TRIPOLI GERLACH Research Rocketry News

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TRIPOLI GERLACH Research Rocketry
TRIPOLI PREFECTURE #138

MARCH 2013 Vol. 03 No. 02

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 Not all Research Rocketry is BIG as shown by Tripoli Gerlach member Cath Bashford who hails from the UK.

Cath is a regular at the BOOBS launches at Black Rock every September.

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RENEWALS

January 1st was the beginning of our fiscal year and with that all Member's Dues where - due! All Tripoli Gerlach Members were mailed a renewal form. From that mailing we got about a 94% renewal. A few members failed to renew, whether oversight or no longer interested. Either way we have not heard from them - except for one.

If you haven't renewed, or can't remember if you did or not, check out the CURRENT MEMBERS Page of our WebSite. If your name is missing you didn't and we'd sure like to have your support.

BOD CANDIDATES

National Tripoli is now accepting candidates for three seats on the Board of Directions going vacant this year. Tripoli Gerlach member Gerald Muex Jr (also Prefect of Tripoli Vegas) has announced his interest to run. As fellow members we should all support his candidacy and hope other "young" members also consider running.

LDRS 32

The LDRS 32 WebSite is up and running and both mail-in and on-line registration is available.

Due to the fact Gerlach only has 40 rooms; the primary hotel is set for Comfort Suites in Fernley. When you reserve your room mention TRIPOLI and receive a 15% discount. All rooms are suites, as their name implies. And it's the closest hotel to Gerlach just south of Exit 46 on Rt80.

The Banquet is set for Saturday evening starting at 6:30pm in the Gerlach Community Center. Our usual Tripoli Gerlach fare of Spaghetti comes with either Meat Balls or Chicken, and all the extras.

The following people have accepted lead positions. Naturally they will need assistance and a call for volunteers will be sent out soon.

RANGE	Robin Meredith Mark Clark
PADS	Paul Holmes
VENUE	Chris Pearson
REGISTRATION	Ken Good
VENDORS	Dave Rose
PARKING	Larry Benek
WAIVER & BLM	Waysie Atkins

BALLS 22

AHPRA has formally announced BALLS 22 for September 20, 21 & 22, 2013. Their WebSite is up at: www.balls22.com.

COMING NEXT ISSUE . . .

TWO PIECE MOLD METHOD FOR MAKING NOSE CONES

PROPEP 3

SOLDIER MEADOWS

The road to Soldier Meadows begins in Gerlach and then heads north on route 34 for twelve miles; then turn right onto Soldier Meadows road to Soldier Meadows Ranch.

A lot of Nevada's roads are gravel or dirt. Even though they are "roads" they can be called off-roads without a second thought. Our past adventures have made us use to these roads (one year we drove almost 500 miles in one day - 450 miles off road!) Soldier Meadows Road is "off road"! Many times we've traveled this road heading for the Soldier Meadows Ranch and every time we were side tracked by other points of interest - like the Opal Mines along the way. Royal Rainbow had a big sign "Closed For The Day" so we didn't go there. This helped us a lot as we could now continue on the Soldier Meadows unobstructed! Hindsight had us thinking maybe an obstruction would have helped!

Of all the roads we've traversed out here, once past the last Opal Mine the road was bad - really bad - like don't ever want to go to Soldier Meadows - we will never go (never say never - J. Bond). The road is very washboard with a lot of loose rock. We were in Dave's Blazer, 4WD and a little higher than the average car. You need a HumVee for this road, and make sure its an H1. It is amazing because this road is the MAIN road into Soldier Meadows, all of the others are worse!

For years and years Soldier Meadows has been talked about as a "working Cattle Ranch for City Slickers". People went there and paid $$$ to sleep in bunk houses, eat cowboy food and herd cows. It was said to have some amenities like laundry service, fancy restaurant and gas. This is NOT true. It is a working cattle ranch but it is run by the Kudrna family and their hands.

City Slickers do come to Soldier Meadows but they come for the isolation. These people explore the area looking for rocks, arrowheads, photograph scenery, hike rock formations and mainly just to get away! To many people this place is Heaven. These people are

The main headquarter of Soldiers Meadows operation houses the bunks, Wash Room, kitchen and Gift Shoppe.

The personal residence of the Kudrna family. The HumVee is definitely the required transportation.

The old calvery barracks still stands and is habitable

A small modern bunkhouse that holds four acceptably?

mostly from the land of California. Owning a good off road vehicle (good tires and high clearance a must) could make this place a nice get away vacation experience, but for what is there the road to get there could cancels out all things of interest!

Soldier Meadows is basically what is left of Camp McGarry (1865), a US Calvary base used to house troops to protect early settlers from Indians along the Applegate-Lassen wagon trail. Several of the old buildings still exist and are used. Again this is a working ranch and it looks exactly as it should - a working ranch.

While Soldier Meadows is NOT a commercial venture, other than cattle, it does address tourist. We met a couple who drove from Missouri and drove up Soldier Meadows road - in a Lincoln town car! The husband was off in the hills and the wife was alone at the ranch. She was in no mood to be talked to!

Now that we've hammered the place lets pretend the road to get there was nice. Here is what we found. This could be a nice vacation place. The facilities for tourist are VERY acceptable. The rooms are far superior to Bruno's and it could happen that a stay in one of these rooms could ease away the tortured image of the roadtrip up. Stepping into one of the rooms, all decorated in real cowboy style, is very calming. The rooms are very clean and bright. Some of these rooms could accommodate large groups of people, some are for individuals. For NOT being a tourist place they sure seem to have set a very accommodating trap.

After the "tourist apartments", reality seeps back in. The ranch has a World Class Korean Chef. We need to mention the world exists as far as the nearby mountain tops. The kitchen is NOT a tourist dining room but more like a kids camp kitchen where the staff hung out. It also holds the Gift Shoppe with things like a bar of soap, some cowboy books, a few stones and a really high tech cash register. Our hostess Kathy gave us a lot of information and history about the surrounding area and the many things that could be pursued while

Jim & George explore a couple of original 1865 buildings.

What’s left of an old Armory Building

staying here. Again, if it wasn't for the road, or the lack of a good off-road vehicle, this could be a relaxing place.

Many people have personal travel trailers parked there all year round. We met another couple who has theirs there. They drive from California once a month to "escape". They seemed a very happy couple - unlike the couple from Missouri!

After discussing alternative possibilities to return to Gerlach it became obvious we would have to endure a return trip via Soldier Meadows Road. The easiest way in and out is by plane. They actually have a landing strip but we didn't have an airplane. So bidding farewell to some very hospitable people we headed south.

While Soldier Meadows promotes to attract people from all over the U.S.. and the fact that they do get people; their main road in and out is the jaw jolting Soldier Meadows Road. An experience.

There is a road out onto the playa about 21 miles north of the 12 mile entrance and we decided to use the playa and get off the gravel road as soon as we could. The winds had died down and the run down the west leg of the lakebed was fast and smooth. Our GPS showed we actually save 35 minutes by taking the lakebed.

WHAT IS Kn RATIO

Kn Ratio is a very important measurement for the solid rocket motor designer/builder. The formula for Kn ratio is:

Kn Ratio = (Total Propellant surface area / Throat Area)

So for example to take the simplest of all case scenarios: an End Burning motor with a flat end and the following dimensions:

Grain Diameter = 25mm
Throat Diameter = 2.5mm
We can calculate the Kn Ratio to be:

Kn = Propellant Surface Area / Throat Area
= (pi x Grain Radius^2) / (pi x Throat Radius^2)
= (3.14159 x 12.5^2) / (3.14159 x 1.25^2)
= 3.14159 x 156.25) / (3.14159 x 1.5625)
= 490.87 / 4.91
= 99.97

Note: The values chosen for this example are purely hypothetical and would normally be well below the normal operating range of most composite motors.

In this example the Kn ratio should theoretically stay the same though out the entire motors operation because the propellant surface area doesn't really change. i.e. It's burning from one end the other keeping the same geometry. i.e. “The area of one end".

Unfortunately this (constant Kn value) only happens with grains like end burners which keep the same surface area throughout the entire burn. Because many propellants don't burn fast enough to support such a small surface area (as the End Burner) many other grain geometries have been developed to allow for more surface area to be exposed at once.

Unfortunately most of these geometries don't supply a neutral Kn like the End Burner and to make matters worse most are quite difficult to calculate surface areas at given point throughout the burn. It is for this reason spreadsheets and software programs haves been created; to allow the motor designer to get an idea of what Kn ratios can be expected from a given geometry and to display a graph of how much surface area is exposed over the distance to which the burn has traveled.

CALCULATING Kn

Kn is a term used to compare the propellant surface area (burn surface area) to the nozzle's throat cross sectional area. (the throat is the small opening in the middle of the nozzle). Kn is actually the ratio of the two areas. When dealing with ratios, it is important to always compare "apples to apples". In the case of Kn's we will be comparing areas to areas. All areas will be expressed in terms of square inches. We will write this as . . Kn = Aps / nt. Read this as Kn = total Area of propellant surface divided by the nozzle's throat cross sectional area (in inches2).

PROPELLANT SURFACE AREA ALCULATIONS
The average composite motor, like most motors used in High Power Rocketry, is a "Bates" grain design. "Bates" grain motors use multiple grains to expose more surface area (burn surface). Since "Bates" grains burn from the core and from both ends, it is possible to come close to a 'flat" burn profile by adjusting the length of each grain. All of the grains used will be identical to each other. To calculate total propellant surface area we will calculate the exposed propellant surface area of one grain and simply multiply it by the number of grains. We will need to know the following information:

1 - the length of each grain = 2.00 inches
2 - the diameter of each grain = 1.283 inches
3 - the diameter of the core = 0.50 inches

Note: although optimum grain length would be 2.130 inches in our motor, we have used 2.00 inches, which will result in a slightly "regressive" bum. This example is designed so that as the chamber temperature increases (during the course of the burn), the internal pressure will decrease. This will allow us to work well within maximum working parameters for our hardware.

EXAMPLE MATH
Our example motor has a core diameter of 0.5 inches. To calculate core surface area, we will multiply the core circumference by the core length. The formula for the circumference is C = πd. Substituting, we get C = 3.14159 X 0.5 or C = 1.570795. This is the core circumference. Now we multiply C times the length of the core or 1.570795 X 2.00 = 3.14159 square inches, which is the core surface area for one (1) grain. This is the first part of our answer.

Note: the results in our example equals 1 only because our length (2n) divided by our core diameter of 0.5” = 1 and 1 X π = 3.14159

Now we will calculate the surface area of the ends of one grain. The grain diameter (O.D.) is 1.283 inches. This is the diameter of the propellant and does not include the casting tube's wall thickness. Since the area of a circle is A = πr2. . we write:

3.14159 X (1.283 / 2) X (1.283 / 2) or 1.2928

We must now calculate the cross sectional area of the core and subtract our answer from the grain's end area since the core area is missing. The core radius = 0.5 / 2 = 0.25 and 0.25 X 0.25 X 3.14159 gives us a core area of 0.19635. We now subtract 0.19635 from 1.2928 and get an end area of 1.09645 sq. inches. We multiply this by 2, since a grain has two ends, and we get 2.1929 sq. inches, which equals the total end area of one grain. To this we add the core surface area of 3.14159 sq. inches and we get 5.3345, which is the total surface area of one grain. We are using six grains so we multiply 5.3345 X 6, which gives us 32.007 square Inches of burn surface in our motor.

We would like this example to operate at a Kn of 225 so we take the burn, or propellant surface area of 32.007 and divide it by 225. This gives us 0.1422533 which is the cross sectional area of the nozzle throat we will need to fire our motor at a Kn of 225.

Since the throat x-section is a circle we will substitute the things we know into the formula for the area of a circle or A = πr2 0.1422533 = 3.14159 r2. . simplifying we get 0.04528 = vr2 and then 0.212792551 = r and since d = 2r, our required throat diameter is 0.4255851 inches. Round this off to 0.426 inches.

A faster way of doing this is divide the propellant surface area by the desired Kn, divide the results by the constant 0.7854 (which is π / 4) and take the square root of the answer. The resulting square root (0.4255851 inches) is the required throat diameter.

It is important to remember that in a composite motor, the core diameter must be larger than the nozzle throat diameter. This is necessary (in most cases) for a stable burn. In this motor, the core diameter is 0.5 inches and the nozzle throat diameter is 0.426 inches. If you ever get a nozzle throat diameter that is larger than the core diameter. . stop! You did something wrong.

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 fuel, 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. AP was used in our example because most of the propellant is ammonium perchlorate. The same hold 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 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

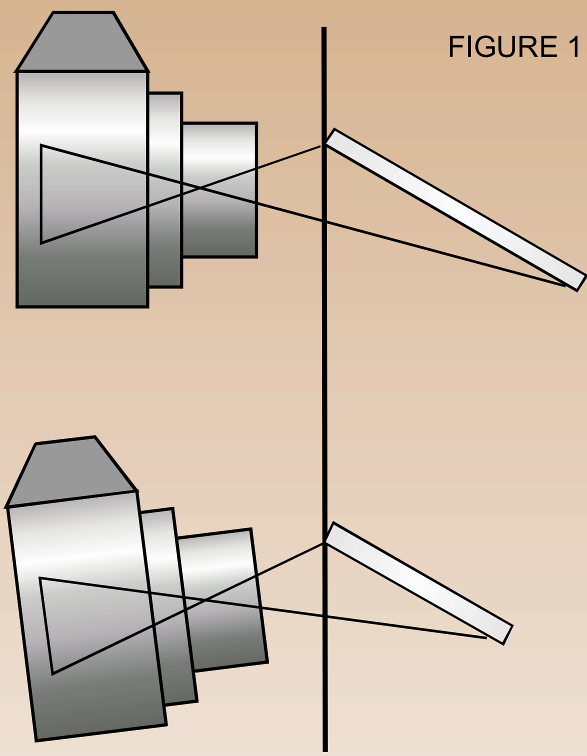
Doug Gerrard

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.

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 mirrors 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.

FIGURE 1



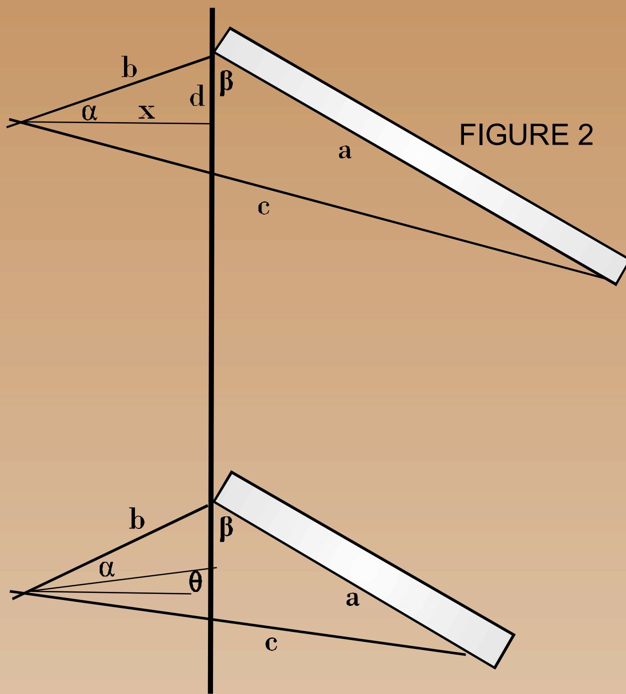
Refer to figure 2 for these definitions and assumptions

.

DEFINITIONS

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

FIGURE 2



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 cameras vertical angle of view:

$$\alpha = \tan^{-1} \frac{1/2 \cdot \text{ film length or width}}{\text{the cameras focal length}}$$

φ ≡ one half of the cameras horizontal angle of view

$$\varphi = \tan^{-1} \frac{1/2 \cdot \text{film width or length}}{\text{the cameras focal length}}$$

For 35 mm cameras mounted horizontally in the rocket:

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

For 35 mm cameras mounted vertically in the rocket:

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

ASSUMPTIONS

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.

$$180 = 90 + (\alpha + \theta) + (180 - 2 \cdot \beta)$$

Therefore,

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

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 and α, and the mirror width as a function of θ, α, and φ.

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

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

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

COMMENTS AND CONCLUSION

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 α 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 .

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 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 PROBLEM

Table 1 gives the data in tabular form and graphs 1 through 4 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 $\alpha = \tan^{-1}$[½(24 mm)/50 mm] = 13.5º, => θ ≈ 21.5º and β ≈ 62.5º.

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:

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

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 β slightly.

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

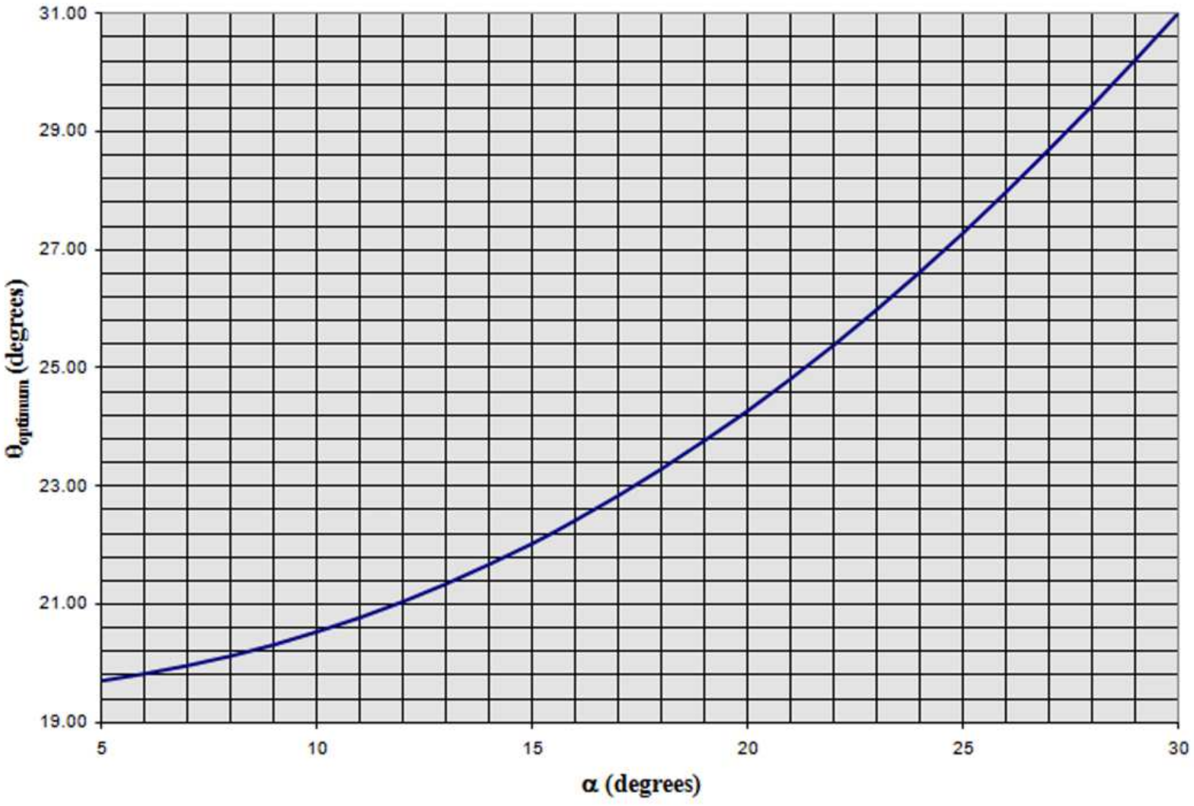


CHART 2

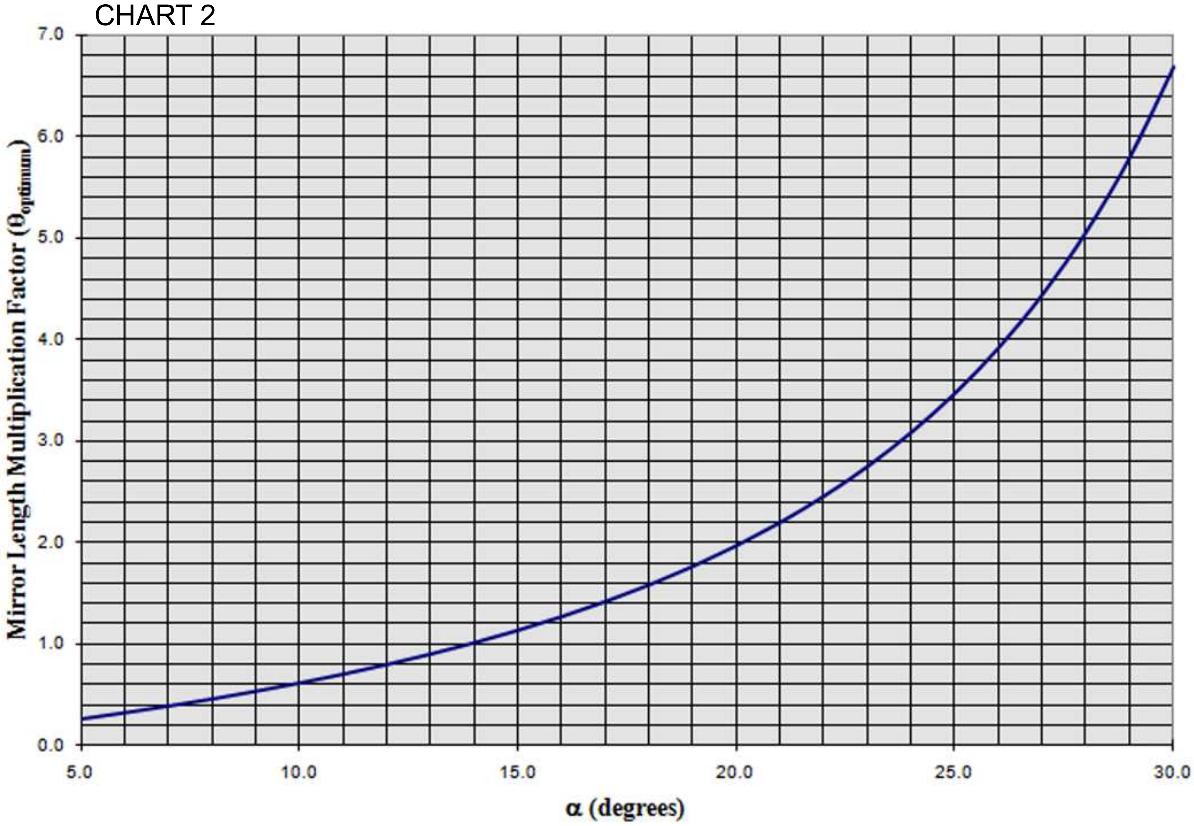


CHART 3

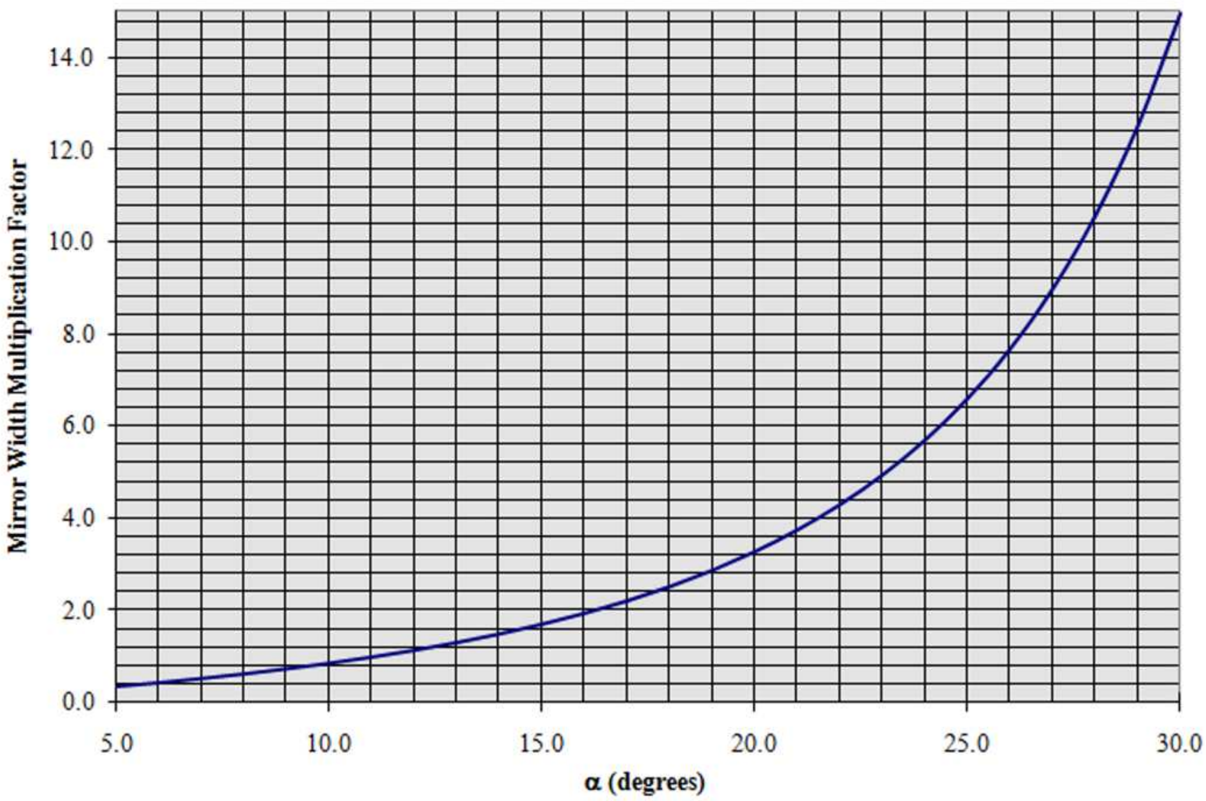
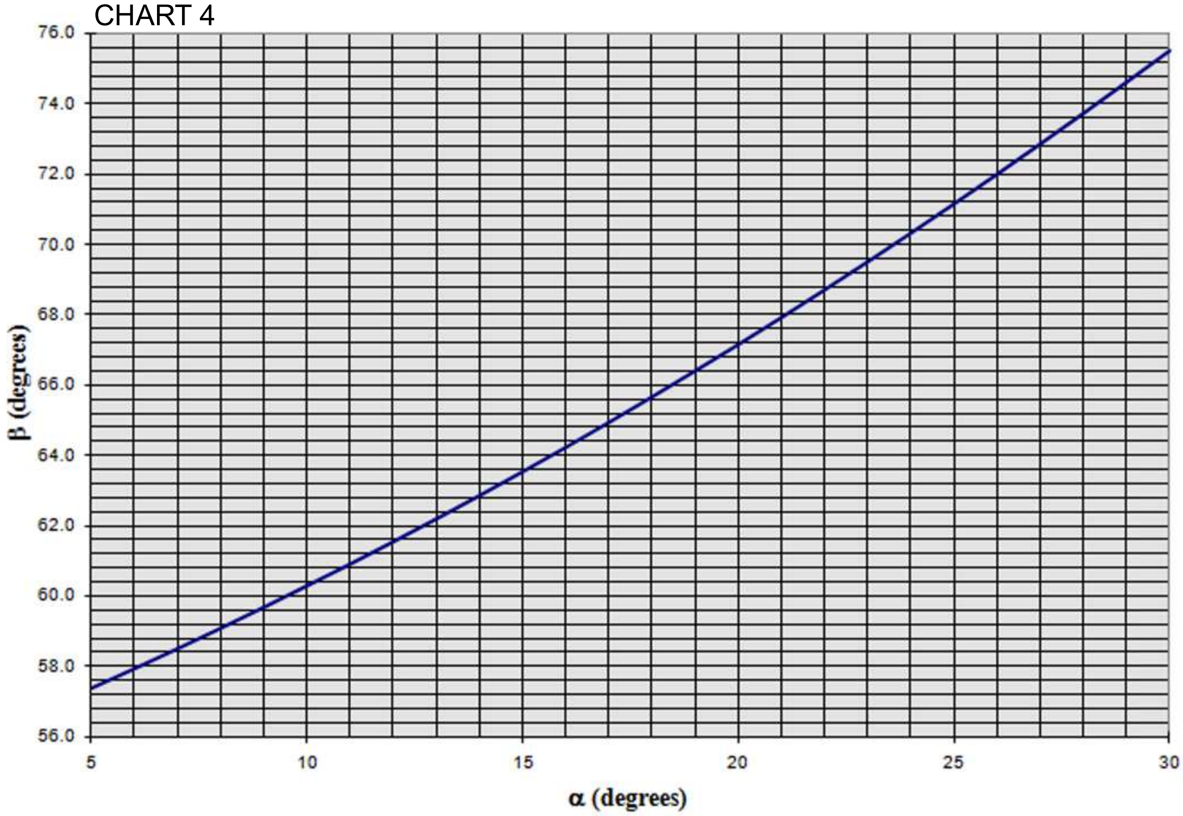


CHART 4



FIELD SOLDER

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 tiped is the best)
2 feet of thin solder
1 Altoids tin box (or simular)

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 with 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 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.

TC LOGGER USB

The Easy Way To Motor Testing & Development

An important part of Research Motor development is to test motors on a test stand for characterizing the propellant, and to test final designs of flight motors on a test stand to measure their actual thrust and specific impulse. Every Research Motor developer should have access to, or own, a motor test stand. There's no need to guess at the chamber pressure versus Kn, and the burn rate versus chamber pressure for your propellant, it can be accurately measured using a motor test stand. You have a theoretical specific impulse for your propellant, what is the actual delivered specific impulse? The actual thrust and burn time of your motor designs? All can be accurately measured with a motor test stand.

NASSA, Nevada AeroSpace Associates, has been pursuing Research Motor technology since the late 90's, and from the beginning developed motor test stands. Their first test stand was a wood piece mounted on a baby scale. It worked great and they began their propellant research.

NASSA Member Oliver Schubert created software to collect motor data from test stands. His TC LOGGER coupled with a steel test stand produced a motor testing system which produced NASSA's motor data for several years, but it used a PC computer relying on reading a parallel port, which is becoming hard to support today.

NASSA Member Dave Cooper then stepped forward and took Oliver's work into a new arena with the TC LOGGER USB system. Based on Oliver's work, "Coop" developed a USB version which could be used on newer Laptops. Capable of operating with a Load Cell and Pressure Transducer for Propellant Characterization, or with just a Load Cell for Flight Motor Thrust Curves, TC LOGGER USB replaces TC LOGGER with a complete system having a solid and consistent 200 samplings per second. Data returned is precise and accurate and screen presentation is everything you'd expect.

The Basic TC LOGGER USB system (shown bottom left) comes with the Black Box, Software, Digital Manual and blank jacks for connecting to your own Load Cell, Pressure Transducer and Battery Charger. Simple to set up and operate it is capable of collecting data to generate Flight Motor Thrust Curves. With the connection of a Pressure Transducer it can collect and process data for Motor Propellant Characterization (chamber pressure versus Kn, burn rate versus chamber pressure).

Additionally, a Complete TC LOGGER USB system (shown bottom right) is available which includes a Load Cell and Pressure Transducers, both of your choice and both wired with 50ft leads. It's as close to a turn-key system for measuring thrust and chamber pressure, ready to test your Research Motors.

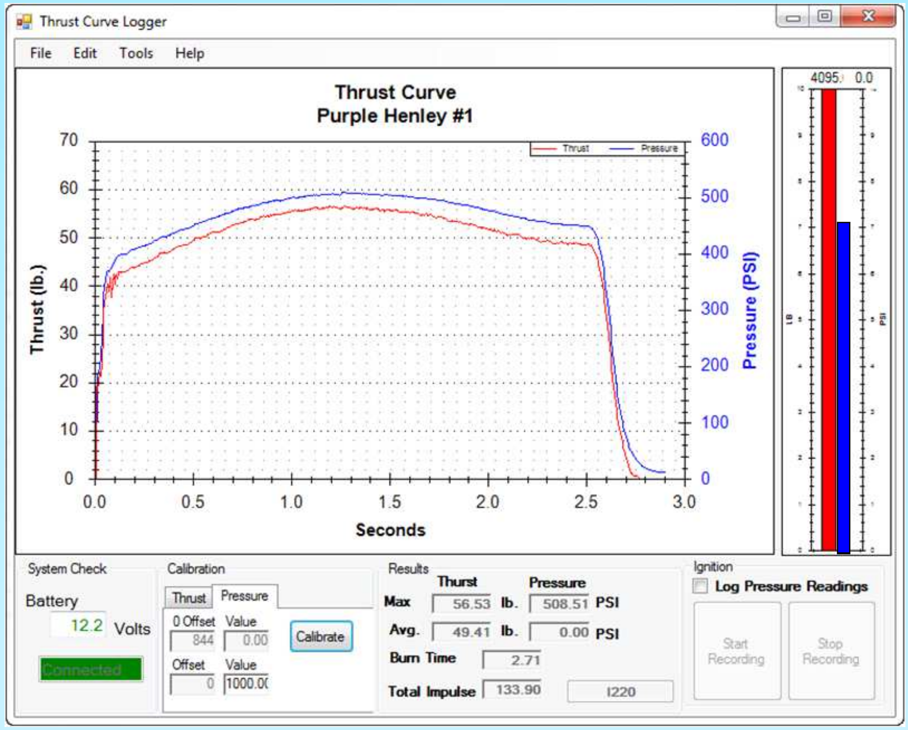
The TC LOGGER USB system can be used on any size test stand provided sensors used will handle the load.

Currently all NASSA Members are also members of Tripoli Gerlach

SYSTEM
2 Input Channels
(Thrust channel is mV input,
Pressure channel is 0-5 V input)
12 bit Resolution
200 samples per second
USB connection

Hardware Requirements
800 mHz PC or better
Windows XP, Vista or Windows 7
1024x768 or better Screen Resolution
1 USB port

The system comes with a built-in battery which should get a full charge before beginning operation.



Above is a screen capture of TC LOGGER in operation. On a Test Motor both Thrust (red) and Pressure (blue) is recorded and delivered. On a Flight Motor only the Thrust is presented along with a declaration as to the motors actual classification.

The installation and operation of the TC LOGGER USB system is simple and clean. Everything is easy to follow and understand and anyone into Research Motor Making should have no problems, and if you do Dave Cooper is readily available to discuss things with you - no matter what level of expertise you have.

FLIGHT MOTOR THRUST CURVES
Firing Flight Motors does not require, nor use, a Pressure Transducer. All you will be collecting is a Thrust Curve and information about the Motor's functioning. Make a good attempt to know what you are firing. You might be surprised at the results.

MOTOR CHARACTERIZATION PROCEDURE
Firing a Motor for Propellant Characterization requires more work. Aside from using a Pressure Transducer a lot of information needs documented before a test firing can be conducted. Luckily all this is documented on their WebSite **www.tclogger.com**. There are plenty of downloadable PDFs including the TC LOGGER USB Manual and other things you'll need to address before getting involved. Makes it a lot easier for when you do step forward and purchase a system.

For Propellant Characterization you will need to fire at least three Test Motors all with the same grain design but having three different nozzle throat diameters. Again, this is all explained on the Website.

THE EXTRAS
In addition to the Black Box and Software, TC LOGGER also supplies much needed components to save time and actual money. For example you can use your own Load Cells, a good source is AEROCON SYSTEMS, or you can purchase an already wired Load Cell of your choice, with a 50' cable, directly from TC LOGGER. For a small fee it can be extended to 100 feet.

TC LOGGER TEST STAND is available. The side slot is for easy placement and removal of Test Motor Cases using a Pressure Transducer. The Load Cell has a client installed blast plate platform and a Load Cell cover for protection.

A heavy gauge Steel Test Stand (shown above) is available. These are especially designed to handle 54mm thickwall Test Motor Cases. They have a slotted motor holder which makes swapping Test Cases with attached Pressure Transducers easy.

Smaller motors can be fired on the stand by simply fabricating a motor adapter.

The Test Cases are made by Jerry McKinlay of Darque Star in Las Vegas. Jerry also supplies the NASSA Flight Motor Cases with the screw on closures, just about the best you can buy.
TC LOGGER Test Cases are unique. They use standard 54mm Propellant Casters & Liners but have a super thick wall with threaded end closures to assure operation at the most extreme Chamber Pressures.

The forward closures have a hole tapped for 1/4" NPT fitting to insert the Pressure Line to the Pressure Transducer. A 1 ½" x54mm nozzle is required.

All brass fitting, O-rings and pressure lines are third party items readily available from hardware or auto parts stores. The website supplies you with sources and part numbers.

At the present time TC LOGGER does not supply Nozzles. This isn't to say it's not in their future but for now they're just not set up for it. Questions can be directed to Dave Cooper at:

david_cooper@alum.bradley.edu

NEWS FROM ARIZONA?

United States District Court,
Southwestern District,
Tempe, Arizona
Case No. B19293,
Judge Lance Ito, Presiding

Wile E. Coyote, Plaintiff
-vs. -
Acme Company, Defendant

Opening statement of Mr. Harold Schoff, attorney for Mr. Coyote: My client, Mr. Wile E. Coyote, a resident of Arizona and contiguous states, does hereby bring suit for damages against the Acme Company, manufacturer and retail distributor of assorted merchandise, incorporated in Delaware and doing business in every state, district, and territory. Mr. Coyote seeks compensation for personal injuries, loss of business income, and mental suffering caused as a direct result of the actions and/or gross negligence of said company, under Title 15 of the United States Code, Chapter 47, section 2072, subsection (a), relating to product liability.

Mr. Coyote states that on eighty-five separate occasions he has purchased of the Acme Company (hereinafter, "Defendant"), through that company's mail-order department, certain products which did cause him bodily injury due to defects in manufacture or improper cautionary labeling. Sales slips made out to Mr. Coyote as proof of purchase are at present in the possession of the Court, marked Exhibit A. Such injuries sustained by Mr. Coyote have temporarily restricted his ability to make a living in his profession of predator. Mr. Coyote is self-employed and thus not eligible for Workmen's Compensation.

Mr. Coyote states that on December 13th he received of Defendant via parcel post one Acme Rocket Sled. The intention of Mr. Coyote was to use the Rocket Sled to aid him in pursuit of his prey. Upon receipt of the Rocket Sled Mr. Coyote removed it from its wooden shipping crate and, sighting his prey in the distance, activated the ignition. As Mr. Coyote gripped the handlebars, the Rocket Sled accelerated with such sudden and precipitate force as to stretch Mr. Coyote's forelimbs to a length of fifty feet. Subsequently, the rest of Mr. Coyote's body shot forward with a violent jolt, causing severe strain to his back and neck and placing him unexpectedly astride the Rocket Sled. Disappearing over the horizon at such speed as to leave a diminishing jet trail along its path, the Rocket Sled soon brought Mr. Coyote abreast of his prey. At that moment the animal he was pursuing veered sharply to the right. Mr. Coyote vigorously attempted to follow this maneuver but was unable to, due to a poorly designed steering on the Rocket Sled and a faulty or nonexistent braking system. Shortly thereafter, the unchecked progress of the Rocket Sled brought it and Mr. Coyote into collision with the side of a mesa.

Paragraph One of the Report of Attending Physician (Exhibit B), prepared by Dr. Ernest Grosscup, M. D., D. O., details the multiple fractures, contusions, and tissue damage suffered by Mr. Coyote as a result of this collision. Repair of the injuries required a full bandage around the head (excluding the ears), a neck brace, and full or partial casts on all four legs. Hampered by these injuries, Mr. Coyote was nevertheless obliged to support himself.

With this in mind, he purchased of Defendant, as an aid to mobility, one pair of Acme Rocket Skates. When he attempted to use this product, however, he became involved in an accident remarkably similar to that which occurred with the Rocket Sled. Again, Defendant sold over the counter, without caveat, a product which attached powerful jet engines (in this case, two) to inadequate vehicles, with little or no provision for passenger safety. Encumbered by his heavy casts, Mr. Coyote lost control of the Rocket Skates soon after strapping them on, and collided with a roadside billboard so violently as to leave a hole in the shape of his full silhouette.

Mr. Coyote states that on occasions too numerous to list in this document he has suffered mishaps with explosives purchased of Defendant: the Acme "Little Giant" Firecracker, the Acme Self-Guided Aerial Bomb, etc. (For a full listing, see the Acme Mail Order Explosives Catalogue and attached deposition, entered in evidence as Exhibit C.)

Indeed, it is safe to say that not once has an explosive purchased of Defendant by Mr. Coyote performed in an expected manner. To cite just one example: At the expense of much time and personal effort, Mr. Coyote constructed around the outer rim of a butte a wooden trough beginning at the top of the butte and spiraling downward around it to some few feet above a black X painted on the desert floor. The trough was designed in such a way that a spherical explosive of the type sold by Defendant would roll easily and swiftly down to the point of detonation indicated by the X. Mr. Coyote placed a generous pile of birdseed directly on the X, and then, carrying the spherical Acme Bomb (Catalogue #78-832), climbed to the top of the butte. Mr. Coyote's prey, seeing the birdseed, approached, and Mr. Coyote proceeded to light the fuse. In an instant, the fuse burned down to the stem, causing the bomb to detonate prior to its release by Mr. Coyote. In addition to reducing all Mr. Coyote's careful preparations to naught, the premature detonation of Defendant's product resulted in the following disfigurements to Mr. Coyote: 1. Severe singeing of the hair on the head, neck, and muzzle. 2. Sooty discoloration. 3. Fracture of the left ear at the stem, causing the ear to dangle in the aftershock with a creaking noise. 4. Full or partial combustion of whiskers, producing kinking, frazzling, and ashy disintegration. 5. Radical widening of the eyes, due to brow and lid charring.

We come now to the Acme Spring-Powered Shoes. The remains of a pair of these purchased by Mr. Coyote on June 23rd are Plaintiff's Exhibit D. Selected fragments have been shipped to the metallurgical laboratories of the University of California at Santa Barbara for analysis, but to date, no explanation has been found for this product's sudden and extreme malfunction. As advertised by Defendant, this product is simplicity itself: two wood-and-metal sandals, each attached to milled-steel springs of high tensile strength and compressed in a tightly coiled position by a cocking device with a lanyard release. Mr. Coyote believed that this product would enable him to pounce upon his prey in the initial moments of the chase, when swift reflexes are at a premium.

To increase the shoes' thrusting power still further, Mr. Coyote affixed them by their bottoms to the side of a large boulder. Adjacent to the boulder was a path which Mr. Coyote's prey was known to frequent. Mr. Coyote put his hind feet in the wood-and-metal sandals and crouched in readiness, his right forepaw holding firmly to the lanyard release. Within a short time, Mr. Coyote's prey did indeed appear on the path coming toward him. Unsuspecting, the prey stopped near Mr. Coyote, well within range of the springs at full extension. Mr. Coyote gauged the distance with care and proceeded to pull the lanyard release. At this point, Defendant's product should have thrust Mr. Coyote forward and away from the boulder. Instead, for reasons yet unknown, the Acme Spring-Powered Shoes thrust the boulder away from Mr. Coyote. As the intended prey looked on unharmed, Mr. Coyote hung suspended in air. Then the twin springs recoiled, bringing Mr. Coyote to a violent feet-first collision with the boulder, the full weight of his head and forequarters falling upon his lower extremities. The force of this impact then caused the springs to rebound, whereupon Mr. Coyote was thrust skyward. A second recoil and collision followed. The boulder, meanwhile, which was roughly ovoid in shape, had begun to bounce down a hillside, the coiling and recoiling of the springs adding to its velocity. At each bounce, Mr. Coyote came into contact with the boulder, or the boulder came into contact with Mr. Coyote, or both came into contact with the ground. As the grade was a long one, this process continued for some time.

The sequence of collisions resulted in systemic physical damage to Mr. Coyote, viz., flattening of the cranium, sideways displacement of the tongue, reduction of length of legs and upper body, and compression of vertebrae from base of tail to head. Repetition of blows along a vertical axis produced a series of regular horizontal folds in Mr. Coyote's body tissues--a rare and painful condition which caused Mr. Coyote to expand upward and contract downward alternately as he walked, and to emit an off-key, accordionlike wheezing with every step. The distracting and embarrassing nature of this symptom has been a major impediment to Mr. Coyote's pursuit of a normal social life. As the court is no doubt aware, Defendant has a virtual monopoly of manufacture and sale of goods required by Mr. Coyote's work.

It is our contention that the Defendant has used its market advantage to the detriment of the consumer of such specialized products as itching powder, giant kites, Burmese tiger traps, anvils, and two-hundred-foot-long rubber bands. Much as he has come to mistrust Defendant's products, Mr. Coyote has no other domestic source of supply to which to turn. One can only wonder what our trading partners in Western Europe and Japan would make of such a situation, where a giant company is allowed to victimize the consumer in a most reckless and wrongful manner over and over again.

Mr. Coyote respectfully requests that the Court regard these larger economic implications and assess punitive damages in the amount of seventeen million dollars. In addition, Mr. Coyote seeks actual damages (missed meals, medical expenses, days lost from professional occupation) of one million dollars; general damages (mental suffering, injury to reputation) of twenty million dollars; and attorney's fees of seven hundred and fifty thousand dollars.

By awarding Mr. Coyote the full amount, this Court will censure Defendant, its directors, officers, shareholders, successors, and assigns, in the only language they understand, and reaffirm the right of the individual predator to equal protection under the law.

SIMPLE TROUBLE SHOOTING FLOW CHART

Many times despite our best efforts, (ahuh - sure), we often get caught in a bind and need to figger a way out. Whether at work or working on someone else's project crap happens. This easy to follow Flow Chart will help expedite a solution in the quickest and simplest manner.