	6730	6/730
4	0.1870	4760	4.766
5	0.1570	4000	4.000
6	0.1320	3360	3.360
7	0.1110	2830	2.830
8	0.0937	2380	2.380
10	0.0787	2000	2.000
12	0.0661	1680	1.680
14	0.0555	1410	1.410
16	0.0469	1190	1.190
18	0.0394	1000	1.000
20	0.0331	841	0.841
25	0.0280	707	0.707
30	0.0232	595	0.595
35	0.0197	500	0.500
40	0.0165	400	0.400
45	0.0138	354	0.354
50	0.0117	297	0.297
60	0.0098	250	0.250
70	0.0083	210	0.210
80	0.0070	177	0.177
100	0.0059	149	0.149
120	0.0049	125	0.125
140	0.0041	105	0.105
170	0.0035	88	0.088
200	0.0029	74	0.074
230	0.0021	53	0.053
325	0.0017	44	0.044
400	0.0015	37	0.037
625	0.0008	20	0.020
1250	0.0004	10	0.010
2500	0.0002	5	0.5

INTERRELATIONSHIP OF PARTICLE SIZE BURN RATE AND VISCOSITY

The relationship between oxidizer particle size and the burn rate and mixing viscosity of propellant confuses many people. However, when you know what is actually taking place, it all makes sense.

Let's start with the binder, or in our propellant, R45 (HTPB). The binder and the chemical agents that "cure" it, hold the dry components in place by locking them into a plastic matrix. To do this, the binder must coat all of the particles that are present in the mix. When the binder is cured, the particles are locked into the binder and the result is "solid" propellant.

The smaller the particles in size, the more of them it takes to make a gram (or an ounce or whatever). The smaller particles also have more surface area than an equal weight of larger particles. When the oxidizer is added to a mix, it must be coated with binder. It takes more binder to coat an equal weight of 200 micron (smaller particles) AP when compared to 400 micron (larger particles) AP. More of the binder is left to act like a liquid in mixes with larger particles. The net result of this is that mixes that contain larger particles tend to have a lower viscosity than mixes which contain more of the smaller particles. APCP was used in our example because most of the propellant is comprised of ammonium perchlorate. The same holds true of any solids in the propellant (i.e. metals, other oxidizers, etc.)

Since smaller particles have more surface area, they can react more vigorously during the burn. This is true because the burn takes place on the surface of the particles and the more surface, the more burn (in the case of oxidizers the oxygen is liberated from the surface of the oxidizer particle). This larger surface area equals a faster burn rate relationship and is true of both propellant surface area and of particle surface area, and for the same reason. The only real difference between the two (propellant surface and particle surface) is in the scale.

Since a more vigorous burn will create more hot gasses and consequently more pressure, and because ammonium perchlorate propellants are pressure sensitive (burn faster as the pressure increases), the finer the particle size of the solids, the faster the bum time of the propellant. In other words, surface area(s) and pressure determine the burn rate to a great extent.

Since "commercial" propellant needs to be pourable, so that it can be mass-produced, some of the solids are replaced with binder (liquid) and this results in a less powerful propellant. Manufacturers try to offset some of this loss by replacing some or all of the AP with finer AP, as in replacing 400 micron with 200 micron. By doing this the weight of the AP stays the same but the surface area is increased and so is the burn rate.

Bottom line (literally):
Smaller Particle Size = More Surface Area = Thicker Propellant Mix = Faster Burn Rate.

MIRROR MINIMIZATION

by Doug Gerrard

INTRODUCTION

Some of the most interesting photographs taken on board a rocket are via a mirror looking down the side of the rocket during takeoff. However, the size of the mirror required can be rather large for a camera that looks out perpendicular to the rocket body (figure 1). If your rocket body is large enough, you can angle the camera to reduce the size of the mirror. By angling the camera upward the size of the mirror reduces until the mirror becomes so far away from the camera that once again the mirror will start to increase in size.

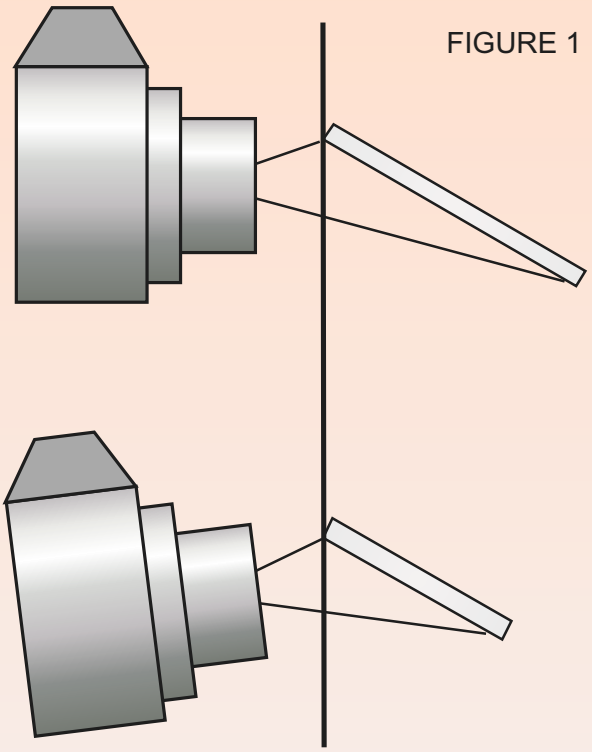


FIGURE 1

There is some point at which the angle of the camera will minimize the size of the mirror required to cover the angle of view. This article will find that optimum camera angle, the mirror's angle, and the required mirror size. Although this article refers to minimizing the "size of the mirror", it is actually minimizing the length of the mirror (distance **a** in figure 2) and then calculating the required width.

Refer to figure 2 for these definitions and assumptions.

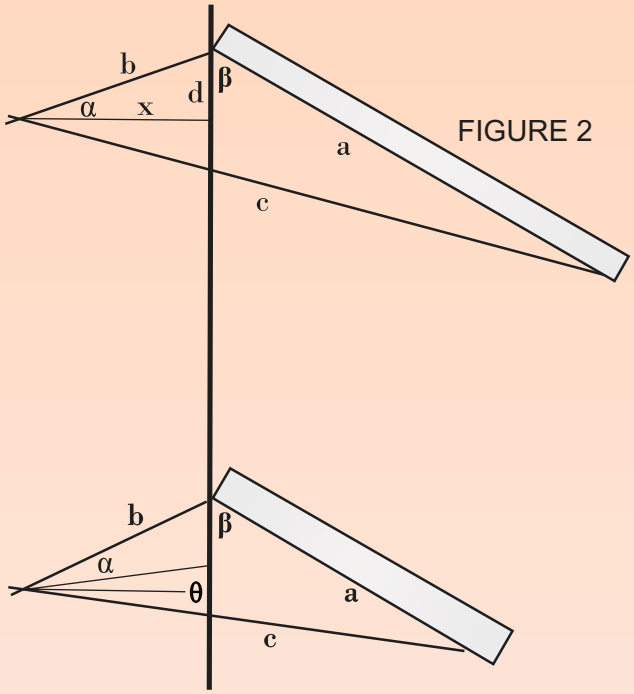


FIGURE 2

DEFINITIONS

a ≡ length of mirror required for specified camera angle of view

b ≡ distance from focal point to mirror along top angle of view

c ≡ distance from focal point to mirror along bottom angle of view

d ≡ distance along body tube from mirror to point perpendicular of focal point

x ≡ perpendicular distance from body tube to focal point

θ ≡ angle of rotation of the camera from horizontal

β ≡ angle of mirror from body tube based on assumptions below

α ≡ one half of the camera's *vertical* angle of view

$$\alpha = \tan^{-1}\frac{\text{½ film length or width}}{\text{the camera's focal length}}$$

φ one half of the cameras *horizontal* angle of view

$$\varphi = \tan^{-1}\frac{\text{½ film width or length}}{\text{the camera's focal length}}$$

For 35 mm cameras mounted horizontally in the rocket: $\tan(\varphi) = (3/2)\tan(\alpha)$

1. The mirror is attached to the body tube where the top angle of view intersects the body tube.
2.The mirror is angled so that the angle of view is reflected parallel down the side of the rocket.
3.The perpendicular distance from the body tube to the focal point (**x**) does not change.
4.This analysis does not assume any aperture opening greater than a "pinhole" camera.

ANALYSIS

If you don't care to follow the mathematical analysis you can skip to the conclusion for the beneficial part of the article. Referring to figure 2 and the smaller right triangle **bdx** the following relationship can be derived.

$$180 = 90 + (\alpha + \beta) + (180 - 2 \cdot \beta) \qquad \text{Therefore,}$$

For 35 mm cameras mounted vertically in the rocket:

$$\tan(\varphi) = (2/3)\tan(\alpha)$$

ASSUMPTIONS

$$\beta = \frac{\pi}{4} + \frac{1}{2} \cdot \alpha + \frac{1}{2} \cdot \theta$$

and

$$b = \frac{x}{\cos(\alpha + \theta)}$$

From the larger triangle **abc**, the law of sines, and the law of reflection yields:

$$\frac{\sin(2 \cdot \alpha)}{a} = \frac{\sin(\pi - 2 \cdot \alpha - (\pi - \beta))}{b}$$

and

$$\frac{\sin(\pi - \beta)}{c} = \frac{\sin(\pi - 2 \cdot \alpha - (\pi - \beta))}{b}$$

Combining the equations above and rearranging gives lengths **a** and **c** as a function of θ and α, and the mirror width as a function of θ, α, and φ.

$$a(\theta, \alpha) = \frac{x \cdot \sin(2 \cdot \alpha)}{\sin\left(\frac{\pi}{4} + \frac{\theta}{2} - \frac{3 \cdot \alpha}{2}\right) \cdot \cos(\theta + \alpha)}$$

$$c(\theta, \alpha) = \frac{x \cdot \sin\left(\frac{3 \cdot \pi}{4} - \frac{\theta}{2} - \frac{\alpha}{2}\right)}{\sin\left(\frac{\pi}{4} + \frac{\theta}{2} - \frac{3 \cdot \alpha}{2}\right) \cdot \cos(\theta + \alpha)}$$

$$\text{Mirror Width} = 2 \bullet (\theta) \quad \frac{x \cdot \sin\left(\frac{3 \cdot \pi}{4} \frac{\theta}{2} \frac{\alpha}{2}\right)}{\sin\left(\frac{\pi}{4} + \frac{\theta}{2} - \frac{3 \cdot \alpha}{2}\right) \cdot \cos(\theta + \alpha)}$$

There are several items that should be noted.

1.Both mirror length and width are directly proportional to the distance **x**. Therefore for simplicity of the charts **x** is defined to be 1.0. These "lengths" are then just **multiplication factors** that can be used for the distance from the focal point to the body tube for your particular camera and rocket design.

2.For a given camera/lens combination (and orientation) there is only one optimum angle to minimize the mirror size. However, any angle of the camera up to the angle q will reduce the required mirror size.

3.The equations for the mirror length **a**(θ , α) and the mirror width are valid for **any camera**. It doesn't matter what the format is as long as you use the definitions and assumptions you can calculate the mirror size required.

4.This brings me to the assumptions. Sometimes they are not very good.

Assumption 1 states that the mirror is attached at the intersection of the body tube and the upper angle of view. Many times this may not be desirable. Moving the mirror up the side of the rocket will increase the required mirror size.

Assumption 2 states that the upper angle of view is angled down the side of the rocket. You may desire some of the rocket to be in the picture. This is important when using the angle β. β is the mirror angle that gives you the angle of view described in assumption 2 with the camera rotated at angle θ.

Assumption 3 states that distance x is constant. Many times when you angle the camera you must place it further back away from the body tube wall.

Assumption 4 states that these calculations are not based on opening up the aperture. This may also require a larger mirror.

At this point, this article may sound like its nothing more than an interesting exercise in geometry. Well it is, but there is some useful information here. As stated before, any angle placed on the camera up to θ will reduce the size of the mirror required. Just don't take the mirror dimensions absolutely. They are a nice starting point. Use the angle for the mirror and take a few test shots to see if the mirror is the correct size and the angle

of view is the one you want.

SAMPLE PROBLEMS

Table 1 gives the data in tabular form and graphs 1 through 6 in graphical form. The way to use this information is as follows. If you have a 35 mm camera (size of the negative is 24 mm x 36 mm) you wish to mount into a rocket horizontally as in figure 1 and it has a 50 mm lens on it. The distance from the focal point to the body tube is 1.6 inches.

Then the angle $\alpha = \tan^{-1}[\frac{1}{2}(24\text{ mm})/50\text{ mm}] = 13.5^{\circ}$, $\Rightarrow \theta \approx 21.5$ and $\beta \approx 62.5^{\circ}$.

The mirror length is 1.6 inches x 0.95 = 1.52 inches.
Mirror width is 1.6 inches x 1.35 = 2.2 inches.

Now if that same camera were mounted vertically, the mirror size would be:

Then the angle $\alpha = \tan^{-1}[\frac{1}{2}(36\text{ mm})/50\text{ mm}] = 19.8^{\circ}$, $=> \theta \approx 24.2$ and $\beta \approx 67$.

The mirror length is 1.6 inches x 1.94 = 3.1 inches.

Mirror width is 1.6 inches x 1.34 = 2.1 inches.

Keep in mind that if you wish to have some of the rocket in the picture, decrease slightly.

Additional charts are available for your research.

TABLE 1

α (degrees)	ϕ (degrees)	$\theta_{optimum}$ (degrees)	Mirror Length $a(\theta_{optimum})$	Mirror Length $a(\theta=0)$	Reduction in size (percent)	Mirror Width (times x)	β (degrees)
5	7.50	19.72	0.25987	0.28634	9.24%	0.33181	57.36
6	9.00	19.84	0.32157	0.35567	9.59%	0.41513	57.92
7	10.50	19.98	0.38738	0.43032	9.98%	0.50603	58.49
8	12.00	20.14	0.45774	0.51107	10.43%	0.60557	59.07
9	13.50	20.33	0.53319	0.59879	10.96%	0.71506	59.67
10	15.00	20.55	0.61435	0.69459	11.55%	0.83594	60.28
11	16.50	20.79	0.70190	0.79977	12.24%	0.96987	60.90
12	18.00	21.06	0.79666	0.91593	13.02%	1.11889	61.53
13	19.50	21.36	0.89956	1.04504	13.92%	1.28536	62.18
14	21.00	21.69	1.01169	1.18958	14.95%	1.47205	62.85
15	22.50	22.04	1.13431	1.35265	16.14%	1.68222	63.52
16	24.00	22.43	1.26893	1.53829	17.51%	1.91996	64.22
17	25.50	22.85	1.41731	1.75174	19.09%	2.18997	64.93
18	27.00	23.30	1.58155	2.00000	20.92%	2.49804	65.65
19	28.50	23.78	1.76418	2.29261	23.05%	2.85120	66.39
20	30.00	24.28	1.96820	2.64293	25.53%	3.25797	67.14
21	31.50	24.82	2.19731	3.07025	28.43%	3.72923	67.91
22	33.00	25.39	2.45598	3.60352	31.85%	4.27816	68.70
23	34.50	25.99	2.74974	4.28820	35.88%	4.92147	69.50
24	36.00	26.62	3.08548	5.20009	40.66%	5.68033	70.31
25	37.50	27.28	3.47183	6.47561	46.39%	6.58187	71.14
26	39.00	27.97	3.91978	8.38759	53.27%	7.66122	71.99
27	40.50	28.69	4.44342	11.57267	61.60%	8.96447	72.85
28	42.00	29.43	5.06115	17.94069	71.79%	10.55258	73.72
29	43.50	30.20	5.79724	37.04096	84.35%	12.50838	74.60
30	45.00	30.99	6.68437			14.94485	75.50

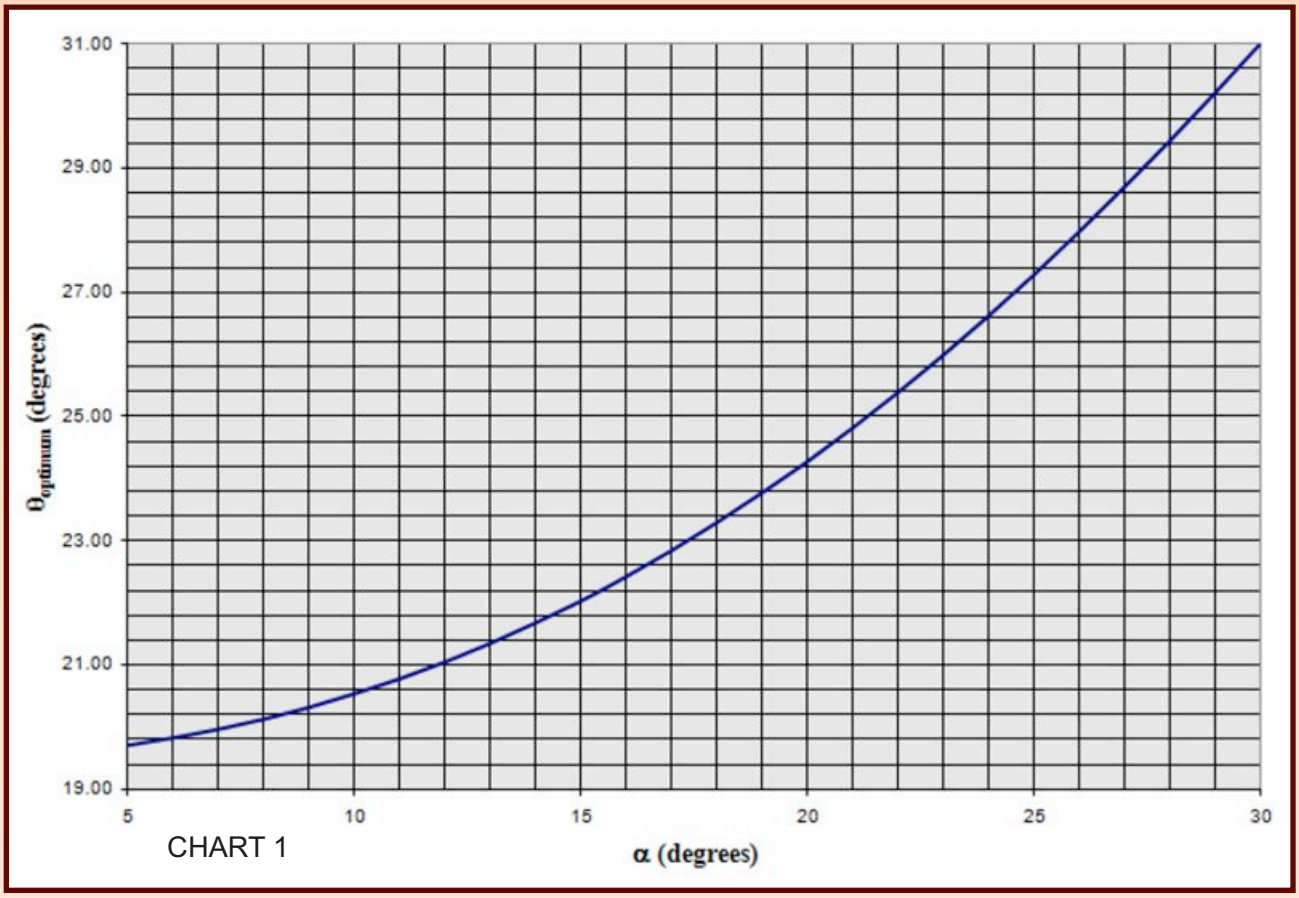


CHART 1

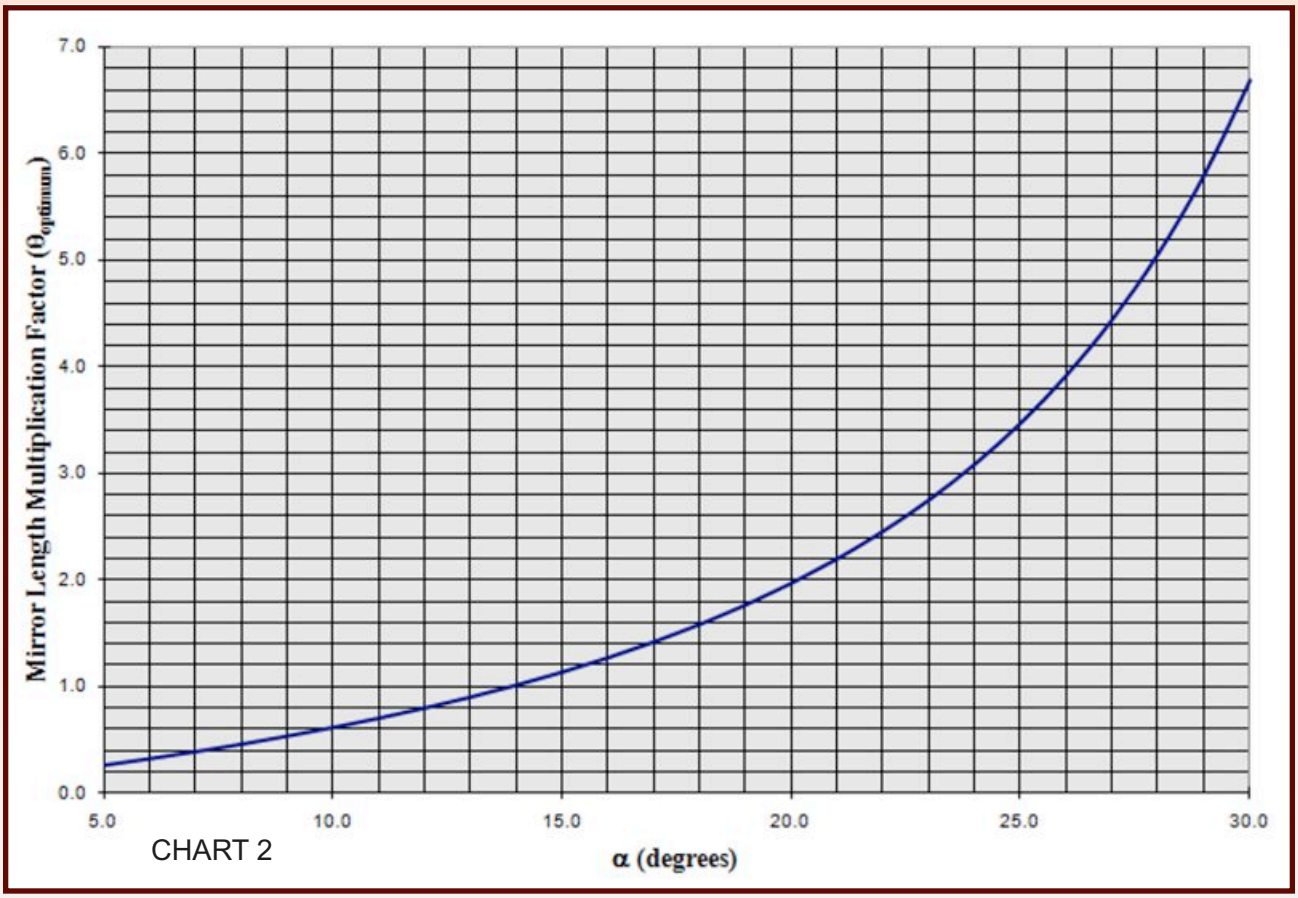


CHART 2

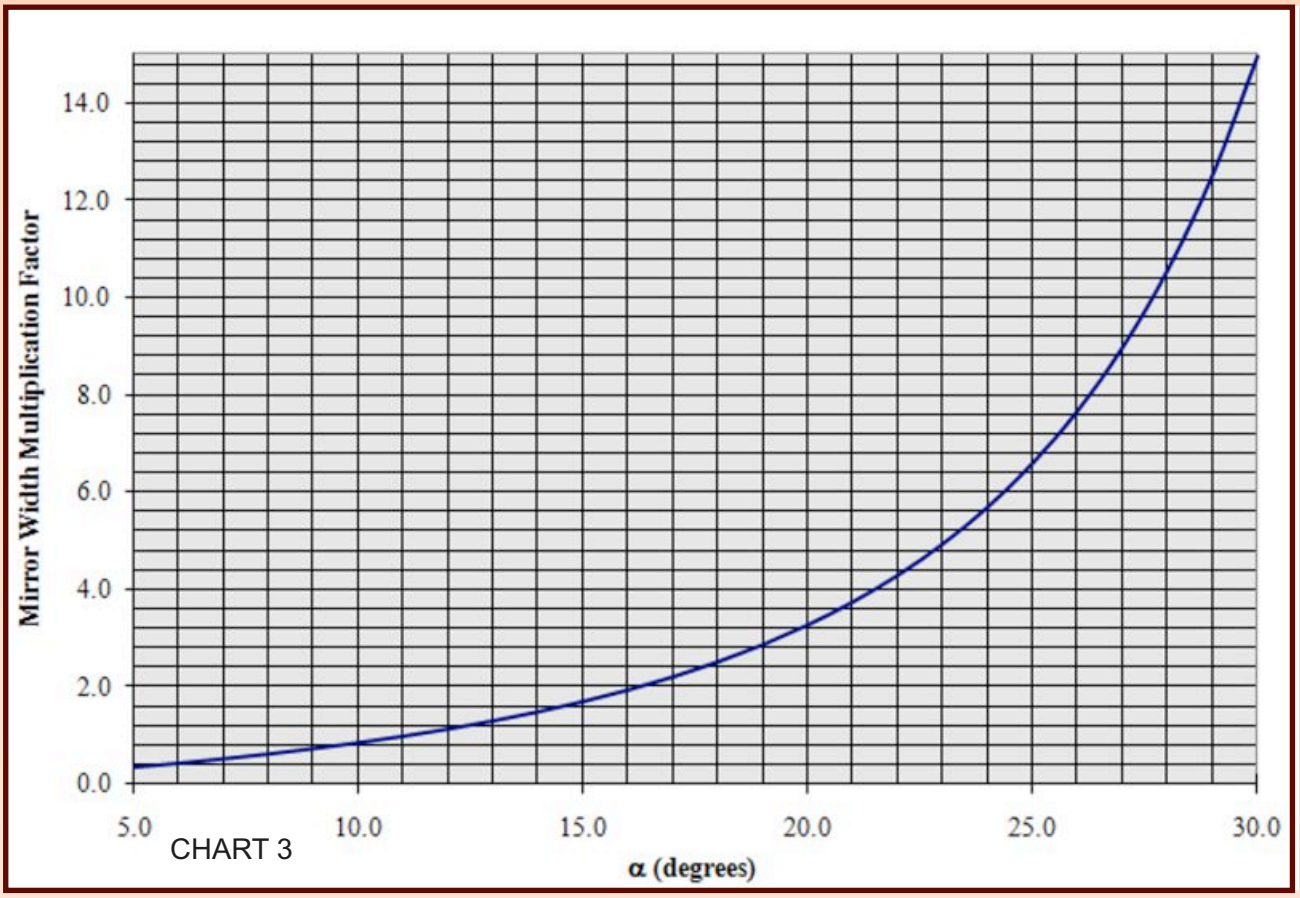


CHART 3

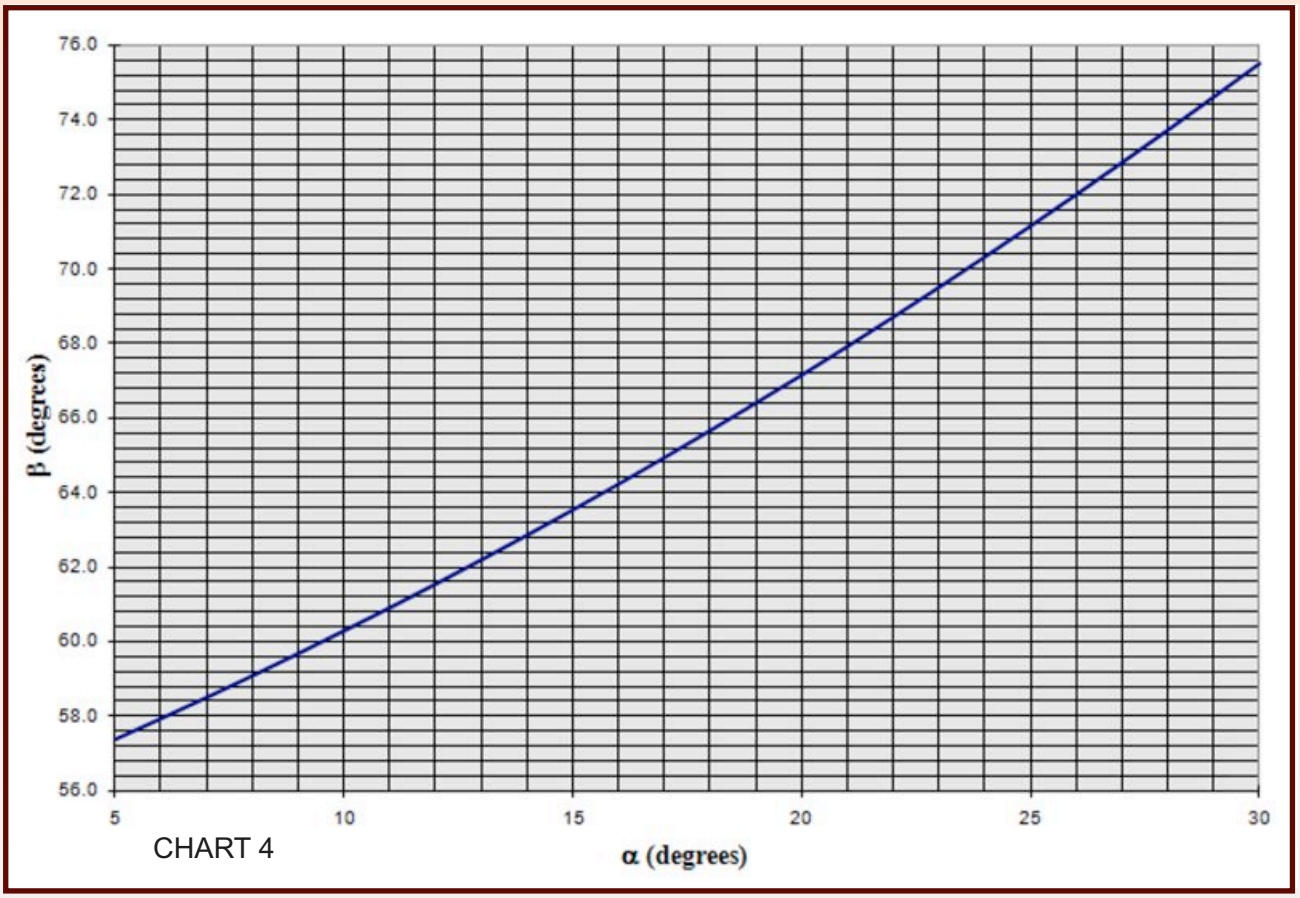


CHART 4

ROUTER CIRCLE CUTTER

by Vern Knowles

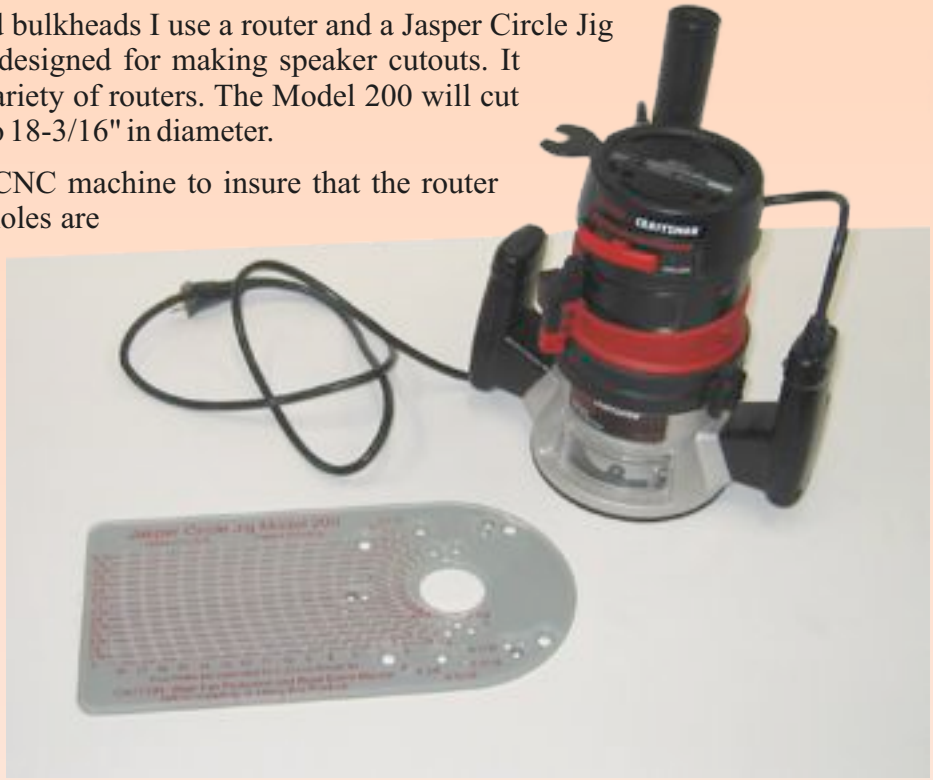
For cutting plywood centering rings and bulkheads I use a router and a Jasper Circle Jig (Model 200). This jig was originally designed for making speaker cutouts. It mounts directly to the base of a wide variety of routers. The Model 200 will cut circles in 1/16" increments from 2-1/4" to 18-3/16" in diameter.

The Model 200 is manufactured on a CNC machine to insure that the router mounting holes and the array of pivot holes are located precisely with respect to each other. It is 1/4" thick and seems to be made of something like Lexan.

I purchased mine from my local Woodcraft store for $35.00. They are also available from Parts Express (part number 365-250).

To help reduce the dust spray I also mounted to my router a Shop Vac extension tube with a PVC elbow fitting on the end of it so that it will collect much of the saw dust that is generated.

My Craftsman router (with Shop Vac extension tube added) and Jasper circle cutting jig ready to be mounted onto the router base.



The circle cutting jig is intended to be used with a plunge router. However, I have had excellent results using just my standard router.

A 1/8" diameter steel pin (not shown) can be inserted into one of the calibrated pivot holes. The pin is then put into a 1/8" diameter hole in the plywood piece to be cut. The router then pivots around the steel pin and delivers a precision circular cut.

A close up of the Jasper Model 200 showing the multitude of holes making possible any number of cutting radiuses.

FIELD SOLDER

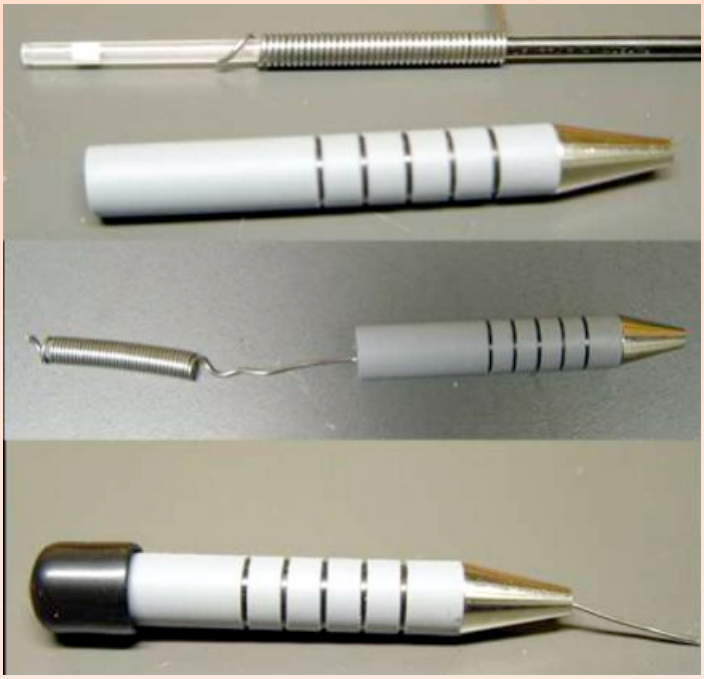
by John Thompson

Hate having to carry a whole spool of solder into the field? Breaking off a few feet of solder and tossing it in a bag or range box can create a tangled mess.

Here's a clean and simple solution. You will need:

1 ink pen (metal tipped is the best)
2 feet of thin solder
1 Altoids tin box (or similar)

First take the pen apart and cut it down so it fits in the tin. Next wrap the solder around the ink cartridge that you just removed from the pen. Pull the solder off the pen and insert it into the portion of the pen that you have retained. Cap off the end with the pen cap, or whatever you have. End caps from old shelving units work well. Metal tipped pens are the best to use because they don't melt if you use this close to a hot iron. The result is a compact solder dispenser! It's amazing how much solder you can fit into one of these deals.



Placed in the tin along with some shrink wrap, clippers and a butane lighter (to heat shrinkwrap) and you've got a neat little kit.

This is a kit that will allow you to do many soldering jobs in the field. It costs about $8.00, and it all fits in an Altoids box.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