

TRIPOLI GERLACH

Research Rocketry



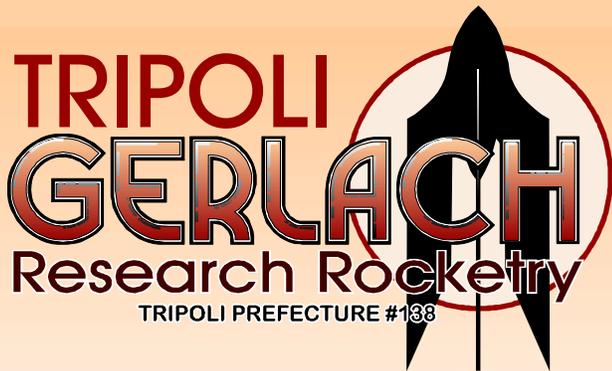
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THE MEMBERS OF TRIPOLI GERLACH
AND ANYONE ELSE INTERESTED

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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

Deb Koloms, one of Tripoli Gerlach originators, with one of her furry rockets at an LDRS in Lucerne. Deb is very much into Motor Making and we visit her WorkShop on page 15.

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NEW MEMBERS

We've moved into 2012 running with new a member to Tripoli Gerlach. More information can be found on our WebSite under CURRENT MEMBERS.

Joe Grubb

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Tell your Tripoli Research Friends about Tripoli Gerlach. Get them interested joining us at Black Rock. Help our membership grow!

TRIPOLI GERLACH
Research Rocketry



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2nd Annual HAMSTER DANCE

The National WEENIEX Launch

HAMSTER DANCE 2 is set for September 20th, 2012 starting at 1pm. A new location for this years event will be AREA 52 just northeast of Black Rock Point in the Black Rock desert.

Last year's First HAMSTER DANCE was a fun time for both flyers & spectators and everyone agreed we should continue the fiasco, so as the song says, "Here We Go!"

The rules remain the same:

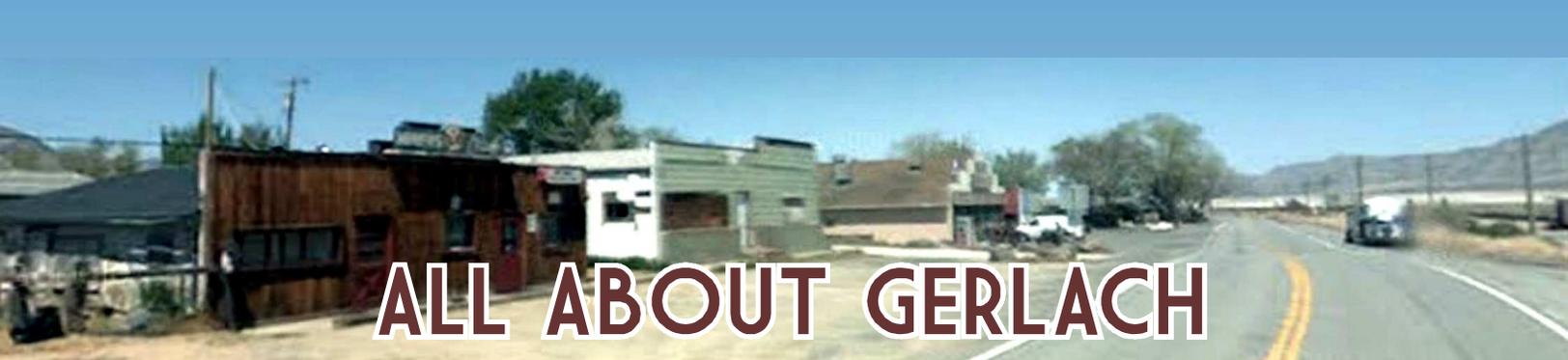
- No rocket exceeds 5 lbs Lift-Off weight LOADED. No metal parts. Q-Links, anchors, eyescrews OK!
- Research Motors ONLY. NO METAL CASES, only Plastic, Phenolic, Fiberglass or Paper and all motors must be single use. You must make your own motor(s). No second party motors permitted.

- All rockets must have a recovery device. Tumble Recovery is not permitted. No clusters, no staging.
- Electronics are permitted though not required. How else will you verify your altitude if needed?



Registration Forms available on the WebSite
WWW.HAMSTERDANCELAUNCH.COM





ALL ABOUT GERLACH

Gerlach is a census-designated place (CDP) in Washoe County, Nevada, United States. In the 2000 census it showed a population of 449 people. This also included the now abandoned company town of Empire, 6 miles away, and those who live on outlying rural ranching properties. It is part of the Reno–Sparks Metropolitan Statistical Area.

On January 31, 2011 the Gypsum Plant in Empire closed its doors. Residents with children were allowed to continue inhabiting their houses through June 30, the end of the school year. After that date, Empire would be a ghost town, inhabited only by sage and the occasional coyote. Roughly 95 full time jobs were eliminated. The Gerlach K-12 School was drastically reduced leaving only six children, one teacher, one office worker and one maintenance person.

Gerlach was founded during the construction of the Feather River Route of the Western Pacific Railroad between 1905 and 1909. It has a total area of 94.1 square miles (243.6 km²), all of it land. Its elevation is 3946 ft.

The economy of Gerlach focuses on tourism in the nearby Black Rock Desert, auto and motorcycle rallies, media production, hunting and of course high power rocketry launches.

So called major industries in Gerlach are a Union Pacific switching station and public services of Washoe County consisting of a Roads Department, a Senior Center and a K - 12 public school. There is also a US Post Office (89412).

Many of the inhabitants of Gerlach are elderly retirees. There are 3 owner-operated bars in Gerlach; Bruno's Country Club, Bev's Miners Club, and Joe's Gerlach Club.

Bruno's Country Club is a bar/restaurant with separate motel and gas station and has been a destination for

travelers in the region for over 50 years, and is the only restaurant and motel for 80 miles (130 km).

Hunters from all over the west travel to Gerlach to hunt a wide variety of game such as chukar, geese, deer, antelope, etc. Joe's Gerlach Club hosts an annual chukar feed in late January. Bruno's hosts their annual Chukers Festival which just about ends the "Gerlach Season". In addition Bruno's restaurant hosts several other private parties in a large room in the back which is available for rent.

Since 1991, Burning Man, a week long counter cultural festival with 53,599 participants (as of 2010), has been held nearby. Due to the appearance and actions of many of the participants, local enthusiasm is mixed, but the event is responsible for around 20% of the sales at the few commercial establishments in the area so the community tolerates them.

Primary highway access to Gerlach is provided by State Route 447 which runs from Wadsworth to the south up through California, the towns of Eagleville and Cedarville and into Oregon. Gerlach can also be accessed via three former state highways: State Route 34, State Route 48, and State Route 49 (also known as Jungo Road or Trego Road).

Airfields are available suitable only for light planes. The Gerlach airfield is simply a graded dirt strip. Nearby Empire had a paved field, but light towers at a baseball field directly adjacent to and in line with the eastern end of the runway make approaches from or departures in that direction hazardous. Neither field is used very much.

The closest grocery store is located in what was Empire. With the Gypsum plant closed the fate of this store is still unknown. Next closest groceries are in the town of Nixon or Wadsworth to the south, or Fernley - which now has a Walmart!

OUR BLACK ROCK DESERT

Many of us have been to Black Rock nearly every year. Some of us are relatively new. The following is a nearly complete information source to the Black Rock Desert, a few towns and the surrounding area. Reading through you'll find a ton of information that even the hardcore old timers may not even be aware of.



The Black Rock Desert region is in northwestern Nevada and the northwestern Great Basin. The playa extends for approximately 100 mi (160 km) northeast from the towns of Gerlach and Empire, between the Jackson Mountains to the east and the Calico Mountains to the west. The Black Rock Desert is separated into two arms by the Black Rock Range. It lies at an elevation of 3,907 ft (1,191 m) and has an area of about 1,000 sq mi (2,600 km²).

There are several possible definitions of the extent of the Black Rock Desert. Often people refer just to the playa surface. Sometimes terrain which can be seen from the playa is included. The widest definition of the Black Rock Desert region is the watershed of the basin that drains into the playa. The intermittent Quinn River is the largest river in the region, starting in the Santa Rosa Range and ending in the Quinn River Sink on the playa south of the Black Rock Range. The watershed covers 11,600 sq mi (30,000 km²) including the Upper and Lower Quinn River, Smoke Creek Desert, Massacre Lake, and Thousand Creek/Virgin Valley watersheds of northwestern Nevada as well as small parts across the borders of California and Oregon.

Humboldt, Pershing and Washoe Counties of Nevada intersect at the Black Rock Desert.

MOUNTAIN RANGES

The following 24 mountain ranges are within or bordering the Black Rock Desert region.

- Antelope Range
- Badger Mountains
- Black Rock Range
- Calico Mountains
- Division Range
- Fox Range
- Granite Range
- Hannan Range
- High Rock Canyon Hills

- Jackson Mountains
- Kamma Mountains
- Little High Rock Mountains
- Massacre Range
- Montana Mountains
- Pine Forest Range
- Poker Brown Mountains
- Santa Rosa Range
- Selenite Range
- Sentinel Hills
- Seven Troughs Range
- Sheephead Mountains
- Smoke Creek Mountains
- Yellow Hills

GEOLOGICAL FEATURES

The desert has numerous volcanic and geothermal features of the northwest Nevada volcanic region, including two Black Rock Points (west and east) at the southern end of the Black Rock Range and which have dark Permian volcanic rocks similar to another Permian black diabase dike formation in Nevada.

The portion of the Lake Lahontan lakebed in the Black Rock Desert is generally flat with Lahontan salt shrub vegetation, widely-scattered hot springs, and a playa. In areas of the lakebed along mountains, rain shadow results in desert precipitation levels.

The world famous Fly Geyser of Fly Ranch is on private land and began during 1964; the result of a water well that went bad. The Gerkach-Leadville fountain, on the same property, is a result of another water well drilling that accidentally penetrated a geothermal source.

The playa of the Black Rock Desert lakebed is ~200 sq mi (520 km²) within an area bounded by the Calico Mountains Wilderness (north), Gerlach (west), the Applegate National Historic Trail (northeast), and the Union Pacific Railroad (south). The "South Playa" (~30 sq mi, with ~13 sq mi (34 km²) in Washoe Co, is

between Gerlach and the southwest boundary of the National Conservation Area (NCA), while the northeast NCA portion of the playa (including ~25 sq mi (65 km²) in Humboldt Co) is between the NCA boundary and the Applegate National Historic Trail. The Nobles route between Gerlach and Black Rock Hot Springs extends through the length of the playa. The playa's Quinn River Sink of ~3 sq mi (7.8 km²) is where the Quinn River discharges/evaporates ~2.75 miles (4.43 km) south-southwest of Black Rock Hot Springs.

MINING

Prospecting and mining has occurred in the Black Rock region since the mid-19th century. US Gypsum Corporation operated a gypsum mine and drywall (brand named Sheetrock) manufacturing plant in Empire, which employed 107 people and produced 266,300 tons of gypsum in 2008 alone.

Allied Nevada Gold Corporation re-opened the Hycroft Gold Mine in 2008 after acquiring it from Vista Gold Corp. Hycroft is a strip-mining operation in the Kamma Mountains near Sulphur on the east side of the Black Rock Desert.

There are many silver & gold mines on the west side of the playa, some abandoned and some still being worked.

Several opal mines are in the base of the Calico Mountains on the west side of the desert. The largest Opal in the world, the size of a man's fist, was found here. The largest Opal Mine, Rainbow Ridge



and Royal Peacock, two of the largest Opal areas in the country, are directly north at the northern fringe of the Humboldt County in the Black Rock area.

PALEONTOLOGY

In 1979 a fossilized Columbian Mammoth was found along the side of the lake bed. Copies of the bones are now exhibited at the Nevada State Museum, Carson City.

HISTORY

More than ~15,000 years ago, the Humboldt River flowed to the Smoke Creek-Black Rock Desert sub-basin, and during the recession of Lake Lahontan, the river diverted to the Carson Desert sub-basin. During the highest Lahontan water level, about 12,700 years ago, the lakebed was under about 500 ft (150 m) of water, under which sediment accumulated to form a flat lakebed.

Great Basin tribes inhabited the area 7,000 years ago, and a Frémont Expedition encountered the site in 1843, but the Fortieth Parallel Survey (1867) conducted the first official exploration. In the late 1840s, Peter Lassen led California Trail emigrants through the desert's Applegate-Lassen Cutoff.

By 1910, Western Pacific's Feather River Route (Oakland-Salt Lake City) had been completed across the east side of the lakebed on the general route first explored by Lieutenant E.G. Beckwith in 1854.

In World War II, 973 sq mi (2,520 km²) of the Black Rock Desert was used for a USAAF aerial gunnery training range, and during post-war, the north region of the United States Navy's Lovelock Aerial Gunnery Range was in the Black Rock Desert area (the Black Rock Desert Gunnery Range was closed by 1964).

MODERN HISTORY

By 1927, the desert had been used for filming "The Winning of Barbara Worth" which was Gary Coopers first movie. The 1961 movie "The Misfits" was filmed in Gerlach. It was the last movie starring Marilyn Monroe, Clark Gable and Montgomery Clift. In 1989 Drew Barrymore starred in "Far From Home" filmed in Gerlach. The 2003 Mythbusters pilot episode was also filmed in the area. Against popular believe the movie "Bad Day At Black Rock" starring Spencer Tracy and Lee Marvin was NOT shot anywhere near here!

For its 30th anniversary, the Black Rock Press published a 1994 book of desert photographs. The Friends of the Black Rock/High Rock organized in 1999, and a National Conservation Area Act the next year created several protected areas of the desert.

The first "Balls" rocket event was held at the desert in 1993, and in 1998, the first annual Gerlach Dash glider race from Reno to the desert was held.

Also in 2000, Lisa O'Shea died 7 days after being scalded in Double Hot Springs when she attempted to rescue 2 dogs, and the Bureau of Land Management subsequently fenced "Double Hot".



Jack Lee Harelson was fined \$2.5 million in 2002 for archeological looting of a pre-historic Indian burial site at Elephant Mountain Cave.

In 2008, an injured man was rescued when an aircraft pilot radioed for help after noticing him lying face-down on the lakebed.

In 2010, the BLM's Winnemucca District Office completed a roundup of 1,922 wild horses in the Calico Mountains Complex, of which 39 died of malnutrition due to overgrazing.

LAND SPEED RECORDS

The flatness of the Black Rock Desert's lakebed surface has led to the area's use as a proving ground for experimental land vehicles. It was the site of two successful attempts on the World Land Speed Record:

In 1983, Richard Noble drove the jet-powered Thrust2 car to a new record of 633 mph (1,019 km/h). Noble also headed up the team that beat the Thrust 2 record.

In 1997, ThrustSSC became the world's first and only supersonic car, reaching 766 mph (1,233 km/h)



Thrust SSC pushing a shock wave through the sound barrier in 1997 Photo taken from an overhead para-glider..

ROCKETRY

In addition to the flat surface, distance from populated areas and uncontrolled airspace over the area also attract experimentation with rockets. The following are highlights of amateur rocketry records set at Black Rock:

On November 23, 1996, the Reaction Research Society launched a rocket to 50 miles (80 km) in altitude, a significant leap in amateur rocket altitude records at the time.

In 2004 the Civilian Space eXploration Team (CSXT) claims to have launched a rocket to 72 miles (116 km) in altitude. To this day it has never been confirmed.

Other rocket launches attempting various altitude records or space flights have occurred at Black Rock. In May 1999, JP Aerospace used a rockoon (balloon-launched rocket) in an unsuccessful suborbital space flight attempt covered by CNN. The rocket reached 75,000 feet (23,000 m), which was far less than the intended Karman Line to reach space.

JP Aerospace returned to the desert in 2009, launching an armchair to the edge of space for Space Chair, an advertisement for Toshiba electronic products.

TRANSPORTATION

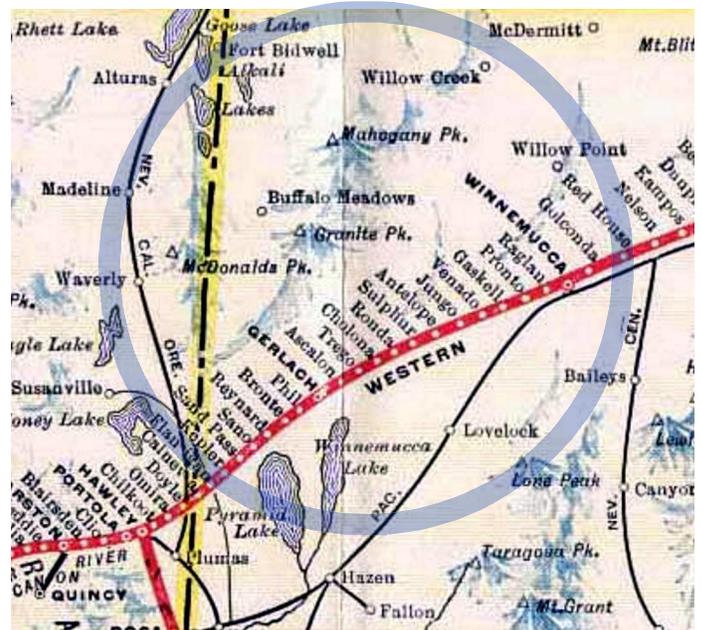
Nevada State Route 447 is the area's main highway and connects Gerlach to SR 427 at Wadsworth, Nevada, near Interstate 80. The desert's dirt roads are generally not usable in wet or snowy conditions. Old Highway 34 provides access to the playa on the west side and to the Hualapai Flat on up to the "town" of Vya.

Old Highway 48 (dirt) connects the playa to Lovelock, and Old Highway 49 (Jungo Road, which is usually unmaintained gravel) provides access to the lakebed from the Sulphur and Jungo ghost towns.

Union Pacific Railroad freight trains use the lakebed's east side between Sulphur and Gerlach. Light aircraft have landed on the lakebed for events (the nearby Empire and Reno-Tahoe International Airports provide commercial service for the area).

BURNING MAN

What? you say. No mention of Burning Man? What can we say that they haven't already said for themselves.



The main railroad line from Salt Lake City to Sacramento showing the various "stations". Red line is the main line and black lines are narrow gauge lines. We've explored from Roynard to Sulphur. Antelope & Jungo are next.

HOW TO MAKE AN IGNITOR

Chris Pearson

This will explain the procedure to make a highly reliable, fast burning, high temperature igniter for quick, reliable and complete ignition of high-power composite rocket motors. This pyrogen burns hotter than 3500 degrees F and will light quickly on a fully charged 12 volt motorcycle or car battery.

This method will produce an igniter comparable to Quickburst or other commercially available igniters for a fraction of the cost.

WARNING! This igniter formula includes magnesium powder and powdered potassium nitrate. These two chemicals should never be mixed dry as there is the possibility of spontaneous ignition or explosion if they are. Fine magnesium powder itself is very dangerous and if spilled can form an airborne cloud that can flash explosively. Do not attempt to work with these chemicals if you have had no prior experience with them. Remember to follow good lab technique and wear gloves and eye protection. Have a source of water or fire extinguisher handy. It is a good idea for people who are inexperienced in chemical handling to mix the chemicals outside, or in a garage and work with someone else present.

WHAT YOU'LL NEED

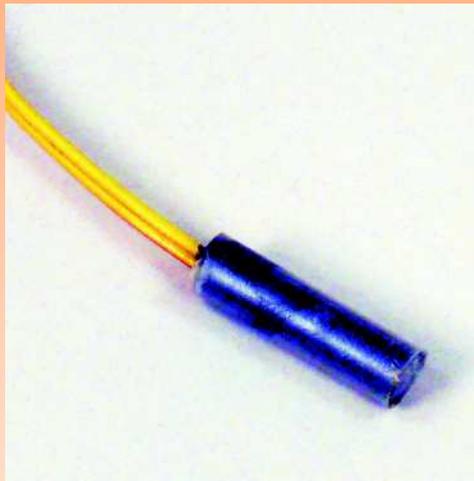
- Soda straw, paper or plastic, various diameters and lengths
- Two conductor insulated copper wire, 22-28 AWG, commonly called "shooter wire"
- 30 AWG Nichrome wire
- Wire cutter/strippers
- Soldering iron, solder and flux
- Potassium Nitrate (KNO₃)
- Magnesium (Mg) powder, preferably 300 mesh or better
- Epoxy (slow setting)
- Q-Tips
- Plastic spoons, mixing cups and wood stirring sticks
- Digital Volt Meter

If you have no experience using a soldering gun, or just don't want to bother with that part, pre-wired and soldered wire leads are available from several igniter manufacturers to be used with their own dipping mixtures

STEPPED PROCEDURE

See the diagram on the next page and follow the steps presented here.

1. Cut the shooter wire to a length that will allow it to reach the top of the motor core and add an additional 6" to reach



past the nozzle. Igniters for motors with small cores should use thinner wire (28 AWG). Igniters for larger motor with larger, longer cores should use thicker wire (22 AWG). Strip 1" of insulation from both leads of one end of the wire.

2. Cut one lead of the other end of the wire approximately 3/4" shorter than the other.

3. Strip 1/4" off insulation off both leads of the uneven end.

4. Take the Nichrome wire and wrap it first around the stripped copper of the longer lead, then wrap about 5-6 turns around the insulated part of the longer lead and then wrap 5-6 turns around the uninsulated part of the shorter lead. Trim the Nichrome wire.

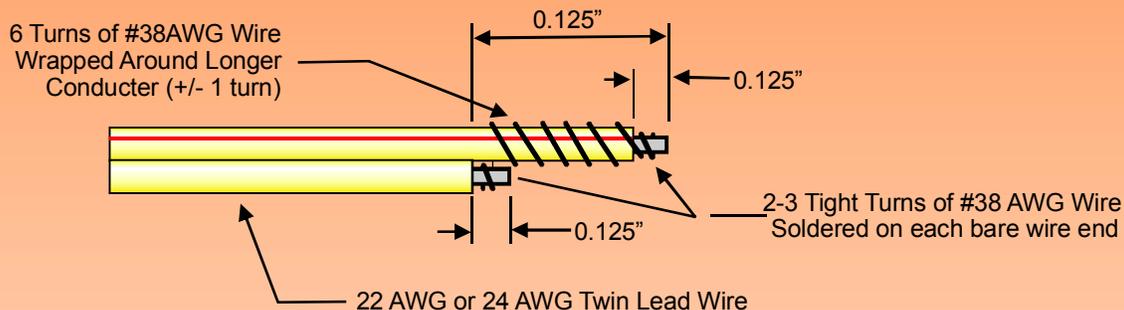
5. Using a Q-Tip apply some soldering flux to the stripped parts of the wire where you wrapped the Nichrome. Solder the Nichrome wire wrappings to the un-insulated wire. The use of flux is necessary as the solder will not stick to the Nichrome wire without it. If you do not solder the wires on, the epoxy in the mixture will act as an insulator between the copper and Nichrome wire and your igniter will not fire. Once soldered, check for continuity and resistance using a digital volt-meter. The resistance of the igniter shouldn't be more than 2-3 ohms. If it is very high (over 10 ohms), you've done a poor soldering job. You can still use these high resistance wires, but ignition time will be longer.

6. Cut the soda straw to length. The length and diameter of the straw will depend on the size of the motor and core. Larger motors should use larger igniters. A 1" piece for smaller motors is usually adequate, while up to a 3" piece is good enough for M and N motors.

7. Most potassium nitrate that is available is either in coarse powder or crystal form. This must be ground into a fine powder in order to work properly. This can be done carefully with a mortar and pestle or with a marble rolling pin on a hard non-metallic surface.

8. Carefully mix together the igniter pyrogen formula consisting of an 8/4/2 ratio of potassium nitrate, epoxy resin/hardener and magnesium powder by weight in a plastic cup. *It is very important to first completely mix the magnesium powder into the epoxy mixture before adding the potassium nitrate as this will greatly reduce the risk of accidental ignition.* This is called "wetting out" the metal, and there should be no powdered magnesium anywhere in the

ENLARGED VIEW of WIRE END



mixing cup before adding the potassium nitrate. Use a plastic spoon for measuring the magnesium into the mixing cup and then discard the spoon. Do not use this same spoon to measure the potassium nitrate! Add the potassium nitrate with another clean spoon, discarding it immediately afterwards, and stir with a wood stick until the resulting mixture is smooth. Using a slow-setting epoxy allows more time for mixing and constructing the finished product. This is important when making more than a couple of igniters. Additionally, slower-setting epoxies are usually thinner and this allows a more uniform mixture.

9. The mixture should have a consistency that is not too thin, as you don't want it to be running out of the ends of the straw. Too thick of a mixture will be hard to get into the straw. Insert the pyrogen into the soda straw by pushing one end of the straw into the mixture in the cup until you fill it to about 1/8" inch from the other end of the straw.

10. Push the end of the two conductor wire that has the Nichrome wire soldered to it into the pyrogen in the soda

straw. Try to place the Nichrome in the middle of the straw. Leaving a gap at the one end of the straw allows the pyrogen displaced by the wire a place to go without coming out of the end of the straw. Lay on a paper towel on a flat surface and allow to cure completely overnight. Your igniter is now finished.

11. Cut a slit down the soda straw and peel it off of the hardened pyrogen. Some people wait to do this until you are actually going to use the igniter, as the straw will protect the igniter from cracking. The igniter should be hard like cured epoxy.

12. Check for continuity and resistance of the finished igniter once again using a digital volt-meter. The resistance of the completed igniter shouldn't have changed. If using these igniters in a cluster, use ones with the same resistance, or ones that are very close. It is usually a good idea to check continuity on the igniter once again at the pad right before you insert it in the motor. Use your own DVM. Don't rely on the continuity circuits (if they exist) of the launch pad.

NOTE: If there is going to be a long time between the time you make the igniters and use them, it might be beneficial to dip the constructed bridge wire unit in nitro cellulous lacquer or clear butyrate dope and let it dry before potting it in the pyrogen/epoxy mixture. This is to prevent the ammonium nitrate from corroding the bridge wire and rendering the igniter unusable. This has happened. The igniter will show continuity but won't fire. After 4-5 months you may find them useless without this protection.



RCS ROCKET MOTOR COMPONENTS INC.

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RCS Rocket Motor Components was founded by Gary Rosenfield in 1995 to offer AeroTech RMS-compatible parts for custom composite propellant rocket motor fabrication. These parts included molded phenolic nozzles, propellant casting tubing, phenolic and fiberglass motor casing material, phenolic and paper liner tubing, o-rings, casting plugs, forward & aft insulator washers, and delay/smoke charge insulator tubes

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CHECKER BOARD PAINT JOB



Many people, mostly professional painters, have asked, after seeing Ken Good's Checker Board paint job on his now deceased DELAMAR Kit, just how did he do that. Painting rockets is a wide open adventure and while this CheckerBoard pattern looks simple, there is more to it than one sees. Just about anyone can paint a checkerboard pattern, this one is actually complex due to the fade applied. Looks simple but try to duplicate!

Several good coats of High Metallic Silver is then applied over the entire rocket. A coat of clear can be applied but not necessary at this time.

We prefer to use Automotive Urethane paint for a harder more durable finish. Those without spray equipment will find a paint job such as this can be done using basic spray cans.



Bare fiberglass is prep sanded and a coat of high fill gray primer is applied. Fine sanding of the entire surface is followed by cleaning all dust from the surface.



Once the Silver is dry a Checker Board pattern is laid out and alternating checks are removed. Note we have pattern running from fins to nose cone. This is for a reason.



Once the pattern is laid we mask off the fin section and apply a rich Metallic Red from the center of the pattern faded to the tip of the nose cone and also fade it to nothing before we reach the fin section. This is part of the trick.



It definitely helps to have a good base stand to paint rockets on. Ours is an old automotive engine stand modified with a long pipe which fits up the motor tube. The rocket can then be rotated as the paint is applied.



Once dry remove all of the remaining checks and apply several good coats of Metallic Red from the tip of the nose cone and faded to nothing before the fin section.

Next spray the Silver Metallic over the fin section and then fade it to nothing well before mid-section of the Checker Board pattern. This will create a more blended fade. Now apply the clear coat, nice and shiny, and you are done.



If properly done with automotive Urethane your last clear coat should be sufficient to present a shiny finish. If not some very fine wet sanding and polishing will create a show piece, But I think we build these things more for go than show and at 900 mph who sees the pattern anyway!.

While this pattern effect can be obtained using Spray Cans it may take a bit of practice. Even still controlling the fade spray from one color to another is tricky and can prove frustrating to most painters. Custom effects such as this, and this is a simple one, are best performed using commercial Automotive Paints.



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USING A STEEL RULE



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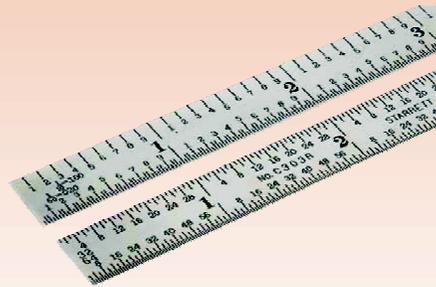
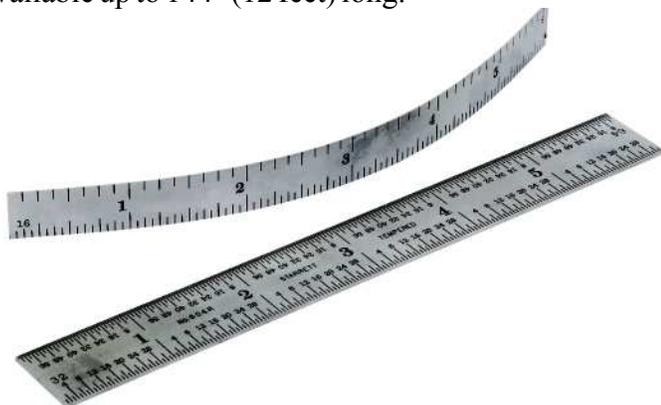
The steel rule is a basic measuring tool. When used correctly, a good steel rule is a surprisingly accurate measuring device.

What is a steel rule?

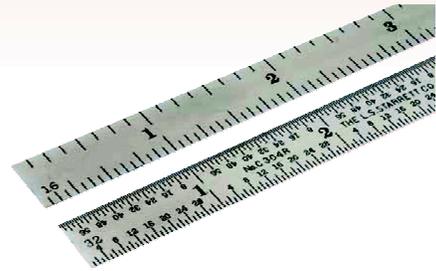
Some people confuse rules and scales. A scale is a measuring device used by architects and engineers that assists them in making drawings to a scale other than full size. A rule is used to measure actual sizes. (But don't ask about shrink rules, which are used to make casting patterns and include an allowance for shrinkage of the casting during cooling.)

Steel rules come in many sizes and formats. Basic 6" and 12" steel rules come in flexible and rigid forms. Flexible rules are usually $\frac{1}{2}$ " wide and $\frac{1}{64}$ " thick. Starrett calls flexible rules "semi-flexible." Rigid rules are usually $\frac{3}{4}$ " wide and $\frac{3}{64}$ " thick. Starrett calls rigid rules "spring-tempered."

While most steel rules are 12" long or shorter, they are available up to 144" (12 feet) long.



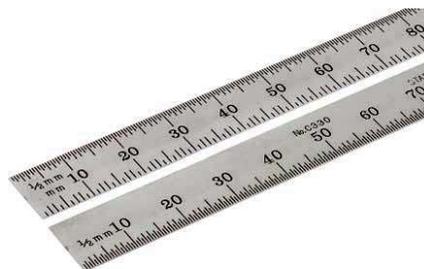
3R
32nds
64ths
10ths
50ths



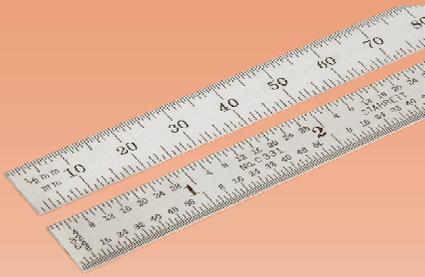
4R
8ths
16ths
32nds
64ths



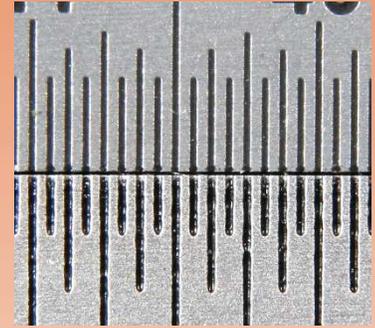
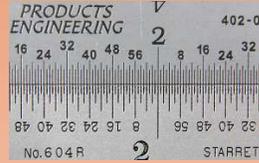
5R
32nds
64ths
10ths
100ths



30 (Metric)
mm & 0.5mm
Both Sides



31 (Inch/Metric)
mm & 0,5mm
Both Sides



What makes a good steel rule?

Conventional wisdom is that the best steel rules are machine divided. This means the graduations are cut on a machine that uses gearing to ensure the graduation lines are evenly spaced and the correct distance apart.

Most steel rules are now made by a photoengraving process called photo etching. A photosensitive resist is exposed through a precision master negative to create a pattern of masked and clean areas. An etching solution forms the graduations and other markings on the rule.

Good steel rules have uniform graduation line widths. Variation in line width makes accurate measurement difficult.

So let's take a look at the conventional wisdom. Are machine divided rules better than photo etched rules? When this marketing claim was first made, it was probably true. But now it is most certainly not true.

The process of machine dividing rules was developed about 125 years ago. It probably produced a major improvement in the accuracy of rules. But anything that relies on gears and mechanics must involve some measure of error, simply because the machine cannot be perfectly made.

Photoengraving, on the other hand, relies on a precision master to transfer the design to the rule. With a perfect master, each rule made from that master should also be virtually perfect. So the question becomes how well can a master be made? And the answer is very well indeed. The basic process for making steel rules is the same process by which computer processors and other integrated circuits are made with extreme precision. Current technology can create a master negative that is orders of magnitude better than required to make a steel rule.

The two major manufacturers of steel rules in the United States are the L. S. Starrett Company (Starrett) and Products Engineering Corporation (PEC).

PEC makes steel rules for many of the other brands that are available in the United States. Starrett rules are machine divided, whereas PEC rules are precision etched. The above photos show the two companies' rules next to each other. The left photo shows the two rules at about full size. The right shows a section of each at a higher magnification. Which rule do you think is easier to read?

The material that a steel rule is made of is also important to the quality. Good steel rules are made from high-carbon spring steel that is hardened and tempered to Rc 47-52. They are chrome plated, usually with a satin finish, for corrosion resistance and readability.

You might have noticed the difference in color between the Starrett and PEC steel rules in the previous photos. PEC steel rules use a unique plating process to achieve a brighter, satin chrome finish that enhances the contrast between the black graduation lines and the surface of the rule. This also enhances their readability.

While you can find many inexpensive steel rules made of stainless steel, it is not a great material from which to make steel rules. The stainless steel used to make steel rules cannot be hardened to the level of spring steel and thus it tends to yield when bent, keeping the curve, and not snapping back to straight.

Both the long edges and the ends of steel rules should be ground for straightness and accuracy. Ends that are ground square, and in proper relationship to the graduations allow accurate measurements from the ends of the steel rule.

A properly made steel rule will have virtually no error in the graduations. Any error in the rule is between the first graduation and the end of the rule. The standards for this error are actually quite lenient. The first graduation can have an error between +0.004" and -0.002" and still meet the standards. Most steel rules will handily meet this standard.

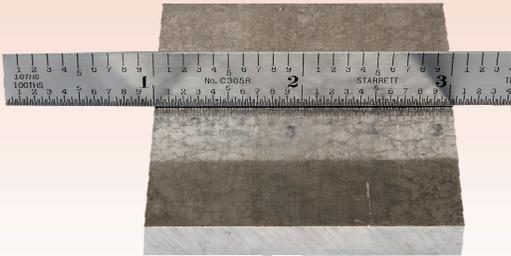
Care of steel rules

Steel rules are precision measuring instruments. Don't use your steel rule as a scraper, screwdriver or pry bar. Don't drop it or bang it around. Keep your steel rule very lightly oiled.

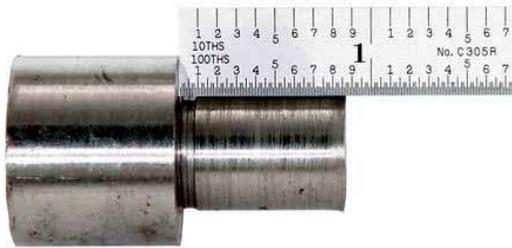
Inspect your steel rule periodically. Be sure that it is not bent or dented. Check that the corners are square and sharp. Be sure there are no burrs anywhere on the steel rule. If you find any of these problems, replace your steel rule.

Measuring

Here is the correct way to measure a part with a steel rule. Notice that we are measuring from the 1" graduation on the left. (Be sure to subtract 1" from the measurement you read.) It is more accurate to measure between two graduation lines than from the end of the rule.

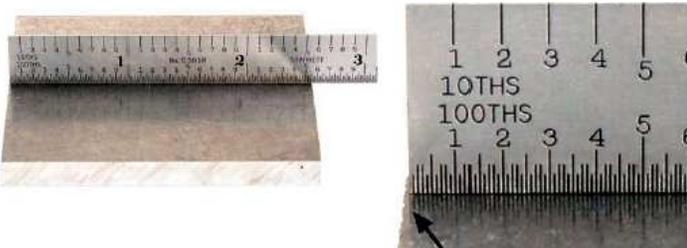


It is okay to measure from the end of the rule when there is a hard stop that you can press the rule against. The accuracy of this measurement depends on the quality of the grinding of the end of the rule.



But trying to align the end of the rule with the edge of a part is simply not an accurate way to measure.

Be sure the graduations on the rule are adjacent to the part being measured. When the rule is laid flat on the part, you cannot get an accurate measurement because of parallax.



Good Technique



Poor Technique

Be sure the steel rule is straight across the dimension you want to measure. If the steel rule is at an angle, the measurement cannot be accurate.

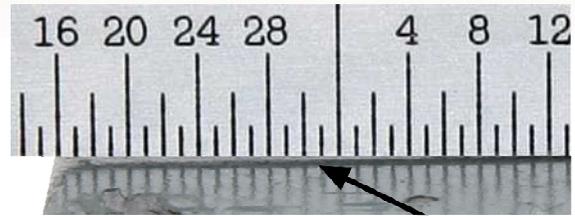


Good Technique



Poor Technique

Another use for a rigid steel rule is to check the flatness of a part. Because the edges are ground, you can make a visual check of the flatness of a part by standing the steel rule on edge across the part. Try it in several places and look for light under the rule. With a good steel rule you should be able to see 0.0005" of deviation from flat.



How accurate is a steel rule?

In general, a measuring device is considered accurate to the smallest graduation. So a steel rule that is graduated to 1/64" is accurate to about 0.015". But with careful visual interpolation, you actually measure to about 0.005" with a good steel rule. That's about the width of one of the graduation lines.

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www.lvhq.net/nomatch/

LET'S VISIT DEB KOLOMS

Dr. Deb Koloms is an Eye Surgeon with several Eye Clinics in the North Central part of New York State. We all know her as the lady with the furry rockets!

Deb is very versed in motor making as her Rocket WorkShop can attest. It is located in the enclosed patio



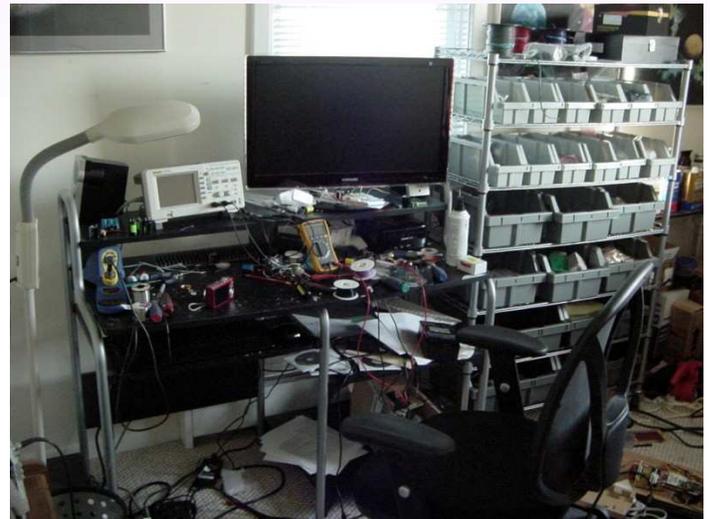
at the rear of here house. It is very airy and clean and she uses it for all of her rocketry activities from motor making to rocket building and road kill stuffing.

Everything is well organized and her attitude to safety is strong as she tries to keep things clean - except for her rocket storage area of the shop. Overall her shop place is well set.

Her second "hobby" is designing and building Vacuum Tube amplifiers and sound systems. She has a room dedicated to just that - and it's well organized - at least she knows where everything is. It's also not dirty but in her words, "Very worn!"

Her third "hobby" is wood working, as she builds and finishes all of the custom cabinets and cases for her vacuum tube electronics.

To the left three shots of Deb's Rocket World. To the bottom her "worn" electronics lab and some nice examples of her cabinet work.



HOW TO GIVE A CAT A PILL

1) Pick cat up and cradle it in the crook of your left arm as if holding a baby. Position right forefinger and thumb on either side of cat's mouth and gently apply pressure to cheeks while holding pill in right hand. As cat opens mouth pop pill into mouth. Allow cat to close mouth and swallow.

2) Retrieve pill from floor and cat from behind sofa. Cradle cat in left arm and repeat process.

3) Retrieve cat from bedroom, and throw soggy pill away.

4) Take new pill from foil wrap, cradle cat in left arm holding rear paws tightly with left hand. Force jaws open and push pill to back of mouth with right forefinger. Hold mouth shut for a count of ten.

5) Retrieve pill from goldfish bowl and cat from top of wardrobe. Call spouse from garden.

6) Kneel on floor with cat wedged firmly between knees, hold front and rear paws. Ignore low growls emitted by cat. Get spouse to hold head firmly with one hand while forcing wooden ruler into mouth. Drop pill down ruler and rub cat's throat vigorously.

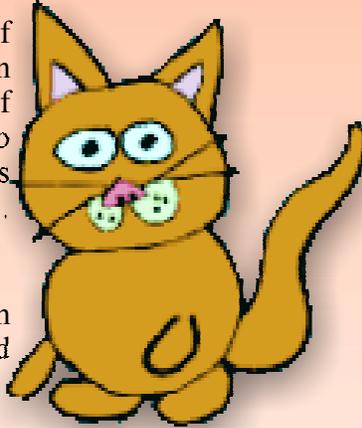
7) Retrieve cat from curtain rail, get another pill from foil wrap. Make note to buy new ruler and repair curtains. Carefully sweep shattered figurines and vases from hearth and set to one side for gluing later.

8) Wrap cat in large towel and get spouse to lie on cat with head just visible from below armpit. Put pill in end of drinking straw, force mouth open with pencil and blow down drinking straw.

9) Check label to make sure pill not harmful to humans, drink 1 beer to take taste away. Apply Band-Aid to spouse's forearm and remove blood from carpet with cold water and soap.

10) Retrieve cat from neighbor's shed. Get another pill. Open another beer. Place cat in cupboard and close door onto neck to leave head showing. Force mouth open with dessert spoon. Flick pill down throat with elastic band.

11) Fetch screwdriver from garage and put cupboard door back on hinges. Drink beer. Fetch bottle of Scotch.



Pour shot, drink. Apply cold compress to cheek and check records for date of last tetanus jab. Apply whiskey compress to cheek to disinfect. Toss back another shot. Throw tee-shirt away and fetch new one from bedroom.

12) Call the fire department to retrieve the &*\$%#@ cat from tree across the road. Apologize to neighbor who crashed into fence while swerving to avoid cat. Take last pill from foil-wrap.

13) Tie the little bastard's front paws to rear paws with garden twine and bind tightly to leg of dining table. Find heavy duty pruning gloves from shed. Push pill into mouth, followed by large piece of fillet steak. Be rough about it. Hold head vertically and pour 2 pints of water down throat to wash pill down.

14) Consume remainder of Scotch. Get spouse to drive you to the emergency room. Sit quietly while doctor stitches fingers and forearm and removes pill remnants from right eye. Call furniture shop on way home to order new table.

15) Arrange for SPCA to collect mutant cat from hell and phone local pet shop to see if they have any hamsters.

HOW TO GIVE A DOG A PILL

1) Wrap it in bacon.



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