Glossary of Common Model and High Power Rocketry Terms

With thanks to Randy Culp for his initial 2008 publication. This is an updated compilation of a number of on-line glossaries of model and high power rocketry terms.

3FNC: Three Fins and a Nose Cone, the description of a generic rocket.

4FNC: Four Fins and a Nose Cone. Another generic rocket description.

1010: A 1.0" x 1.0" T-slotted aluminum rail produced by 80/20.

1515: A 1.5" x 1.5" T-slotted aluminum rail produced by 80/20.

80/20: A company that makes aluminum extrusions that can be used as launch rails. The 80/20 1010 Extrusion is compatible with standard rail buttons (such as those from railbuttons.com). The company's 1515 Extrusion is compatible with larger rail buttons.

Ablative: To wear away under stresses of heat, oxidation, and high velocity gas erosion as during supersonic flight.

Acceleration: Increasing velocity with time.

Accelerometer: An electronic device for detecting the presence of acceleration. An accelerometer can be used for flight data gathering or for controlling flight events. For example, an accelerometer with a memory chip can record the strength and duration of a rocket's acceleration. This information can be used to calculate the rocket's approximate altitude. An accelerometer can be used to determine the proper time for a deployment charge or sustainer motor to be activated).

Advanced Rocket: see “High Power Rocket”

AERO-PAC: The **A**ssociation of **E**xperimental **RO**cketry of the **PAC**ific, a prefecture of Tripoli in Northern California. Despite the name, this is an HPR club and does not fly liquid fueled or other amateur rocketry vehicles. Its main purpose is education through experimentation with rocketry while following the NAR and Tripoli safety codes.

Aft: The rearward end of something on a rocket. Ship terminology is often used because "top" and "bottom" are confusing as orientation changes.

AGL: Above Ground Level. This is FAA-speak which, when talking about an altitude waiver, refers to the maximum altitude you can legally fly under that waiver. It is usually added to the MSL (Mean Sea Level) altitude of the launch site to give an altimeter reading that pilots must avoid.

Aerodynamic Heating: The heating of a solid object in an airflow caused by the friction of the air against the object.

Airframe: The rocket structure. This usually refers to just the cylindrical body tube, but may also refer to the entire body of the rocket.

Air Start: Any motor that is started after first motion of the vehicle. Upper stage ignition of a multi-stage rocket is a special case of air starting. Usually it is outboard boosters started after a central motor has lifted the vehicle, or visa

versa. A first motion sensor, g-switch, timer or barometric pressure sensor can do this. Many modern altimeters have the capability to do this.

Altimeter: A device, which measures at least the maximum height a rocket in flight reaches. These are often combined with circuitry to separate the rocket at apogee and/or for dual deployment of the recovery system. Some have circuitry that can also be used to air-start additional motors in a cluster or attached outboard pods.

AmSpam: Deprecating but affectionate abbreviations for "American Spacemodeling" (q.v.)

American Spacemodeling: The journal of the National Association of Rocketry. Previously known as "The Model Rocketeer" (q.v.), it underwent yet another name change and became "Sport Rocketry" (q.v.) starting with the Sept/Oct 1993 issue.

Amateur Rocket or Experimental Rocket: The class of non-professional rocket beyond HPR. Amateur rockets use structural metal parts and very often the motor casing doubles as the airframe (as with professional rockets). These rockets can be very large and powerful, capable of placing payloads many miles up. Activities in this field (one can scarcely call it a hobby) include formulation and manufacture of propellants and thus can be EXTREMELY hazardous. This is the main reason that amateur rocketry is not to be attempted alone. Another is expense as these vehicles can run many hundreds or thousands of dollars and take months to build. The equipment necessary to safely pursue amateur rocketry (sandbagged bunkers, loading pits, standby fire truck, etc.) is quite beyond the resources of most individuals. Not all amateur rockets are so large. Many of the "beginner" vehicles would qualify as HPR or even model rockets in terms of liftoff weight and total impulse, but fail the NAR/Tripoli codes due to their metal airframes and user-compounded propellants. Note: There is a fine, but significant, difference between using a metal cased reloadable motor with pre-manufactured fuel slugs and packing a pipe with zinc/sulfur (a common amateur beginner fuel). Liquid fueled vehicles are becoming more popular among amateur groups. These can produce up to 1,000 lbs. of thrust for up to a minute from a LOX/Kerosene engine, which can propel the vehicle to altitudes of over 40 miles. Neither Tripoli nor the NAR sanction amateur rocket activities. See also:

Black Rock Society
Experimental Spacecraft Society
Pacific Rocket Society
Reaction Research Society
Rocket and Space Foundation

AN: Ammonium Nitrate, an oxidizer sometimes used in experimental motors.

Anti-Zipper: Any number of techniques used to prevent "zippering" of airframe tubes by the recovery system. See "Zipper Motor Effect".

AP: Ammonium Perchlorate, the oxidizer used in most composite rocket motors. Often referred to as AP90, AP200 or AP400 as a designation of the size of the AP particles measured in microns.

APCP: Ammonium Perchlorate Composite Propellant. The type of propellant used in the majority of high power rocket motors. APCP has 3-4 times the delivered impulse of conventional black powder rocket propellant.

Apogee: The highest point of a rocket's flight path. (More literally, the point farthest on the flight path from Earth.)

Apogee Deployment: Ejection of the rockets recovery system at peak altitude, usually in low and mid-power rockets using the rocket motor (and no electronics) for coast delay and pyro ejection of the main recovery system. In rockets using altimeter-based deployment, the rocket will separate at apogee, deploying a small drogue parachute to slow its decent to a lower altitude where the main parachute will deploy.

AR: American Rocketeer - Centuri's attempt to produce an MRN (q.v.) clone in the late '60s. While the contents were fairly typical (product announcements, club news, rocket plans, reports on "real" aerospace events, etc.) it had a curiously over-produced look to it and ran very heavy on the advertising. Someone looking beneath the surface would notice that there was no reader input (e.g. rocket designs or "Idea Box" style tips); that all the rocket plans came from the Centuri design department and the "tips" were for problems that could be solved by items straight from the catalog! While each issue carried a volume/number identification, there was only one "Number" for each "Volume." V1, N1 was in 1966 and continued for at least four years.

ARA: Australian Rocketry Association, Inc. Also ARA Press, a publication house for rocketry and science fiction subjects.

BATFE: Bureau of Alcohol, Tobacco, Firearms and Explosives; a federal regulatory agency. Sometimes called ATF, BATF (older acronyms).

B/G: Boost Glider: A glider, which is boosted to altitude by a rocket motor. The pod containing the expended motor may separate from the glider at ejection to be returned by streamer or parachute (this is typical but is not required). The more aerodynamically clean glider section is then free to glide more slowly.

Baffle: (See "Ejection Baffle")

BALLS: The National Experimental Rocket Launch. An annual launch sponsored by Tripoli and hosted by Tripoli Gerlach for the purposes of launching very large (K and above) HPR rockets. An outgrowth of the one-day Experimental launch traditionally held the day after LDRS, Tripoli "adopted" the concept to provide insurance and continuity on an annual basis. The idea originated with Steve Buck, and Bill Lewis, of AERO-PAC, sponsored the first launch. The name came from jokes surrounding the event (e.g. "It takes BALLS to launch a rocket that big"). Steve claims that it was never intended to mean "Big Ass Load Lifting Suckers" as implied in early advertisements. The main difference between BALLS and other Tripoli launches (e.g. LDRS) are that no rockets below K power are permitted (no model rocket launch pads) and that Research or EX motors are allowed as long as they conform to the Tripoli Research Safety Code. This is also the only launch where metal vehicles can be flown.

Ballistic Coefficient: A measure of a projectile's ability to coast. It is defined as Cb = M/CdA where M is the projectile's mass and CdA is the Drag Form Factor (q.v.). At any given velocity and air density, the deceleration of a rocket from drag is inversely proportional to this value. Intuitively, it is the principle behind why a tightly crumpled piece of paper can be thrown farther than a loosely crumpled one.

BAR: **Born Again Rocketeer**. A former rocketeer who has re-discovered the hobby after an absence of several years or even decades. A marketing term coined by North Coast Rocketry in the 1980's to characterize the aim of their advertising and product line. (Contrast "BOR")

Base Drag: A component of aerodynamic drag caused by a partial vacuum in the rocket's tail area. The vacuum is the hole created by your rocket's passage through the air. Base drag changes during flight. While the motor is firing, the drag is minimal since the tremendous volume of gas generated by the motor fills this void. The drag takes a sharp jump at burnout when this gas disappears (note: tracking smoke has very little effect on base drag due to its low density). Base drag can be reduced by the use of a boat tail to transition the main body diameter down to the motor diameter, which helps direct air into the evacuated area. When properly designed, a boat tail can reduce base drag below zero (i.e. actually generate a small amount of forward thrust) by making use of the "pumpkin seed" effect.

Bates Grain: Tubular grain uninhibited on the ends, which can provide a nearly neutral burning characteristic (**BA**TCH **TES**T motor).

Bernoulli Effect: A phenomenon first described by the 18th century Swiss scientist Daniel Bernoulli who studied the pressures in moving fluid streams. The effect states that moving air will have a lower pressure than the still air around it. This is the principle behind how airplane wings generate lift and why beach balls stay "balanced" on top of fans in those hardware store displays. The effect is significant in rocketry when using altimeters or any other kind of payload that

senses the ambient pressure around the rocket. The air moving by the payload section could cause the payload to indicate a lower pressure than the ambient still air, thus giving a false altitude reading. The effect drops to zero at apogee when your rocket stops moving, but the altitude vs. time curve will be wrong.

Bernoulli Lock: A phenomenon similar to the "Krushnic Effect" (q.v.) where the rocket seems to be "glued" to the pad at liftoff. This afflicts larger, flat-bottomed rockets launched too close to pads with flat blast deflectors. The exhaust gasses escape at great speed through the small annular space between the rocket and the pad creating a venture, which generates a low-pressure region at the base. This pressure deficit can be significant, and if it is greater than the thrust being generated by the motor, the rocket won't go anywhere! This is quite possible as a 2" diameter rocket has, potentially, over 45 lbs. (200 N) of "suction" available to hold it back, while a 3" rocket has over 100 lbs. (460 N)! The old Centuri "Point" was an infamous Bernoulli locker when launched from an Estes Porta-Pad with its perfectly matching round blast deflector.

Binder (propellant): A two-part material, which binds the constituent elements of a composite propellant into a solid (usually rubbery); provides the fuel for the composite propellant; (See “HTPB” and “PBAN”)

Black Powder: Basically, gunpowder. The 'traditional' model rocket motor fuel. Used by Estes and most other model rocket companies to produce A through F motors. (See also "AP", “APCP” and "Composite Motor")

Black Rock Society (BRS): An amateur rocketry organization founded by Tom Blazanin to cater to those who find HPR confining. It is a serious organization for those dedicated individuals who wish to explore rocketry in a semiprofessional vein. It is open to all forms of reactive propulsion: solid, liquid and hybrid. The mailing address is: Route 1, Box 100 Loving, TX 76460 Phone: 817-378-2590 FAX: 817-378-2593

Blast Deflector: An angled or flat plate or other device that prevents the rocket motor exhaust from directly impinging on the ground and protects flammable materials like grass; surrounding a launch pad, from being ignited by the rocket exhaust. Required by the Safety Code.

Blow-By: A motor malfunction where the hot motor gasses escape past the delay grain and ignite a motor ejection charge prematurely, many times, causing damage to the rocket. Often happens at motor start-up.

Blow-Out: Failure of one or more parachute canopy panels caused by excessive loading, either by the opening shock; i.e., rocket too heavy for that size parachute or rocket is traveling too fast when parachute opens; “The rocket blew out its parachute!” (See also “Strip” and “Shred”)

Blow-Through: The physical ejection of propellant, many times burning through the front of the rocket body caused by a forward closure failure. Usually happens at motor start-up. Usually very damaging to the rocket.

Boat Tail: A transition section at the tail of the rocket, which gradually narrows the body down to the motor diameter. Used to reduce base drag (q.v.). Also known as a tail cone.

Bonus Delay: Slang for an unexpectedly long delay, sometimes resulting in crashing, airframe damage or parachute stripping. See “Zipper”

Boosted Dart: A method of maximizing altitude for any given impulse motor. A sub-minimum diameter, unpowered "dart" section weighted for Optimum Mass (q.v.) is placed on top of the powered section. At burnout (maximum velocity) the dart is released and coasts higher than even a minimum diameter rocket could due to its small cross sectional area. This technique is used in professional sounding rockets (e.g. Super Loki) as well as hobby rocketry.

Booster: On a multi-stage rocket this refers to the sections (stages), which drop off in mid-flight. On single stage rockets, the term is used for the lower powered portion to distinguish it from the recovery system and/or payload section. (See also "Air Start")

BOR: Burned Out Rocketeer (facetious). Counterpoint to BAR (q.v.). Someone who has been going at the hobby too intensely, such as in preparation for a major launch.

Bridgewire Igniter: A type of igniter for composite rocket motors, which uses a thin nichrome wire, soldered to heavier lead wire (often called “shooter wire”) and coated with a pyrogen, which ignites when voltage is put across the leads causing motor ignition.

Bulkhead: A solid partition in the rocket, especially one set perpendicular to the rocket's long axis, designed to not allow gases to pass.

Burn: Descriptive term used in conjunction to the operation of a rocket motor. Also used in a phrase by Research rocketeers; “he makes and burns propellant” or just “he burns propellant”.

Burn Area: The actively burning surface of a rocket motor grain, either solid or hybrid.

Burn Rate: The rate at which a substance is consumed by burning, such as propellant. In solid rocket motors, the rate at which the burning surface recedes as it combusts. Affected by pressure, temperature and the scrubbing of the propellant surface by hot gases.

Burn Rate Coefficient - BR Coef *(a)*: A propellant characterization value and is defined as the “rate constant.” The value of *a* depends of particle size of the oxidizer and solid fuel and generally indicates how temperature affects the burn rate.

Burn Rate Exponent - BR Exp *(n)*: A propellant characterization value, represents the “molecularity” and describes the burn rate of the propellant at a given chamber pressure.

Burn Rate Catalyst: An additive used to increase the burn rate of a propellant (such as iron oxide).

Burn Rate Modifier: An additive used to increase or reduce the burn rate of a propellant.

Burn Rate Suppressant: An additive used to slow the burn rate of a propellant (oxamide is an example).

Burn Time: The actual operating time, or the time that it takes for a rocket motor to fully expend its fuel in seconds.

Burnout: The point at which propellant is exhausted in a rocket motor and the thrust drops to zero.

Burn Out Velocity: The velocity the rocket is traveling when the motor runs out of fuel. Usually the highest speed achieved by the rocket. See also "Hyperterminal Velocity"

CA: Cyanoacrylate ('super glue'). A very strong adhesive popular for use in high power rockets, as well as 'on the field' repairs. The three most common forms of CA are often referred to as 'hot', 'gap filling' and 'slow'. Hot CA is very thin and has strong wicking properties. It dries in only a few seconds. Gap filling CA is a little thicker and generally comes in 15 - 30 second bond times. Slow CA forms the strongest bond but its bond times are also much longer. Hot or gap-filling CA is often used to tack parts into place prior to applying a stronger adhesive with a much longer bonding time (such as an epoxy).

CAR: The Canadian Association of Rocketry and it's essentially the Canadian version of the NAR and Tripoli Rocketry Association all rolled into one.

C-Slot: A fuel grain geometry where the grain has a radial slot cut on its edge; the burn is relatively neutral until the end.

Caliber: In rocketry, the diameter of the main body tube. Usually used when referring to some function of length, e.g. "The CP should be behind the CG by at least one caliber." The term is borrowed from the small arms industry where it refers to the bore of a rifle or pistol barrel, e.g. a .38 caliber pistol has a barrel with a .38" bore. Note that in large

artillery, caliber refers to the ratio of barrel length to bore. For example, a 3 inch 40 caliber gun would have a barrel 120 inches long.

Candy Fuel: (See "Sugar Motor")

Canopy: The fabric of the top of a parachute, which catches air, slowing the decent of the rocket. Can be made of rip-stop nylon or in the case of many surplus parachutes, silk.

Capacitive Discharge: A type of launch controller, which uses a large capacitor to store electrical energy from a battery. When commanded by the launch controller, the capacitor discharges a large current into the igniter. These controllers are often used with large cluster rockets to ensure all motors ignite simultaneously.

Case Bonded: Propellant which is cast directly into chamber and made to bond securely to the chamber wall in a monolithic (one piece) grain.

Casting Cap: A cast plastic or machined metal cap of different motor diameters used for the casting of propellant by Research rocketeers. Many times with holes corresponding to the different motor core diameters.

Casting Tube: A tube in which composite propellant is cast, typically cardboard, phenolic or fiberglass.

CATO: A motor failure, generally explosive, where all the propellant is burned in a much shorter time than planned. This can be a nozzle blow-out (loud, but basically harmless), an end-cap blow-out (where all of the pyrotechnic force blows FORWARD which usually does a pretty good job of removing any internal structure including the recovery system) or a casing rupture which has unpredictable, but usually devastating, effects. Another form of CATO is an ejection failure caused by either the delay train failing to burn or the ejection charge not firing, but the result is the same: the model prangs. A CATO does not necessarily burn all of the fuel in a rocket motor (especially true for composite fuels, which do not burn well when not under pressure). For this reason you should be especially careful when approaching a CATO.

> Origin: Opinions on the meaning of the acronym range widely. Some say it's not an acronym at all, but simply a contraction of 'catastrophic' and should be pronounced 'Cat-o' (which sounds better than 'cata' over PA systems. Others maintain that it is an acronym but disagree on the meaning, offering a broad spectrum of 'CAtastrophic Take Off,' 'Catastrophically Aborted Take Off,' 'Catastrophe At Take Off' and the self referential 'CATO At Take Off.' The acronym crowd pronounces it 'Kay-Tow', like the Green Hornet's sidekick. It has been pointed out, though, that all of the above are 'post-hoc' definitions since LCO's were using the term over range PA systems long before any formal acronym was established.
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> Opinions on the origins say that it is either from the military rocket programs of WW II, the post war development era, or even a modroc-only term, which originated with the MESS (Malfunctioning Engine Statistical Survey) performed by NAR's Standards and Testing committee. There is also a claim that it started with the Boston Rocket Club and that the spelling has evolved over the years. It supposedly started out as 'KATO', which, of course, stood for KABOOM At Take Off!

Centuri Engineering Co: Estes' Industries main competitor in the model rocket business until Damon purchased both them and Estes in the mid-70's. Centuri continued to operate until 1980. Centuri was notable as they produced large black powder D, E and F motors and a high power kit line. In 1970 they purchased the rights and technology to make composite E and F motors from Rocket Development Corp., which later became known as "Enerjets".

CHAD: Acronym for **CH**eap **A**nd **D**irty. Used to refer to a quick and inexpensive (but usually inelegant) way to solve a particular problem or produce some end result.

CHAD Staging: A simple technique used to make a multi-stage rocket out of a single stage vehicle. A booster motor is taped to the end of the standard, single stage motor in the rocket. The booster is totally external to the rocket. The booster is then ignited in the usual manner. This technique only works with black powder motors. It will only work with

models that are VERY over-stable to begin with. When CHAD staging does work, however, it is the most efficient staging method because it minimizes increased drag and mass associated with an added stage. (See “Optimum Mass”)

Chamber Pressure: The pressure generated within a motor by the combustion of the rocket propellant(s).

Characteristic Specific Impulse (***I_{sp}****) **Char. ISP**: The expected propellant performance in seconds not including nozzle contribution. This is not the same as **Delivered ISP**.

Characteristic Velocity (C*): Iso called **c-star** or simply ***c*,*** is a figure of thermochemical merit for a particular propellant and may be considered to be indicative of the combustion efficiency.

Chuff: A form of unstable combustion marked by brief bursts of thrust separated by periods of no thrust. Typically, the bursts come faster and become longer as burning proceeds, until stable burning results. The sound of chuffing is similar to that of a steam locomotive starting up. It generally occurs in a composite motor that is ignited too low in the grain. Chuffing can be dangerous, since a short burst of thrust can launch the rocket off the launch rod, and a lull immediately following the burst can put the rocket on the ground. When stable burning ensues, such a rocket will be flying horizontally. (See "Land Shark")

CG: Center of Gravity. The point about which a free body will rotate when disturbed by an outside force. For a model rocket, this is the point where the effects the masses of the individual components cancel out and the model will balance on a knife edge. As with a see-saw, a mass further from the CG will have a greater effect than the same mass closer in.

Class B Motor: Rocket motors containing more than 62.5 grams of propellant or motors that impart more than 120 newton-seconds of thrust.

Class C Motor: Rocket motors contain less than 62.5 grams of propellant or impart 120 newton-seconds of thrust or less.

Clip Whip: A number of micro clips on short wires (usually three) all connected at their free end. Used to aid in the ignition of clusters (q.v) where each motor uses a separate igniter.

Closure: Fore or aft. Refers to the ends of a reloadable rocket motor. Aft being the nozzle end and fore being the top part of the motor, either a solid bulkhead (plugged) or with a pyro delay element and black powder ejection charge.

Cluster: A rocket that fires more than one motor simultaneously. A technique once widely used before the advent of larger composite motors. (See also "Clip Whip" and "Davis Douche")

Coast Phase: That part of the rocket's flight between burnout and the air start of the next stage or between burnout and activation of the recovery system.

Combustion Chamber: The part of the motor where the actual combustion occurs. Composite fuels require a set pressure in the combustion chamber to continue burning at the proper rate. Failure to maintain the pressure results in chuffing.

Composite Material: Hi-tech materials, other than paper, wood or metal, such as fiberglass or carbon fiber, used in the construction of rockets. (See "Phenolic")

Composite Motor: The term used broadly to cover solid fuel rocket motors using propellants other than black powder. Can include motors using AP, KN or AN as oxidizers. Composite motors require different igniters and ignition systems from black powder motors.

Composite Propellant: In Hobby Rocketry, any propellant other than black powder. In military parlance (where the term originated) the term is used to denote propellants that are mixtures of oxidizers and fuels and to distinguish them from Single, Double, and Triple base propellants (which are either monopropellants or mixtures of monopropellants). Note that by the military definition, black powder is itself a composite propellant because it consists of separate oxidizers (KNO3 and sulfur) and fuel (charcoal). Further note that by the hobby definition, single/double/triple base propellants are composites because they are not black powder. No ambiguity arises, however, since the military doesn't use black powder (in rockets, anyway), and no hobby rocket motors use single, double or triple base propellants. (See also “APCP”, "Single Base Propellants", "Double Base Propellants" and "Triple Base Propellants")

Confirmation Certification: The process whereby a member of Tripoli or the NAR becomes certified as eligible to purchase high power (H and up) motors.

Coning: An unstable flight condition in which a rocket's spin causes the rear portion of the rocket to describe a circle. Coning greatly increases aerodynamic drag and reduces peak altitude.

Continuity Check: A group of electrical techniques for checking the firing circuit through the igniter to ensure that the circuit is functional. This usually involves some type of light or audio tone activated by a push-button. The techniques range from a simple current limiting light bulb or buzzer placed in series with nichrome igniters, to sophisticated bridge circuits for sensitive, low current flashbulbs and electric matches.

Copperhead™: The trademark name for an igniter produced by AeroTech, Inc. It is a laminated assembly consisting of a two copper foil strips separated by an insulator, with a quantity of pyrogenic compound on one end. It normally requires a special clip for electrical connections, but some rocketeers have mastered the "Z-Fold" which allows use of normal alligator clips. Notoriously unreliable, particularly in 24mm motors.

Core: The cavity within a solid or hybrid propellant grain, most often cylindrical but often star or wagon wheel shaped to offer higher burning surface or a constant surface with regression. (See “core burner” and “moon burner”)

Core Burner: A rocket motor, which has an open core, often cylindrical, in the center of the propellant. This allows for ignition at the top of the propellant stack and burning of a greater propellant surface area allowing higher thrust levels than an “end burner”.

Core Sample: Synonyms describing a failure mode where the model comes down fast and hard (nose first) and ends up tail-high in the ground (this is where large, colorful fins come in handy. Often the nose cone has separated (taking the recovery device with it) and the body tube ends up containing a nice 'core sample' of mud/dirt when pulled out of the ground. Also known as: Auger In, came in Ballistic, Lawn Dart, Tent Peg, Yard Dart.

CP: Center of (Aerodynamic) Pressure. The point on a rocket where stability-restoring forces due to airflow against the back part of the rocket (fins, etc.) exactly equal the disturbing forces against the part of the rocket ahead of that point. A good rule of thumb for sport models (both high and low power) is to design the rocket with the CP one or two body diameters behind the CG.

CPSC: Consumer Product Safety Commission. The government agency, which has the task of deciding whether or not, a given product is safe for 'general consumer' use.

Cruise Missile: A rocket flight that has failed in such a way that it ends up flying horizontally while still under power. A common example would be a cluster rocket that didn’t have all motors igniting or a multi-stage rocket which stages "dirty" (due to stability or structural problems) causing the upper stage to bend to near horizontal at ignition. Severe launch rod tip off or high winds have also been known to cause a cruise missile attitude.

Curative: The chemical compound used to “cure” or harden epoxy compounds such as fiberglass or polyester resins, which use MEK peroxide or the propellant binders HTPB or PBAN, which use isocyanate compounds. The curative for propellant binders can cause allergic sensitization with repeated exposures, or lung damage an/or death with ingestion

or inhalation so caution must be taken with use. Certain two-part paints and expanding polyurethane foams also use isocyanates for a curative.

Davis Douche: A method of igniting clustered motors by using a piece of fuse in each motor with all fuses dropping into a pie plate that has been dusted with black powder and taped to the bottom of the model. A single igniter in the black powder "flashes the pan" igniting all the fuses at once. Developed in the early '60s by Joel Davis and detailed in an early Model Rocketry Magazine in late 1968 or early 1969. Also called “flash-in-the-pan” ignition. This method was used for the record 169 motor cluster ignition at LDRS-3.

Degassing: The process where gas bubbles are eliminated from a propellant mixture after the curative is added but before the propellant is cast. This is done to eliminate voids in the cured propellant, which can affect the burn rate. The mixed propellant is subjected to a hard vacuum, which causes much of the suspended gas and even gas held in solution to be eliminated from the mixture. Professional propellant manufacturers will mix and cast the propellant under vacuum.

Delay Train or Delay Charge: Pyrotechnic material in the rocket motor which burns slowly between the propellant charge and the firing of the ejection charge. This allows the rocket to coast towards apogee and slow down to deploy the recovery system at low speed. It also generates smoke that allows the flyer to track his rocket at altitude.

Density: The measured propellant weight in pounds per cubic inch (lb/in^3).

Deployment Bag: A bag constructed of some fireproof material such as Nomex, in which a rocket's parachute is packed. The bag serves to protect the parachute from hot deployment charge gasses, and assists in the orderly deployment of the parachute to prevent shroud line and shock cord tangling.

Dog Barf: Slang for flame retardant cellulose insulation, as used as recovery wadding in low and mid-power rockets. Replaced fiberglass insulation as wadding because of environmental concerns. (See “Wadding”)

DOT: US Department of Transportation. The Federal agency responsible for regulating all ground and air material transportation in the US. All composite rocket propellant needs to be “DOT Certified” before it can be sold and shipped.

Double Base Propellant: A solid propellant consisting of two monopropellants (usually nitroglycerin and nitrocellulose) and various additives. Double base propellants are used as smokeless powders in ammunition. They are also used in smaller military rockets but have been largely replaced by composites in larger vehicles. Double base propellants are not used in hobby rocketry. See also "Composite Propellant"

DQ: Disqualified flight. (See also ‘Midwest Qualified’)

Drag Coefficient (Cd): A dimensionless number used in aerodynamics to describe the drag of a shape. This number is independent of the size of the object and is usually determined in a wind tunnel. It is part of the basic drag equation F=.5*rho*V^2*Cd*A where F is the drag force, rho is the air density, V is the air velocity and A is the cross sectional area. All of these, except Cd, are directly measurable in a wind tunnel so Cd can be thought of the "fudge factor" that accounts for all of the aerodynamic peculiarities of a shape. The Cd for most sport type hobby rockets is in the range of .4 to .5. (See also "Reynolds Number")

Drag Form Factor (CdA): The Drag Coefficient (q.v.) of an object multiplied by its cross sectional area. This is used to scale the drag value for a particular object from the dimensionless Cd. Theoretically, every object of a similar shape will have the same Cd regardless of its size, meaning that both a grain of rice and a Zeppelin would be the same. Multiplying by the area allows comparisons of the true drag between dissimilar objects. (See also "Optimum Mass")

Drag Race: An event, usually informal, in which multiple rockets are launched simultaneously, usually the same rocket kit with the same size and type of motor. This can be spectacular if large and/or sparky motors are used.

Drag Recovery: Recovery method using the shape of the model to slow the model down enough for safe recovery. Used only in small model rockets. Also called Tumble Recovery. Lower stages of multi-stage model rockets use tumble recovery.

Drag Separation: (See "Lovelace Effect")

Drogue Parachute: Small, heavily reinforced parachute designed to slow the rocket so safe release of the larger main chute(s) is possible at lower altitudes. (See "Dual Deploy")

Drop Staging: In a multi-stage rocket, the dropping of airframe/fin sections with expended rocket motors during flight. Two, three and four stage rockets are not uncommon. On low-power rockets, the stages are usually light enough as not to warrant a recovery system for each stage, but this is mandatory for high-power rockets. Also once referred to powered side pods which would separate from the main airframe upon burnout by aerodynamic drag. This technique is not longer allowed by the TRA. (See "CHAD Staging")

Dual-Deploy: A method of recovery for high power rocket with employs an electronic timer or altimeter to detect apogee where a small black powder charge will separate the rocket and a small parachute will slow its decent to a lower altitude where the main parachute will deploy. This eliminates long walks to recover rockets in high winds.

Effective Exhaust Velocity: (See "Impulse (Relative)")

Ejection: Refers to the actual separation of two pieces of the rocket airframe at apogee caused by a pyrotechnic charge or mechanical system and the deployment of a recovery device from a rocket. The "ejection delay" is the amount of time between motor burnout and the deployment of the recovery system. Also referred to as an "ejection event".

Ejection Baffle: A device used in some rockets to eliminate the need to use wadding to protect the recovery system. Usually composed of some type of metal wool or mesh to absorb the heat and burning particles of the ejection gases before they reach the recovery compartment. With extended use it can clog and become a fire hazard. Or can be restrictive if designed poorly, preventing easy or full recovery system deployment. Usually only used in mid-power commercially produced rocket kits.

Ejection Charge: A small quantity of black powder used to generate positive gas pressure within the rocket airframe to deploy the recovery system. This is activated when the delay train (q.v.) burns through. On rockets with electronic ejection timers, this may be a separate small container of black powder, which is triggered by a signal from a radio control device, timer or altimeter.

Electric Match or E-Match: A type of igniter originally designed to set off fuse-type blasting caps (i.e. a match that can be set off from a great distance electrically). It requires a very low electrical current (~50 mA range) to activate. Purchase and storage of electric matches requires a LEUP. (See "Squib")

End-Burner/End-Burning: A "cigarette burning" grain inhibited or case bonded on the external surface burning only on its face. Most black powder motors are end-burners, or "cored end-burners". Composite end-burners didn't exist until Composite Dynamics released the E9 motor in 1980. Composite end-burners are common today. Also used to describe a certain type of composite motor ignition malfunction; that is igniting the motor at the bottom of the core instead of the top.

Enerjet: A division of Centuri Engineering Company that produced composite rocket motors and high power kits from 1970 to 1975. At the time all rocket kits were limited to a one-pound takeoff weight, so the models would have seemed very small and fragile compared to modern high power rockets. Enerjet kits and motors are very collectable today and have been cloned by North Coast Rocketry, Semroc and others.

Engine: A machine that converts energy into mechanical motion. Such a machine is distinguished from an electric, spring-driven or hydraulic motor by its consumption of a fuel (from *American Heritage Dictionary*). A term often used incorrectly in place of rocket "motor".

Erosive Burning: Increased burning rate in solid and hybrid rocket motors created by the action of high velocity gases over the surface of the combusting propellant.

Estes Industries: One of the first companies that started it all in 1959 when they introduced the Scout, a tumble recovery rocket which was this company's first model rocket. They got their start by first producing the black powder model rocket motors for Harry Stine's company, Model Missiles, Inc., who they later bought out. Estes is currently the largest manufacturer of model rockets in the world at this time.

Estes Dent: A semicircular deformation of the leading edge of the body tube cause by the nose cone snapping back and striking the body at ejection. The problem is intensified by short shock cords, which don't absorb as much energy before reversing and give the nose a closer target with better aim. So named due to that company's policy of providing very short shock cords in their kits.

Event: Something that happens to the rocket during flight, such as air starting of motors, staging, apogee separation or main parachute deployment. Not always a good thing. (See "Shred")

Expansion Ratio: The ratio of the area of the exit diameter of the exhaust portion of a nozzle to the area of the throat - determines Cf (thrust coefficient).

Experimental Rocket: (See "Amateur Rocket")

Experimental Rocketry: (See "Research Rockety")

Experimental Spacecraft Society: An amateur group whose purpose is to orbit a small (10" to 16") telescope for use by amateur astronomers. While not directly in the propulsion end of experimental rocketry, it is very much in the same philosophical vein. Director is Linda Kenny-Sloan who can be reached at:

Experimental Spacecraft Society
17701 South Avalon Blvd.
Carson, CA 90746
Internet: l.k.sloan@genie.geis.com

FAA: Federal Aviation Administration. This is the organization that governs airspace in the U.S.

FAR 101:The Federal Aviation Regulation by which the FAA determines the procedures to be followed for launching non-professional rockets. The rule is quite involved and beyond the scope of this document but briefly, it divides the hobby into three categories for the purpose of regulation:

1) Model rockets with a gross launch weight of less than 1 pound or containing motors with less than a total of 113 grams of fuel are exempt from FAA involvement if launched more than 5 miles from an FAA controlled airport.

2) Large model rockets which exceed the FAA definition of a model rocket but otherwise fall within the NFPA 1122 definition of "model" (i.e., between 1 and 3.3 pounds liftoff weight and between 113 and 125 grams of total fuel) must notify the nearest Air Traffic Control center (ATC) between 24 and 48 hours prior to the launch. There are further restrictions when launching within five miles of an FAA controlled airport.

3) High power rockets (weighing more than 3.3 pounds, containing motors with a total of more than 125 grams of fuel) require a formal waiver be approved by the FAA and activated prior to the launch. There are further restrictions when launching within five miles of an FAA controlled airport.

FAI: The Federation Aeronautique Internationale. An international organization located in Paris, France that tracks world records for aeronautics and aero modeling.

Fiberglass: A man-made material consisting of glass fibers spun and woven into a mat-like cloth adhered to a rocket with epoxy resins. It is used to add strength to high power rockets, so that they can withstand higher-powered motors than they otherwise could. Although fiberglass is a commonly used word, it is actually a trademark of Owen-Corning Inc.

Fillet: A reinforcement of the joint between the fin and the body tube of the rocket to improve the rocket's aerodynamics and to strengthen the fin mount. White (Elmer's) glue is often used in model rockets but in high power rockets epoxy is the glue of choice, often mixed with micro-balloons or another filler. (See also "TTW")

Fins: Are usually planar surfaces placed at right angles to the body tube and provide stable flight. Can be made of balsa, plywood, fiberglass, carbon fiber or aluminum. Without fins (or other special arrangements), the rocket will not fly in a straight line.

FIREBALLS: Also called just "BALLS". An experimental rocketry/HPR launch hosted by AERO-PAC (q.v.). Against the wishes of its founder, "Fire" was placed in front of "BALLS" from 1993-95 to placate those few who had a problem with the name. The 1993 FIREBALLS was sponsored by Tripoli for the purposes of insurance coverage, and after that they decided to "adopt" the event with a name change.

Flame Bucket: An opening at the base of a launch pad to allow the exhaust to vent. One side is angled to form a blast deflector to prevent the rocket exhaust from directly hitting the ground.

Flameproof Recovery Wadding: Most often refers to the chemically treated toilet paper sold by Estes Industries for protection of the plastic parachutes from ejection gases in their model rocket kits. Not used in large or high power rockets.

Flashbulb: A magnesium and oxygen filled glass bulb, once commonly used in film photography. In rocketry, flashbulbs are used to ignite thermalite fuses or black powder charges for second stage ignition or recovery device deployment. They have the advantage of requiring very low voltage and current to fire them (usually only 3v). However, this attribute also makes them susceptible to accidental activation by static electricity. Many prefer using flashbulbs instead of electric matches for recovery system because of the occasional difficulty in obtaining electric matches.

Flash-in-the-Pan Ignition: (See "Davis Douche")

Free-fall: The fall of an object without guidance or retardation other than through drag. Usually not a good thing.

Friction Fit: The joining of two objects, relying not on adhesive but on the interference fit caused by one object being inserted into another, such as the nose cone inserted into a body tube.

FSI - Flight Systems Inc.: A 1960's rocket company noted for their large E and F black powder motors, called "Load lifters". All their motors didn't follow the standard size form-factor, with their A-D motors being 21mm (as opposed to 18 or 24mm). Their E60 and F100 motors were often used in clusters in early high power rockets. They also made rocket motors for Hollywood special effects companies. The company shut down in 1994. Restarted with a new owner in 2014 but have no products available to date.

G-10: A grade of fiberglass commonly used for fins on high power rockets. G10 designates a laminate made of fiberglass cloth laid in epoxy resin.

G-Switch: A mechanical device, which detects the presence of acceleration through the movement of a weighted electrical contact. G-switches are normally used in combination with other electronic devices such as altimeters and timers.

Glassing: The process of laminating rocket components, such as fins and body tubes, in fiberglass cloth, which is soaked in epoxy resin. This process greatly increases the strength of the item being "glassed".

GPS (Global Positioning System): A position/location service provided by the US Government via a constellation of LEO satellites; good for identifying the exact location of your launch site; some newer flight computers are providing a GPS interface.

Grain: Any size of monolithic propellant structure designed to be combusted as rocket propellant. (See "Bates Grain")

GSE: Ground Support Equipment. Anything you bring to the launch site, which is necessary to fly your rocket, but doesn't actually fly with it. Obvious examples are the launch pad and launch controller. The term was popularized by HyperTek to describe their hybrid motor launch support system.

Hang Fire/Misfire: Terms, which refer to abnormal ignition. With hang fire, the motor usually ignites after a considerable delay. Misfires never ignite. Hang fires often appears as a misfire until the motor ignites some time later. This is the main reason the safety code advises not to approach a misfired rocket for one minute.

Head End Igniter: An igniter that is installed on the top of a motor in place of the forward end closure; this type of igniter is currently non-standard but is being used experimentally. This arrangement is not uncommon on professional rockets.

High Power Rocket(ry) (HPR): Hobby rockets that exceed the total weight, total propellant or single motor total impulse restrictions of model rockets as defined in NFPA 1122 (q.v.) but otherwise conform to the same guidelines for construction materials and pre-manufactured, solid propellant motors. High power rockets have no total weight limits, but do have a single motor limit of no more than O power (40,960 NS total impulse) and have a limitation of 81,920 NS total impulse.

HMR: The Handbook of Model Rocketry. The official NAR handbook for the hobby. Originally written by G. Harry Stine (NAR #002) the first edition came out in 1965 and currently in it's seventh edition. It has expanded its scope with the hobby by adding computer programs in the fourth edition and giving a nod towards the existence of HPR in the sixth edition. Currently being edited by Bill Stine (Harry's son) after Harry's death in 1997.

Hobby Rocket: A general, collective term used to describe both model and HPR rockets to differentiate them from amateur/experimental rockets. Also called: Hobby Rocketry, or in the case of motors, Hobby Rocket Motors.

HPR Lite: A term once used to describe rockets using motors in the 'E', 'F', and 'G' power classes. Now called "Mid-Power Rocketry". It describes rockets, which fall between the old NFPA 1122 weight limit of 1 lb (454 grams) and the current model rocket weight limit of 1500 grams. Rockets in the 'E' through 'G' class aren't normally considered high power rockets but, to be successful, must be built using many of the same construction techniques as the larger rockets. Also, any rocket over 3.3 lb requires an FAA waiver to fly legally.

HPRM: High Power Rocketry Magazine - formerly "Tripolitan" (q.v.). A no longer published independent magazine dealing with all aspects of consumer rocketry, but with a definite emphasis on high power, advanced and experimental consumer rocketry. Published six times a year. A subscription was included with membership in Tripoli, but could be had separately. Also available on magazine racks in larger hobby stores. Replaced as the official Tripoli journal by "Rockets" magazine. Prior to HPRM, another high power rocketry magazine called simply "HPR" was published in Ohio in the early 80's. More akin to a club newsletter than an actual magazine, it had limited circulation, similar in size and scope to California Rocketry magazine.

HTPB: Hydroxyl-terminated polybutadiene; a common binder used in composite rocket fuels. The two main types of R45 used in APCP are R45M and R45HTLO. (See “Binder”)

Hybrid: Refers to the use of mixed states of matter in a bi-propellant system - solid-liquid, gas-solid, etc. Either oxidizer or fuel may be the liquid or gas component.

Hyperterminal Velocity: A situation where a rocket is traveling faster than terminal velocity (q.v.) for a given motor. This is possible, for example, with a staged model with grossly mismatched motor combinations such as an F motor staged to a B motor. At staging, the upper stage will already be beyond its terminal velocity for the "B" motor. In this case, the upper stage will actually decelerate during thrusting and approaches terminal velocity from above.

Igniter: An expendable electrically initiated pyrotechnic device used to ignite a solid rocket motor. Composite motors require a different type of igniter than black powder rocket motors.

Impulse (Relative): A measure of the efficiency of a rocket engine. Similar to Specific Impulse, it is defined as the Total Impulse (q.v.) divided by the mass of the propellants. A little dimensional juggling shows that this gives the same units as velocity (ft/sec or m/sec) hence is sometimes called "Effective Exhaust Velocity." How quickly the reaction mass leaves the nozzle is a good measure of efficiency.

Impulse (Specific): A measure of the efficiency of a motor/propellant system. It is determined by taking the Total Impulse (q.v.) and dividing by the weight of propellants. This carries the potentially confusing units of "seconds" (as if it had something to do with the burn duration) but is due to weight and thrust both being force parameters hence canceling out (e.g. lb-sec/lb or N-sec/N). This is actually very handy since it makes the term independent of the units system (metric or English) since they both use "seconds" for time.

Impulse (Total): A measure of the total momentum imparted to the rocket by the motor. It is defined (for those who know calculus) as the integrated area under the thrust-time curve. For the rest of us, it can be thought of as the motor's average thrust times the duration of the burn. Measured in N-sec or Lb-sec.

Kato: Not one of OJ’s fans. (See “Cato”)

Kevlar: A synthetic fiber, originally woven into mats for use in bullet-resistant body armor. Kevlar is highly resistant to tearing or burning. Kevlar thread is used in some model rockets as a shock cord. In model rockets, this provides the advantage of allowing the cord to be anchored to the motor mount rather than to the open end of the airframe. This design is less susceptible to zippering and burning. Larger-diameter Kevlar cord is increasingly being used as shock cords on high-power rockets for the same reason, and because Kevlar is stronger than bungee or elastic straps. Kevlar is also woven into sheaths or bags, and used to protect elastic shock cords and parachutes in larger rockets. (See “Deployment Bag”)

Kicked: A term used to describe a motor, which is ejected from the rocket while in flight instead of ejecting the recovery system. This often results in a “Prang”(q.v). It is usually caused by not fitting the motor into the motor mount properly.

Kitbash: Taking two (or more) kits and combining ("bashing") them into a new design. Origin: The term appears to have come from the model railroading hobby where kits for buildings and other diorama items have, for decades, been modified from their original intent to suit the needs of a particular layout.

KN: Potassium nitrate; the oxidizer used in “sugar motors”. Also the definition of the propellant surface burn area divided by the throat area at motor start up (Kn).

Krushnic Effect: A very dramatic phenomenon where your rocket makes a tremendous amount of noise and smoke but doesn't go anywhere! This happens when the motor is recessed into the body tube by more than one tube diameter. If so recessed, the cylindrical volume below the motor forms a secondary expansion chamber, which allows the exhaust gasses to expand below atmospheric pressure before leaving the rocket. Surrounding air aspirated into the exhaust

stream causes turbulence, which negates much of the thrust, along with creating the characteristic roar. A multi-stage model that ejects its booster motor, but not the airframe, is a perfect example. Named for Richard Krushnic, the rocketeer who characterized the effect in the late '60s. Not to be confused with "Suction Lock" (q.v.).

L!, L2, L3: Levels one through three: reference to the three levels of high power rocketry certification. Unless you are in Canada, Eh?

Land Shark: A rocket that has failed in such a way that it ends up hitting the ground while still under power. Upper stages of unstable multi-stage rockets often end up like this, as do some (too) heavy HPR rockets with long-burning, low thrust motors, or cluster rockets in which all motors do not ignite.

Launch Controller: An electrical device used to activate the motor igniter, which in turn ignites the motor. The launch controller should always incorporate a lock-out device such as a key, to prevent accidentally activating the igniter before the rocket is ready to be launched.

Launcher: A launcher is required to hold the rocket in a vertical position and guide it straight during the beginning of its flight (before the rocket gains enough airspeed for the fins to take effect). The most common kind of launcher is a base with a thin steel rod attached to which the rocket mounts with a "launch lug."

Launch Lug: Typically a section of 1/8" to ¼" diameter paper tubing attached to the rocket at its center of gravity and used to guide the rocket during initial powered flight by a steel rod attached to the launch pad. Used primarily in low and mid-power rockets.

Launch Rail: Typically a single six or eight foot long section of 1" or 1.5" 80/20 structural rail used in conjunction with "rail guides" to guide high power rockets during their initial flight. The launch rail has replaced launch rods greater than ¼" on most launch ranges. It has the advantage of being stiffer and not suffering "rod whip" during powered boost.

The Laundry: Slang term for recovery components, especially the parachute(s).

Lawn Dart: Similar to a "Core Sample" but requires the nosecone to remain in place prior to impact. Named after a popular (but dangerous) lawn game of the sixties in which large darts were thrown into the air to land inside rings placed on the ground about 25' apart (as in horse shoes).

Liner Tube: Used in reloadable motors. A tube, usually paper or phenolic, that holds the propellant grains inside the motor case. Acts as additional insulation and protection for the metal motor tube.

LCO: Launch Control Officer: the individual responsible for safe operation of the launch range.

LDRS: The annual national high power sport launch sanctioned by Tripoli. LDRS stands for 'Large and Dangerous Rocket Ships,' the derivation of which is best left to others. Note: LDRS has NEVER stood for 'Lets Do Rocketry Safely', despite what you hear from historical revisionists trying to mollify public officials. Originated in Medina, Ohio in 1982. The first five LDRS events were held there before moving to Colorado and other states.

LEUP: Low **E**xplosives **U**ser **P**ermit. A BATFE permit previously required to purchase high power rocket motors. No longer needed for motors but still needed for purchase of igniters and black powder. A Magazine Permit is still needed to legally store black powder and certain igniters, including electric matches.

Lovelace Effect: A phenomenon where the nose cone is apparently "sucked" out of the body right at motor burnout. It is more prevalent on parabola, ogive and other low drag nose shapes. First observed with Dual Egg Loft models using the CMR egg cones. The theory (as yet unproven) is that since the nose cone has much less drag than the body, its momentum tends to carry it forward faster (or, more correctly, the body's drag decelerates it more quickly) putting tension on the nose-body joint. The condition is exacerbated by any nose weights added for stability (which also raise the momentum of the nose) and/or a loose fit of the nose in the body. Another possible contributing factor could be

the denser air (trapped in the body tube from ground level) exerting pressure on the nose cone once the rocket reaches a higher altitude. The term is named after an early '70s pornographic movie actress who had certain oral skills. First coined by the SNOAR NAR section who were frequent Dual Egg Loft flyers and avid moviegoers.

Low Power Rocketry: Typically rockets flying on motors in the A to D range, usually weighing less than one pound or 500 grams.

Mach Diamonds: A diamond shaped pattern that develops in the supersonic flow of gas from a rocket nozzle; these are caused by shock waves, which reflect off of the pressure boundary between the exhaust plume and the ambient environment.

Magnelite™: An igniter made by Rocketflite used mainly to start composite motors. A medium power device (2-3 amps at 12 volts), it requires significantly more than an electric match (q.v.), but not as much as a Copperhead (q.v.). It consists of a nichrome bridge wire dipped in a magnesium-based pyrogen, which burns very hot (~6000F), aiding in the ignition of stubborn composites, such as sparky, smoky or certain colored effect motors. The head can be quite large so they work best in motors with larger nozzles and cores. Sometimes used as a generic term to describe any igniter pyrogen.

Mandrel: A rod or bar, usually nylon or Delrin used as a core around which a material is molded, cast, or wound; typical uses in rocketry are to form the core in a propellant grain, to make an airframe, or mold a nosecone.

Marginal Stability: Rockets with a static margin between 0.5 and 1.0 caliber are considered to be 'marginally stable'. These rockets may fly fine, but extra attention must be given to the wind conditions, thrust-to-weight ratio, and launch rod velocity. For example, short stubby rockets with a length-to-diameter ratio of under 10 typically will be stable with under one caliber of static margin.

Mass Launch: A launch of large numbers of rockets, usually small model rockets, at the same time. The Guinness world record was captured by launching 3,973 model rockets at the same time on October 29, 2014, during Rocket4theCure, a campaign created to raise $20,000 for breast cancer research and awareness, according to the World Record Academy. The previous Guinness World Records world record was 3,130 rockets launched at the same time. (See also “Drag Race”)

Max-Q: The point during the powered flight phase of a rocket's ascent at which acceleration stresses on the airframe are the greatest. This is the point at which a “Shred” is most likely to occur.

Micro Clips: Small, toothless electrical clips commonly used to connect the launch system to the thin nichrome igniter wire on black powder model rocket motors. Larger toothed clips are used in HPR but usually called “igniter clips”.

Mid-Power Rocketry: The term describes rockets, which fall between the old NFPA 1122 weight limit of 1 lb (454 grams) and the current model rocket weight limit of 1500 grams. Rockets in the 'E' through 'G' class aren't normally considered high power rockets but, to be successful, must be built using many of the same construction techniques as the larger rockets.

Midwest Qualified (flight): During the 1970's, NAR contest flyers circulated a persistent rumor that meets held on the East Coast were held to a much higher standard of flight qualification than those flown in the Midwest. The Contest Board steadfastly maintained that contest rules were uniformly enforced. The differences in flight qualification occasionally surfaced at NARAM. If an RSO qualified a flight that many people felt should not have been, his or the flyer's geographical location came under scrutiny. While no rule changes or procedures were modified, flyers continue to refer to those marginal flights squeak through as "Midwest Qualified." The term also gained popularity when a group of competitors from the SNOAR section in Cleveland began offering at NARAM the "Best Midwest Qualified Flight" award. A collection of wreckage of NARAM's prangs, large and small, were attached to a large sheet of cardboard, along with local flora, fauna, tourist brochures, food wrappers, etc. SNOAR members then decided who had the best prang of NARAM, and presented the "trophy" to the "winner" at the awards banquet. Nomination was cause for pain enough, but winning made one a legend in his own time.

MIF: Missing In Flight. A rocket that disappears with no sign of the recovery system deployment, and no other obvious failure mode (e.g. Prang or CATO). Sometimes called "into orbit."

Minimum Diameter: A rocket built with the smallest possible diameter body tube for the size of motor casing. Usually done to reduce drag in sport or competition models even though it can increase the difficulty of attaching fins and recovery systems. (See also "Boosted Dart")

Mini-Max: A line of high power D-F black powder motors sold by Centuri Engineering before the introduction of their composite Enerjet line. Discontinued in 1969. Centuri bought the technology from Atlas Rocket Motor Company in the 1960's, who, along with Coaster Corp., made black powder motors up to G class.

Model Rocket: An aero-vehicle that ascends into the air by means of a reaction motor, but without the use of aerodynamic lifting surfaces. The restrictions, as defined in NFPA 1122, are as follows: The gross launch weight, including motor(s), will not exceed 1500 grams. Motor(s) will not exceed 160 NS of impulse (total) and/or contain more than 62.5 grams of propellant each, and no more than a total of 125 grams of propellant in multiple motor applications (clusters and/or multi-stages). All components of said vehicle will be of wood, paper, rubber, and breakable plastic or similar material and without substantial metal parts. See also "FAR 101" and "NFPA 1122"

Model Rocketeer: The original NAR newsletter. First published in the AMA magazine as a single column. Later published as an insert to MRM (q.v.) while it lasted and thus available to non-NAR members for a while. After MRM folded, it was again published stand-alone and gradually expanded to a magazine style format. It became "American Spacemodeling" (q.v.) in July 1984, although there continued to be a section called "The Model Rocketeer" for the NAR president's column and other association news (just like in MRM!) which became the "President's Corner" in 1992. Now called "Sport Rocketry".

Modroc: Model Rocket. Also seen as 'modrocer', or similar spelling, to mean 'model rocketry enthusiast'.

Monopropellant: (See "Single Base Propellant")

Moon Burner: A grain geometry where the cylindrical core is offset and touches the outer wall of the grain; a moon burner is regressive throughout its burn.

Motor: Something that imparts or produces motion, such as a machine or engine. The motive force causing a rocket to take to flight. A device that converts any form of energy into mechanical energy (from *American Heritage Dictionary*). Solid fuel propellant devices are called "motors" (despite what Estes says) because there are no mechanical moving parts, which is the definition of an "engine".

Motor Class: The commercial motor class letter designation and the average thrust in N-s. Also shown is what percentage (%) of that letter class the motor actually is.

MRM: Model Rocketry Magazine - An early attempt at a "news rack" style rocketry magazine. It attempted to do for rocketry what "Model Railroading" did for that hobby or "RC Modeler" did for model airplanes, namely create a forum where the whole industry could talk directly to the hobbyist without limiting him to a single company (e.g. the MRN or AR) or making him join an organization (e.g. the NAR). What it actually proved was how tiny the hobby was back then as it only lasted a bit over three years from 10/68 through 1/72 then quietly folded. Despite the crude graphics and generally marginal production values, the magazine was treasured by its small band of followers and copies are in great demand today. Photocopies are circulated by an "old boy network" at meetings and swaps. While it lasted, it also incorporated "The Model Rocketeer" the NAR newsletter that later became "American Spacemodeling" and still later "Sport Rocketry" (available off the rack in larger hobby shops). "HPR Magazine" (q.v.), the Tripoli journal, likewise started as a captive publication for TRA, which was later taken private.

MRN: The Model Rocket News - The oldest continuously published rocketry periodical. Started by Vern Estes and his small crew in 1960, it is still sent to all of Estes's active mail order customers. Somewhat sophomoric in style, it contains

a great deal of practical information, especially for beginners. It has survived a bewildering array of changes in format over the years, but is still published three or four times annually.

MSL: Mean Sea Level.

Murphy's Law: The guiding principle of Rocketry preparation: "If anything can go wrong, it will."

NAR: National Association of Rocketry. A national hobby organization promoting model and high power rocketry in the United States. The NAR promotes rocketry related sport flying, competitions, and education.

NARAM: National Association of Rocketry Annual Meet. The NAR national model rocket competition championships, held in August of each year at a different location.

NARCON: National Association of Rocketry Annual Convention. An annual event sanctioned by the NAR oriented towards non-competitive (i.e., sport) model and high power rocketry. It includes seminars, R&D presentations and lots of sport flying. Held at a different location each year. Replaced the Pittsburgh Spring Convention (PittCon) and MITCon, the model rocketry convention held at MIT in Boston, both which ceased to be held in the late 70's. Previously, the Kent State Model Rocketry Convention (KentCon), a replacement for both discontinued conventions was held from 1980-83.

NARTS: National Association of Rocketry Technical Services. A service provided by the NAR for both members and non-members. NARTS stocks rocket plans, technical reports, and other items of interest to rocketry enthusiasts. NARTS may be reached at:

NAR Technical Services (NARTS)
P.O. Box 1482
Saugus, MA 01906
CompuServe account: 73320,1253

Neutral Burn: When the thrust of the motor is relatively flat throughout the burn. (See also "Burn", "Progressive Burn", and "Regressive Burn")

Newton & Newton-second: Metric units used to measure thrust and total impulse (q.v.) respectively. One pound = 4.448 newtons.

Nichrome: An alloy of nickel and chromium drawn into a wire of varying gauges typically used to heat a pyrogen to ignition with the application of sufficient voltage and amperage. Before the advent of pyrogen-type igniters, bare nichrome was used for the ignition of black powder model rocket motors.

Nitrous Oxide: Gaseous oxidizer used in current hybrid rocket motors. Also called NOX. There are several grades of nitrous available, with industrial grade, the type used in nitrous injection systems for cars being the most common for use with hybrid motor systems. It has an adulterant added which renders it unbreathable.

Nomex: A lightweight, fire-resistant Nylon fiber, originally woven into fireproof garments for fire fighters, racecar drivers and astronauts. Also commonly used in aircraft upholstery. In hobby rocketry Nomex is used as sheaths and bags to protect elastic shock cords and parachutes. (See "Deployment Bag")

NOS: Acronym for "**N**ew **O**ld **S**tock." Often used to describe old black powder MR or HP composite motors still available for sale and use. It isn't unusual to see 20+ year-old composite motors still being flown at Research launches. Not to be confused with NOX. NOS is also the shortened name of Nitrous Oxide Systems, a manufacturer of nitrous oxide gas injection systems for race cars.

Nose: The forward end of a rocket. The tapering (pointy) part of the rocket is often referred to as a "nose cone," even though the shape is rarely conical.

Nozzle: The portion of the rocket motor which accelerates the exhaust gases to supersonic velocity at the narrowest part of the nozzle (the throat) then expands them to greater velocity in the exit cone. These are usually made from graphite or phenolic.

NSL: National Sport Launch. An annual, national high-power sport launch sanctioned by the NAR. It was originally held in February of each year so that it is midway between NARAM national meets, but that limited it southern and western states. Now it is held over the Memorial Day weekend. Started as a NAR alternative to Tripoli's LDRS launch.

NFPA: National Fire Protection Association. A private for-profit organization responsible for crafting rules and regulations dealing with fire safety issues, which are beyond the expertise of local agencies. The NFPA is NOT a government agency and has no enforcement power of its own. It gathers experts in various fields to write safety regulations for adoption by local fire agencies (at the discretion of the Fire Marshal). The current NAR Model Rocket Sporting Code was developed by the NAR and NFPA. Both the NAR and Tripoli are members of the NFPA.

NFPA 1122: The current NFPA regulation defining Model Rocketry. This document defines a model rocket as having less than 1,500 grams total launch weight, containing less than 125 grams of fuel (no more than 62.5 grams in any one motor), and no more than 160NS total impulse in all motors (no individual motor having more than 80NS of total impulse).

NFPA 1127: The NFPA regulation defining High Power Rocketry. The draft provisions of 1127 (not yet ratified) defines HPR as follows: High power rockets have no total weight limits, but do have a single motor limit of no more than O power (40,960 NS total impulse) and have a total limitation of 81,920 NS total impulse.

NXRL: The National Experimental Rocket Launch. A term rarely used. (See "BALLS" and "Fireballs")

O-Ring: A round rubber gasket used to contain combustion gasses in solid rocket motors, or liquid nitrous oxide in hybrid motors.

October Sky: A movie about a group of boys in a coal town in West Virginia who build their own rockets. October Sky is responsible for much new interest in the hobby. The movie was based on the book "Rocket Boys" by Homer Hickam, Jr. The name for a fall launch formerly held by the Erie Rocket Group (ERG).

Oddrocs: A rocket not shaped or configured like a traditional rocket. These can include pyramids, spools, saucers, or anything else that normally doesn't fly.

Ogive: A shape defined by the intersection of two circles. It is not the same as a parabola (q.v.). Both ogives and parabolas produce low drag sub-sonic nose shapes. They can be told apart since a parabola always has a rounded nose while an ogive comes to a point.

OOP (Out Of Production): A rocket kit or other rocketry product no longer currently made, but many times remembered fondly from the past. Many discontinued Estes and Centuri rocket kits are highly prized by BAR's and have high collector value.

Opacifier: An propellant additive, usually lamp black or aluminum, which makes the propellant opaque in order to limit excessive infrared propellant preheating. A translucent propellant will transmit and absorb infrared light energy from the combustion chamber, heating the remaining unburned propellant, which can cause an increase of the burn rate. Many early composite motors had clear propellant (no metals) and translucent fiberglass cases, which allowed you to see the motor burn on static tests.

Open Rocket: A freeware computer program that allows you to design any size rocket, and then simulate its flight to see how high, and how fast it will fly. Even before you start building your creation, you'll find out if it is stable and safe to launch.

Optimum Mass: For any given motor and Drag Form Factor (q.v.) the liftoff mass for which a rocket will reach maximum altitude in dense atmosphere. At first this might seem to be just the lowest possible mass, but there is a two edged nature to mass covering both powered flight and coasting. Lower mass will give higher burnout velocity, but will dissipate its momentum to drag faster. Conversely, a heavier rocket will have more momentum at burnout to coast farther, but too much mass will hold down both burnout altitude and velocity. Hence, there is a "knee" on the liftoff mass vs. altitude graph.

Over Stabie: Rockets with a static margin over two calibers are considered 'over stable'. These rockets will tend to weathercock badly and may oscillate or even become unstable. Care should be given to the thrust-to-weight ratio, launch rod velocity, and wind conditions.

Oxidizer: A substance, which provides oxygen to a combustion process, aiding in the speed and efficiency of combustion. The addition of an oxidizer to the chemical process of combustion can cause a fuel that would barely burn under normal atmospheric conditions to burn so enthusiastically that it can be used as a rocket propellant.

Pacific Rocket Society (PRS): An experimental rocket organization which experiments with amateur rockets both solid and liquid fueled, although mostly the latter. It is a very old organization by hobby standards with roots dating back to the '50s thus predating hobby rocketry in its current form. They launch in the Mojave Desert from facilities leased from the Reaction Research Society (q.v.). Their mailing address is:

Pacific Rocket Society
1825 Oxnard Blvd., Ste. 24
Oxnard, California 93030

Pad Manager: Person responsible for assigning pads and controlling the launch pad area. Helps rocket flyers set up pads and rockets for flight.

Parabola: A shape produced by the formula y=x^2. Used to produce low drag nosecones. (See also: "Ogive")

Parachute ('**chute**): The most common rocket recovery system and the only one used with larger rockets. Model rocket often use flat plastic "parasheets" which are attached to the rocket with tape and thread. Larger rockets use true parachutes made of rip-stop nylon or silk because of the size and weight of the rockets being recovered.

Parachute Protector: Also called a “recovery blanket” or “flame resistant blanket”. A piece of fireproof cloth, usually Nomex, used to protect the recovery device from damage caused by the hot gasses of the ejection charge. In low and mid-power rockets, the traditional Estes “flameproof recovery wadding” (actually toilet tissue soaked in boric acid to make it fireproof) or “Dog Barf” is used.

Payload: Anything carried aloft by the rocket that is not part of the rocket itself. Common payloads include altimeters, computers, cameras, and radio transmitters. The Safety Code specifically prohibits the launching of live payloads.

PBAN: Polybutadiene Acrylic Acid Acrylonitrile prepolymer; another binder used in APCP. (See “Binder”)

Pink Book Lawyer: Any NAR member who uses his own many times loose interpretation of the Associations competition rules (called The Pink Book) to allow his questionable flight to be ruled qualified.

Phenolic: A heat-resistant plastic most familiar as the material from which plastic ashtrays are made. When mixed with carbon black, it is used to make casings for composite propellant rocket motors. Several manufacturers, such as Public Missiles also sell phenolic airframe tubes.

Pilot Chute: A small parachute attached to the apex of a large main parachute, and so oriented that it emerges from the airframe first. Air drag from the inflating pilot chute assists the main chute to exit the airframe, pulling it out apex-first so that it is less likely to tangle. Not to be confused with “Drogue Parachute”

Plasmajet: A high power rocket motor company founded by Randy Sobszak and John Krell. Tested and sold 29mm composite motors to local rocketeers at Lucerne, CA launches from the late 70's to early 80's. Had motors certified by TRA in early 90's but ceased production because of severe manufacturing and shipping restrictions. Other motor companies put out of business for the same reasons at this time were Synerjet/R3, Propulsion Industries, Energon and Rocketflight. Plasmajet motors still occasionally show up at Research launches.

Plasticizer: A chemical additive, which makes the composite propellant mixture more fluid during the mixing process thus allowing a more homogenous distribution of the chemicals in the binder, in addition to making it easier to mix and reducing mix times.

PMC: Plastic Model Conversion. The term used to describe a plastic, static model of some type (typically an aircraft, rocket or spaceship) that has been converted to fly as a model or high power rocket. This term is also used as an abbreviation for an NAR-sanctioned competition using converted models.

Power Shred: (See "Shred")

Prang: Term describing a failure mode whereby a rocket comes down aerodynamically stable, in other words, 'streamlines in'. This is almost always caused by some sort of recovery system failure, usually the result of a too-tight nose cone, too-tightly packed parachute or a too-loose motor that ejects out the back. Multistage models with upper stage ignition failures also result in a prang.

A Prang that occurs while the motor is still burning (e.g. a marginally unstable rocket that performs one large half loop) is called a 'Power Prang'.

> Origin: If you insist on it being an acronym, the postwar military sounding rocket program had a quasi-official failure mode category "Parachute Recovery Apparatus No Good." However, like CATO (q.v.), this is another "Post Hoc" definition. The term was in widespread use during WW II in aviation circles to describe aircraft crashes, especially experimental or military ones. Prior to use in the U.S., it was popular in Britain since at least the '30s where the expression "Prang his Kite" was equivalent to our "Auger in" or "Buy the Farm."

ProDyne - Propulsion Dynamics: A manufacturer of early high power composite rocket motors in the 60's and 70's. Operated by John Rahkonnen, a real rocket scientist who worked at Thiokol. ProDyne produced the Cyclone and Hurricane lines of motors, but only had one composite motor ever TRA certified. One of his early motors is on display at the National Air and Space Museum.

Progressive Burn: When the thrust of the motor increases throughout the burn. Typical of monolithic (one piece) propellant grains. (See also "Burn", "Neutral Burn", and "Regressive Burn")

Prototype: An initial, development design used to test out principles and concepts but never intended to be a finished or production design. In scale modeling, the original "real" rocket after which the model is patterned.

> Origin (in the modeling sense): The term comes from model railroading where hobbyists model sections of entire railroads including whole towns, mountains, lakes, etc. in addition to the engines, cars and tracks. (See also: "Scale Data" and "Scale Plan")

PTFE: Tetrafluoroethylene; (See "Teflon")

Pyramid: A rocket shaped like a 3 or 4-sided pyramid. High power versions of this are often called "flying pyramids of death" because of their tendency to fly into the ground under power. The Tripoli Rocketry Association no longer allows these, or any other "oddrocs" such as spools, to be used for Level 3 Certification attempts.

Pyrodex: A black powder substitute made by Hodgton; intended for muzzle loading firearms, it is actually considered a propellant and does not require a LEUP for purchase or storage. Not recommended for use in ejection charges but solid Pyrodex pellets are being used as propellant grain igniters in CTI motors.

Pyrogen: Liquid solution that is used to make igniters or a highly flammable substance used to ignite rocket motors; typically a liquid that igniters are dipped in. One common commercial pyrogen is Magnalite by Rocketflite.

Rail Guides (or rail buttons): Small, round "H" shaped buttons made of nylon or phenolic attached to the rocket airframe with screws and used in conjunction with a launch rail to guide the rocket during its initial flight. Used instead of "Launch Lugs", they have less aerodynamic drag.

Range Box: A box used to carry everything that you need for flying rockets on the rocket launch range.

Range head: The part of a launch site where the rocket launch pads are located.

RASP: The **R**ocket **A**ltitude **S**imulation **P**rogram. Originally written by G. Harry Stine in BASIC in the late '70s (and included as an appendix in the later editions of the Handbook), it performs a simulation of rocket flight using small time interval approximations. The original was relatively primitive assuming constant Cd, vertical flight and other simplifications. There have been several rewrites into "C" and other languages to both broaden its appeal and increase its sophistication.

Reaction Research Society (RRS): One of the oldest amateur rocketry organizations. Founded in 1943, members of this Southern California group investigate all forms of reaction based vehicles: solid/liquid/hybrid. Their current very ambitious plans include orbiting the first *completely*amateur satellite with a vehicle based on the "10K" (10,000 lb thrust) LOX/Kerosene motor now in development.

They have the decided advantage of owning their Mojave Desert launch site, which is adjacent to Edwards Air Force Base and thus protected by their "infinite" restricted airspace. They lease the use of their launch facilities to the Pacific Rocket Society (q.v.) and welcome HPR fliers to come down and fly anything as big and high as they want as long as it's prearranged and you play by their safety procedures.

For more info there is a message on the Pacific Energy voice mail system which can be accessed after 6 PM (Pacific time) on weekdays and any time on weekends (213) 725-1139, ex 777. PR coordinator: Niels Anderson.

Mailing address is:
Reaction Research Society
P.O. Box 90306 World Way Postal Center
Los Angeles, California 90009

Recovery: Rockets must be recovery safely. Getting your rocket back in once piece is important as part of a successful flight (not to mention that it allows you to fly again). The most common recovery systems are parachutes and streamers although many others have been devised, such as rocket gliders and helicopter recovery.

Red Baron: A boost glider, which has tangled with the streamer or parachute of the booster pod. The entire model tends to nose dive into the ground, like a WWI airplane, which has just been shot down.

Reef: A series of techniques used to gather the shroud lines of a parachute together to prevent it from fully opening. This is usually done on rockets that reach extreme altitudes or launched on windy days, which need higher sink rates to help them land near the launcher. There is also a "traveling reef" technique of placing a soda straw or metal washer on the shroud lines and sliding it all the way up to the chute canopy during prep. At deployment, the parachute is prevented from opening until the chute is fully deployed and the rocket stabilized beneath it. The straw/washer then slides down the shrouds allowing the canopy to open gradually. On manned parachutes, this is called a "slider". This is

used mostly on large rockets, which might have very high speed or high altitude recovery deployment since it allows the rocket to slow and drop considerably before chute opening.

Regressive Burn: When the thrust of the motor diminished throughout the burn. (See also "Burn", "Neutral Burn", "Progressive Burn")

Re-Kitted: A (painfully) humorous term that refers to any situation where a rocket goes to pieces such as a prang (q.v.) or a CATO (q.v.). Thought to have originated at LDRS XIII. Typical usage: "That M motor sure re-kitted my Black Brant!"

Relayer - Relay Launcher: A launch controller that controls electrical current to the igniter through an electrical relay. This arrangement allows the power source, usually a 12v automotive battery, to be placed close to the range head, reducing the voltage and current loss through long wires.

Reload: A complete kit containing propellant grains, nozzle, liner tube, o-rings, delay/smoke element and a black powder ejection charge used by the rocketeer to load a commercial rocket motor case.

Reloadable Motor: A rocket motor with a reusable metal case, end closures and sometimes a graphite nozzle. The rocketeer loads propellant "reloads" into the case himself instead of having the motor manufacturer do it as in the case of single-use or expendable motors. Supposedly less expensive than an equivalent sized expendable motor. Examples are the Aerotech RMS System or the Kosdon TRM System.

Research or Research Rocketry: A niche of high power rocketry in which rocketeers mix, cast and "burn" their own homemade APCP or sugar propellant, in existing commercial but sometimes in homemade reloadable casings, rather than using commercially made motors. Can also include hybrid, but not black powder motors. Formerly called "EX" (pronounced E-X) or **EX**perimental rocketry.

Reynolds Number (Rn): A dimensionless number used by fluid flow engineers to characterize the way a fluid (gas or liquid) will behave when passing over a solid surface. The number combines the fluid's density, viscosity and velocity with the length it's traveled along the surface. No matter what the fluid is or what size the surface, the flow conditions (laminar, turbulent, detached, etc.) should be the same at the same Rn. Discovered by Osborne Reynolds in the 19th Century while studying the flow of water in pipes and channels, it has proven most useful to aerodynamic engineers and naval architects in scaling up wind/water tunnel test results to full size.

R/G: **Rocket glider:** A glider, which is boosted to altitude by a rocket. The entire model glides down together. No part of the model separates, as in a boost glider. Technically, an R/G is a particular form of B/G.

Rip-Stop Nylon: A common parachute material; it is distinguished by a fine pattern of boxes (barely noticeable) that are designed to keep fabric from tearing

RMS™: Reloadable Motor System. The trademarked name of the AeroTech/ISP reloadable motors. Often used (incorrectly) as a generic name for all reloadable technology.

Road Flare: A reloadable rocket motor that has blown out one of its end-closures and is still burning propellant but producing no measureable thrust. Can cause great damage to the rocket if it is the forward closure and motor stays in the airframe.

RDC - Rocket Development Corp: A model rocket company operated by Irving Wait famous for offering the first true composite propellant rocket motor to hobby rocketeers in the '60's. The "Enerjet 8" was a 40 s-sec E motor with 8 pounds (or about 34 n-sec) of thrust. It used a fuse for an ejection delay, which the rocketeer trimmed for the desired delay time. RDC sold the composite motor technology to Centuri Engineering Company and they introduced the "Enerjet" line of E, F and G rocket motors and high power kits. RDC then shut down their model rocket division, although they continued to produce motors for professional and military contracts until about 1990. In the mid-80's RDC

produced the “Whirlwind” composite E motor for North Coast Rocketry, which was the first smoky composite motor available for sale.

Rocket and Space Foundation: An organization in Holland that supports both model and amateur rocketry and amateur astronomy. The Secretary is Marcel Verhoef, Delft University of Technology, who can be reached at:

Rocket and Space Foundation
P.O. Box 314
3350 AH Papendrecht
The Netherlands
Internet: marcel@dutct05.tudelft.nl

RockSim: A computer program that allows you to design any size rocket, and then simulate its flight to see how high, and how fast it will fly. Even before you start building your creation, you'll find out if it is stable and safe to launch.

(Launch) Rod Whip: The flexing of a launch rod during rocket lift-off, which may cause the rocket to head off at an undesirable angle.

Roman Candle: A failure of the motor restraint (thrust ring or engine hook) where the rocket stays on the pad while the motor flies out of the body (usually pushing the nose cone and recovery system ahead of it). Sometimes mistaken for a CATO (q.v.).

RSO: The Range Safety Officer, the individual responsible for ensuring that rockets presented for launch are properly constructed, prepped and balanced for stability.

Safety Nazi: A person overly concerned with safety to the point of detracting from the enjoyment of the hobby. Someone who feels the Safety Code doesn't go "far enough" in preventing injuries despite the hobby's outstanding safety record.

Sears-Haack: A series of nose cones designed and used for maximum aerodynamic efficiency on very high-speed rockets. The most commonly encountered cone in this series is a Von Karmon cone.

St. Louis Arch: The trajectory of a Prang (q.v) when viewed from a distance. Named for the famous monument whose shape it mimics.

Scale Data: Drawings, photos, dimensions, and descriptions of a prototype (q.v.) rocket used in making a model of that rocket.

Scale Plan: Instructions, diagrams, and patterns for building a model of a prototype (q.v.) rocket. A scale plan specifies details of a model that may not have anything to do with the prototype, including materials, scale factor, internal construction, and compromises in accuracy necessary for safe flight or ease of construction. (See also "Scale Data")

Sectional Density: A projectile's mass divided by the square of its diameter. Used as a measure of a round projectile's ability to coast. (See also "Ballistic Coefficient")

Separation (Sep): When the recovery system comes out too early or too late during the rocket flight and/or the vehicle is still moving too fast, the recovery system can take higher loads than designed for. If the shock cord breaks, the two parts become detached and you have a separation. Also if the nose cone accidently detaches from the rocket at ejection.

Shear Pin: A pin or pins that retain a nosecone or other airframe section to avoid drag separation or premature main parachute deployment caused by the shock of an apogee ejection charge. They are sheared off by the force of the ejection charge; often nylon screws are used.

Shock Cord: A length of rubber, elastic, bungee, nylon or Kevlar strap or tube, which provides shock absorption for the rocket components at the point of flight where the ejection charge fires and the parachute opens.

Shock Cord Mount: The attachment point for a shock cord.

Shred: A model, which has lost one or more fins due to aero loads and/or acceleration or the condition in which a rocket's airframe fails during launch. This is caused when the force applied by a rocket motor exceeds the tensile strength of the rocket airframe. The effect of a shred is similar to an explosion. Also called a "Power Shred". Can be used as either a verb or noun. (See also "Strip")

Shroud Line (Parachute): Lines or strings, which pull down on the edges of a parachute. The shrouds come together at their bottom ends to provide a point of attachment between the parachute and the rocket.

Silver Streak™: A large black powder motor (F & G class), once made by Rocketflite, Inc., which produced a large plume of sparkling exhaust when ignited.

Single Base Propellant: A solid propellant based on a single monopropellant. In practice, usually nitrocellulose in a mixture with stabilizers and plasticizers. Single base propellants are used as smokeless powders in ammunition. In rockets, such propellants have been largely replaced by composites. Single base propellants are not used in hobby rocketry. See also "Composite Propellant"

Sink Rate: The rate of vertical drop during the recovery phase of a flight, in feet or meters per second. Sink rate used to specify parachute or streamer size for a rocket.

Sliver: Remnant of propellant or fuel in composite motors as a consequence of initial geometry. The last 10% of a motor burn is usually considered "slivering" and not included in the total impulse of the motor.

Skid Mark: A motor by CTI/Animal Motor Works that uses a binder rich propellant with metallic titanium to produce a lot of flame, black smoke and sparks. Also used as a generic term for any sparky motor. Variation by other manufacturers are the Firestorm, Metal Storm, Dark Matter, Black Lightning, Spitfire and others.

Snap Ring: A spring metal ring that is intended to snap into a groove either inside or outside a pipe or shaft; inner snap rings are used to retain nozzles and forward closures in Kosdon/AMW/Gorilla-style reloadable motors, and an outer ring is usually used as a thrust ring; requires a special set of pliers to install/remove.

Sorbitol: An artificial sweetener, very similar in appearance and with similar physical characteristics to both sucrose and dextrose sugars used in "sugar motors".

Solar Igniter™: Estes Industries brand of Igniter. Made from two wire conductors with a piece of nichrome wire connecting them at one end. The nichrome wire tip of the igniter is dipped in a pyrotechnic compound, which flares to ignite the rocket motor.

Solids Loading: The proportion of solids in a propellant formulation; increasing the solids loading has several effects, including increasing the Isp.

SpaceCAD: A computer program that makes it easy for you to design rockets. You can view them in 2D and 3D, you can zoom into your design and you can get see how your rocket will look like - before you even start building it.

Specific impulse (Isp): Refers to the power per unit of propellant. For instance, when a motor manufacturer says that

their propellant delivers nearly three times the power of the equivalent amount of black powder propellant, they're referring to the specific impulse.

Spill Hole: An opening cut in the top of a parachute to increase the sink rate (thus decrease drift distance) and aid recovery on windy days.

Sport Rocket: A model rocket designed and built with no specific purpose in mind other than to fly it. Most high power rockets are sport rockets.

Sport Rocketry: The journal of the National Association of Rocketry. Previously known as "American Spacemodeling" (q.v.). Published six times per year. Distributed as part of membership to all active NAR members but also available off the rack in larger hobby shops. It has no connection with the CompuServe discussion group of the same name.

Squib: A small explosive device used to detonate larger explosive charges. While the term is sometimes used to describe igniters used in hobby rocketry, especially HPR igniters such as electric matches (q.v.), true squibs are almost *never* used as igniters since their purpose is to set up a detonation pressure wave to set off pressure sensitive explosives (e.g. plastic explosive), while an igniter must start a (relatively) low speed flame front so that the motor burns, rather than explodes.

Stability: Hobby rockets almost always depend on fins and balance to guide the rocket in a straight line during flight. A particular rocket is stable on a particular motor if it will launch and fly in a straight line.

Static Test: Firing a rocket motor in a restrained, protected area for purposes of recording chamber pressure, thrust, wall temperature, plume characteristics, burning duration, etc.

Strand Burner: A device that measures the burn rate of an energetic composition in an elevated pressure environment. Also called a Crawford Bomb.

Streamer: A recovery system for the smallest of model rockets. Streamers are flat plastic, crepe paper or Mylar bands, which are attached to the rocket, and flap as the rocket comes down, slowing the descent. Sometimes used to slow the decent of dual deploy rockets after apogee deployment.

String Test: A simple method for testing the stability of a model rocket. A string approximately 10ft long is tied to the center of gravity of a fully prepped rocket which is then twirled overhead in a circle. If the nose points in the direction of the spin and the rocket does not wobble then it is very likely a stable design. Not a practical method to use with large high power rockets.

Strip, Stripped: Terms describing a parachute that has had one or more shroud lines break or pull free due to opening shock. Usual cause is recovery deployment at too high a speed, but can also be due to age (of the tape disks on a plastic chute) or poor construction. Can be used as a verb or noun. (See also "Shred" and "Reef")

Stuffer Tube: A small-diameter tube - commonly an extension of the motor tube - which is used in large-diameter rocket airframes to duct deployment charge gases to the recovery system storage area. This reduces the internal area, which must be pressurized by the deployment charge.

SU: Single Use (motor) A one-time use disposable motor, which cannot be re-used. Before reloadable motors became the standard for high-power, all rocket motors were single use.

Suction Lock: The Mother of all Base Drag. (See "Bernoulli Lock")

Sugar Motor: An experimental motor that uses a mixture of potassium nitrate and sugar (typ. sucrose, dextrose or sorbitol) as a propellant; also called "candy fuel" or a "candy motor"

Surfactant: Compounds that lower the surface tension (or interfacial tension) between a liquid and a solid. In composite propellant production, it acts as a wetting agent to better allow the binder to coat the AP particles. An example is Triton X-100 surfactant.

Tail Off: Refers to gradual reduction in pressure and thrust at end of burning of a rocket motor.

TARC: Team America Rocketry Challenge. An aerospace design and engineering event for teams of US secondary school students (7th through 12th grades) run by the NAR and the Aerospace Industries Association (AIA). The goal of TARC is to motivate students to pursue aerospace as an exciting career field, and it is co-sponsored by the American Association of Physics Teachers, Estes Industries, the Department of Defense, and NASA. The top 100 teams from among all those who have entered will meet in a final fly-off competition in Great Meadow, The Plains, VA to compete for $100,000 in prizes and a free trip to either the Paris or the Farnborough air show in Europe.

Teflon: The polymer PTFE, an extremely slippery material that is inert to almost every known chemical; rocket uses include lubricants, release films, and reusable recovery wadding; patented by DuPont.

Test Stand: Designed to restrain a motor during test and permit enough motion to actuate a load cell. (See "static test")

Terminal Velocity: In the powered phase, the speed where the motor thrust equals the combined forces of gravity and aero drag. Theoretically, the rocket would continue ascending at a constant speed (i.e. no acceleration) with these forces in balance. This doesn't actually happen since motor thrust varies with time and aero drag with altitude. A second meaning is, when descending, where aero drag balances the weight of the descending model. If under a 'chute or other high drag recovery aid, this is quite slow. If in core sample (q.v.) mode this speed can be several hundred feet/sec. (See also "Hyperterminal Velocity")

Thermalite: A material, originally used to detonate plastic explosive, which burns at a controlled rate and high temperature. Used with rocket motors as an ignition enhancement. It can be ignited by electric (nichrome) means, electric matches, flash bulbs or the exhaust of a previously started motor. It comes in three burning speeds color-coded as pink (slow), green (medium) and black (fast). For a rough order of magnitude, slow is around 1 in/sec and fast is 5 in/sec in free air, but this can be affected by temperature, humidity, pressure and whether or not the fuse is sheathed in a tube.

Thrust: This is a measure of instantaneous force (in Newtons or pound of force). The "average thrust" of a motor is the average amount it pushes on the rocket during it's entire burn phase. Note that the motor generally produces different amounts of thrust as it burns and a graph of this is called a "thrust curve."

Thrust Curve: The propulsive force of a rocket motor plotted against time. (See "Thrust")

ThrustCurve.Org: A website that contains specifics including size, weight, average thrust, total thrust, and thrust curves of certified commercially available rocket motors.

Thru The Wall (TTW): An HPR fin attachment technique, which provides much greater strength than the typical surface mount used in model rocketry. To use TTW, slots are cut in the body tube where the fins mount and the fins are built with extended tabs on the root edge, which fit through these slots. In one form of TTW, the tabs are short and just provide a surface to build up epoxy fillets on the inside as well as the outside. In a stronger version of TTW, the tabs reach all the way to the motor tube where they are glued forming a very rigid box structure.

Thrust Coefficient: The amount a motors thrust is augmented by nozzle effects. Values usually range from 1.2 to 1.4. 1.25 is the value normally used.

Tiger Tail™: An igniter sold by Quest Aerospace consisting of two very thin copper foil leads separated by and even thinner plastic insulator with the pyrogenic compound at the tip. Essentially a mini Copperhead (q.v.), its name comes from the orange and black striped tape strip provided to allow it to be used with ordinary alligator clip ignition systems.

Meant for use with Quest black powder motors, they are widely used for igniting ejection charges in rockets fitted with dual deploy recovery systems.

Time Delay: (See "Delay Train")

Total Impulse: The total thrust produced by a rocket motor across its full burn time. Usually expressed in Newton-seconds or pound-seconds.

Triple Base Propellant: A solid propellant based on three monopropellants and additives. In practice, the monopropellants are usually nitroglycerin, nitrocellulose, and nitroguanidine. In military rockets, such propellants have been largely replaced by composites. Triple base propellants are not used in hobby rocketry. (See also "Composite Propellant")

Tripoli (TRA): Tripoli Rocketry Association. A consumer rocketry organization founded to promote the interests of high power and advanced rocketry enthusiasts.

Tripolitan: "The Tripolitan ... America's High Power Rocketry Magazine" The bimonthly journal of the Tripoli Rocketry Association, published until July/August 1992. It became "HPR Magazine" (q.v.) with the Sept/Oct 1992 issue).

Tube Fins: The case where the fins are made of sections of tubing that are tangentially connected to the airframe; 6 sections of tubing, the same diameter as the airframe, will completely enclose an airframe.

Tube Fin Rocket: A rocket that uses several tubes rather than conventional fins for stability. Tube Fin Rocket - A rocket that uses several tubes rather than conventional fins for stability. Several kit manufacturers sell rockets of this type.

Unsymmetrical Thrust: A condition in which the thrust of a motor or motor cluster is not parallel to the axis of the rocket. This is most often caused by the failure of part of a cluster of motors to ignite or a protuberance extending into the exhaust stream of a single motor.

Upscale(ing): The practice of building large versions of smaller model rockets. Popular amongst old-time high power rocketeers. Many of the first high power rockets were upscaled Estes and Centuri model rocket kits.

USLI – NASA's University Student Launch Initiative: A competition that challenges university-level students to design, build and launch a reusable rocket with a scientific or engineering payload to one mile above ground level. The annual launch event is hosted at Bragg Farms in Toney, Alabama, and launch services are provided by the National Association of Rocketry.

Volume Loading: Total percentage of motor volume that is propellant.

Von Karmon: A nose cone shape. Von Karmon is a special case of the Sears-Haack series of nose cone shapes, used on very high-speed rockets. It is the most efficient volume per unit nose drag.

Vulcan Systems: A professional rocket motor company run by Scott Dixon, now located in Colorado Springs. Vulcan manufactured hobby rocket motors for North Coast Rocketry and themselves in the 80's and 90's. Specializing in what they called "stump pullers", that is, high thrust, short burn motors. One of the early producers of smoky composite propellant. Vulcan manufactured the "Dark Star" line of rocket motors for North Coast Rocketry and later, Estes Industries. Vulcan no longer makes motors for HPR, instead they concentrate on professional, military and DARPA contracts. Vulcan, through a subsidiary, makes the rocket motors that deploys small airplane parachute recovery safety systems. Vulcan motors can still be seen being flown at Research launches.

Wadding: Any flame-retardant material used to prevent the scorching of the recovery system due to the heat of the ejection charge. The material is placed in the body tube between the engine and the recovery system. (See also "Dog Barf" and "Flameproof Recovery Wadding")

Waiver: The term used to describe the official permission given by the FAA allowing rockets with more than 113 grams of fuel or weighing more than 3.3 pounds to be flown into FAA controlled airspace. (See also "FAR 101")

Weathercocking: The tendency of a rocket to fly into the wind direction because of wind loading on the fins when it leaves the launch rod or rail, altering the flight path from vertical. Rockets with large length/diameter ratios or with large fins are especially susceptible.

Web: The thickest depth of the propellant that the flame front will burn through. In a Bates grain motor that is the distance from the outside edge of the propellant grain to the outside of the core. It varies for other core geometries.

wRASP: Windows Rocket Altitude Simulation Program; a public domain program that simulates the flight of a rocket in one dimension

X-Form Parachute: A parachute that is formed by connecting together two rectangles of material, forming a 'X' pattern.

YABAR: Yet Another Born Again Rocketeer.

Zipper (or Zippering): **or Zipper Motor Effect:** A devastating side effect of mounting the shock cord to the motor mount (which is often done for strength or to anchor a piston ejection system). If strong and thin cord is used (e.g. Kevlar) and the recovery system opens at too high a speed then the line can "zip" open the body tube all the way down to the motor mount. A sufficiently strong top mounted shock cord can partially zip a body tube if opened at a high enough speed.