

Introduction to Rocketry Glossary

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Rocketry is a very technical hobby, and like any technical field it has its own language. This mixture of engineering terms, jargon and slang can be very baffling to a newcomer.

You can become familiar with most of the basic terms, like nosecone, body tube, thrust ring, bulkhead, recovery system, launch controller, etc., by simply reading the manufacturers' catalogs. The more involved engineering terms such as drag coefficient, thrust-time curves, force vector sums, etc., can be understood by studying the various technical report series (such as sold by Estes/North Coast), Harry Stine's *Handbook of Model Rocketry* or any of the excellent publications from the NAR Technical Service (NARTS).

Let's say, though, that you've been into the hobby for a while. You've built several kits, a few scratch-built models, and flown them from the local school grounds. You've got the catalogs memorized and have bought several of the technical reports to expand your knowledge. You feel like you've got a pretty good handle on the terminology and would like to discuss the hobby with others.

So you drop by the local rocketry club for their monthly launch all ready to jump right in discussing stability margins and tripping the boundary layer. Instead, you hear conversations like: "Yeah, the motor in my B/G CATO'd. The glider Red Baron'd and the pod pranged; a real lawn dart!" Or: "I CHAD-staged my Alpha with a composite. It would have been a total shred if I hadn't used TTW." What the heck are they talking about?

Congratulations! You've just run into the REAL language of hobby rocketry! While most of the hard-core technical terms are well defined in the documents I mentioned above, it's been very hard to find any definitions of the slang in the hobby...until now! Following is a fairly complete glossary of hobby rocketry terms, both technical and slang. It was compiled by me over several years for the readers of the Usenet rocketry discussion group rec.models.rockets.

GLOSSARY OF HOBBY ROCKETRY TERMS

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- BFNC Body Fins and a Nose Cone, the description of a generic rocket.
- Advanced Rocket see "High Power Rocket"
- Aero-PAC The Association of Experimental Rocketry of the Pacific, a prefecture of Tripoli in Northern California which flies from the Black Rock Desert in Nevada. Despite the name, this is an HPR club and does not fly liquid fueled or other amateur rocketry vehicles. It's main purpose is education through experimentation with rocketry while following the NAR and Tripoli safety codes.
- 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. Example: if your launch site is at 1,500' MSL and you have a 3,000' AGL waiver, then pilots must stay above 4,500' to be safe.
- 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. This can be done by a flashbulb/motion switch, timer, or simply a piece of fuse started by the exhaust of the pad start motor.
- AmSpac Deprecating but affectionate abbreviations for *American
AmSpam Spacemodeling* (q.v.) [archaic]
- American Spacemodeling The journal of the National Association of Rocketry from the July 1984 issue until the July/August 1993 issue. 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 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 significant 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 years to build. The equipment necessary to safely pursue amateur rocketry (sandbagged bunkers, loading pits, standby fire truck, etc.) are 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 motor casing with zinc/sulfur (a common amateur beginner fuel).

Liquid fueled vehicles are becoming more popular among amateur groups. These can produce more than 1,000 lbs of thrust for over a minute from a LOX/Kerosene engine which can propel the vehicle to altitudes of over 40 miles. Some hobby!

Neither Tripoli nor the NAR sanction amateur rocket activities.

See also:

- Black Rock Society
- Experimental Spacecraft Society
- Experimental Rocket
- Pacific Rocket Society
- Reaction Research Society

AP Ammonium Perchlorate, the oxidizer used in most composite rocket motors. Other components include polybutadiene rubber (fuel) and sometimes aluminum powder as a burn enhancer to raise the Specific Impulse (q.v.). This latter is the propellant mixture that the Shuttle SRB's use.

Not all composite motors use ammonium perchlorate, although it is the most common. Potassium perchlorate and ammonium nitrate are also used. A few people have experimented with strontium nitrate and potassium nitrate.

Apogee 1) The highest point of a rocket's flight path or, more literally, the point on the flight path farthest from the center of the Earth. 2) Manufacturer of kits and motors located in Colorado Springs, Colorado.

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 five years.

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 except in competition). The more aerodynamically clean glider section is then free to glide more slowly. See also "Contest Acronyms" and "R/G"

Baffle See "Ejection Baffle"

Ballistic Coefficient (Cb) A measure of a projectile's ability to coast. It is defined as $C_b = M/C_dA$ where M is the projectile's mass and C_dA 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.

BALLS See "FIREBALLS"

BAR Born Again Rocketeer. An individual who has re-discovered the hobby/sport after an absence of several years. Contrast "BOR"

BATF The Bureau of Alcohol, Tobacco and Firearms. This federal agency is responsible for regulations concerning storage and use of explosives. They have an interest in how HPR motors are transported, sold, stored and used. Whether they have the legal right to regulate the hobby is currently (early 2002) the subject of a lawsuit brought by the NAR and Tripoli against the agency.

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 the 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: delay smoke has very little effect on base drag due to its low density). Base drag can be reduced by the use of a boattail to transition the main body diameter down to the motor diameter which helps direct air into the evacuated area. When properly designed, a boattail can reduce base drag below zero (i.e. actually generate a small amount of forward thrust) by making use of the "pumpkin seed" effect.

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 venturi 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" dia. 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.
- Black Jack Tango A variation on a Chuff (q.v.) describing the up and down movements of a rocket with a difficult-to-ignite composite propellant, such as Aerotech's "Black Jack" (hence the name). With each power pulse, the rocket will dance up and down on the launch rod.
- Black Powder Basically, gunpowder. The "traditional" model rocket motor fuel. Used by Estes and most other model rocket companies through F range. Rocketflite had black powder motors through the H range. See also "AP" and "Composite Fuel"
- 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 chemical reactive propulsion: solid, liquid and hybrid.
- Boattail A transition section at the tail of the rocket which gradually narrows the body down in order to reduce base drag (q.v.). A full boattail will reduce the body all the way down to the motor diameter, but many HPR rockets stop short of that for practical considerations (motor retainer access, etc).
- 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 payload rockets, the term is used for the powered portion to distinguish it from the payload section. See also "Air Start"
- BOR 1) 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 contest. 2) Born Once Rocketeer. An equally facetious definition suggested by Greg Horine when describing long time hobbyists who have never left the hobby.

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 "Boosted Dart," "Terminal Velocity" and "Hyperterminal Velocity"

CA Cyanoacrylate ("super glue"). A very strong adhesive popular for use in competition and high power rockets, as well as 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 to 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).

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" diameter 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.

California Rocketry Magazine (CRm) The first magazine devoted to what is today known as High Power Rocketry. Published by Jerry Irvine from 4/81 through 4/84. Content included NAR contest events, HPR events, amateur rocket events, product reviews, technical articles, scale data (the usual stuff) and political debate (unusual stuff).

More important than the reports and reviews, though, was that this was the first forum that brought together the fledgling high power rocket companies, consumers and leaders into a single group leading to the formation of Tripoli Rocketry Association. Also notable was it's promotion of LDRS-1,2,3 and Lucerne launches.

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.

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 side kick. 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.

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!

CHAD Acronym for CHeap And Dirty. 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 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)

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 combustion results. The sound of chuffing is similar to that of a steam locomotive starting up (hence the name). 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 let the rocket hit the ground. When stable burning ensues, such a rocket will be flying horizontally at ground level. See also "Land Shark" and "Black Jack Tango"

Humorous: Any lapse in logic or loss of train of thought is referred to as a "Brain Chuff."

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 each other 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.

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.

Cluster A rocket that fires more than one motor simultaneously. See also "Air Start," "Clip Whip" and "Davis Douche"

Composite Material "Phenolic" Materials, other than paper, wood or metal, used in the construction of rockets. Usually non-metallic. See also "Phenolic"

Composite Motor The term used broadly to cover solid fuel rocket motors using propellants other than black powder. 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 both 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 "Monopropellant," "Single Base Propellants," "Double Base Propellants" and "Triple Base Propellants"

Confirmation Certification The process whereby a member of Tripoli or NAR becomes certified as eligible to purchase and use high power (H and up) motors. Done in stages by building a rocket using the larger motors then successfully flying before witnesses. Witnesses must be Senior members of the Certifying body (NAR or Tripoli), and must be themselves certified. Certification is done in three levels: Level 1 (H and I motors), Level 2 (J, K and L motors), and i Level 3 (M and up).

Contest Acronyms The NAR uses a bewildering number of acronyms to describe its contests. As with most things of this nature, there is a logic to the naming which makes things much easier to understand once learned.

 The basic structure of an event name is a prefix, the event acronym and a suffix. The prefix is always the motor code (currently 1/4A through G) and the suffix is either an "A" for altitude events or "D" for duration events if such a distinction

needs to be made (some events, such as parachute duration, have the suffix "built in" to its name, thus don't use one). A further appendage is the use of "MR" for "Multi-Round" events where you make several flights and pick the best ones.

Lastly, there is a set of scoring acronyms used in judging the events, but are not part of the event itself.

Event Acronyms:

ALT - Altitude
BG - Boost Glider
DEL- Dual Eggloft
DR - Drag Race
EL - Eggloft (Single)
FW - Flexwing BG
F/FSC - Fiction/Future Sport Scale
HD - Helicopter Duration
OSL - Open Spot Landing
PAY - Payload
PD - Parachute Duration
PMC - Plastic Model Conversion
PRA - Predicted Altitude
PRD - Predicted Duration
PSL - Parachute Spot Landing
R&D - Research & Development
RDA - Random Altitude
RDD - Random Duration
RC/RG - Radio Controlled Rocket Glider
RG - Rocket Glider
SC - Scale (often seen written out)
SCA - Scale Altitude (sometimes seen as Sc.Alt)
SD - Streamer Duration
SL - Spot Landing
SPSC - Sport Scale
SPSY - Space Systems
SR - Superroc
SSL - Streamer Spot Landing
STA - Set Altitude
STD - Set Duration
SUSC - Super Scale

Note that there is an ambiguity in the Eggloft event notation. "DELA" could mean the generic Dual Eggloft Altitude event or D Eggloft Altitude. For this reason, the prefixes are normally separated from the event acronym by spaces.

Flight Card/Results Acronyms:

BRK or EGG - Broken Egg
CATO - obvious, I hope
DQ - Disqualified flight
NC - Track Not Closed
NG - No Glide
NR - No Return

PRG - Prang
ROT - No Rotation
SHR - Shred
TL - Track Lost

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 current sensitive flashbulbs, etc.

Copperhead(tm) 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.

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

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.

The location of this point depends on the rocket's orientation at the time of measurement. If it is at a very small angle to the "local wind" (line of flight), the fins' restoring contribution will be large, while the nose's disturbing contribution will be small, resulting in a CP that is way back. The CP in this case can be located using the Barrowman Equations. If the rocket is nearly sideways, the CP will be much more forward. The CP in this case can be located by balancing a cardboard silhouette of the rocket.

Since all free bodies can rotate only on their Center of Gravity (q.v.), stability is usually a simple matter of placing the rocket's CG ahead of your CP, which ensures that the restoring forces of airflow on the rear of the model will always overcome the disturbing forces on the front.

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 which has failed in such a way that it ends up flying horizontally while still under power. A common example would be 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 know to cause a cruise missile attitude.

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 [late 1968 or early 1969, before they went to color covers].

Delay Train Pyrotechnic material in the rocket motor which burns slowly after the main propellant charge and the firing of the ejection charge. This allows the rocket to slow down as it coasts towards apogee and deploy the recovery system at low speed. Black powder motors ignite their Delay Trains upon burnout of the main propellant charge, while composite motors light them at primary ignition.

Delay Charge

Double Base Propellant A solid propellant consisting of two monopropellants (q.v.), 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 In competition, a 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 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 .5 to .7. 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. For example, the original Honda Civic had a horrible Cd, and makers of large luxury cars, with a little edge rounding, were easily able to beat it and proclaim "Lower drag than a Honda Civic!" in their ads. This is patently absurd as the Honda had such a tiny cross section, thus much

lower *actual* drag. See also "Optimum Mass"

Drop Staging See "CHAD Staging"

Effective See Impulse (Relative)
Exhaust Velocity

Ejection A device used in some rockets to eliminate the need to use
Baffle wadding to protect the recovery system. Usually composed of
some type of metal mesh to absorb burning particles and the
heat of the ejection gases before they reach the recovery
device.

Another form of baffle works by simply removing the straight
line path between the motor and the parachute. Most damage is
done not by the hot gasses, but by the still-burning particles
of the ejection charge. This is usually done by putting a pair
of adapter rings with misaligned through-holes to block the
particles. loser target with better aim. So named due to that

company's

policy of providing very short shock cords in their kits.

Experimental Rocket Currently a synonym for Amateur Rocket (q.v.) but, according
to early HPR advocate Jerry Irvine, this was the original term
describing what we today call High Power Rocketry (q.v.).

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.

Extreme Rocketry Magazine A new magazine, started in 2000, intended to give the hobby
a third voice independent of the two national organizations.
Published by McNeely and Associates, it is a high quality, all
color "slick" publication that comes out ten times per year. It
is associated with the web site "Rocketry Online" which is also
a McNeely run enterprise. Current editor: Brent McNeely

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

2) Large Model Rockets: Those 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). Fliers of
these 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: Those weighing more than 3.3 pounds, containing motors with a total of more than 125 grams of fuel. These 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 aeromodeling.

Fillet A reinforcement of the joint between the fin and the body tube of the rocket to improve the rocket's aerodynamics and strengthen the fin mount. See also "TTW"

FIREBALLS An experimental rocketry/HPR launch hosted by Aero-PAC (q.v.) The emphasis is on VERY LARGE advanced rockets of "K" impulse or higher. The idea originated with Steve Buck and the first launch was sponsored by Bill Lewis of Aero-PAC. 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. Against the wishes of its founder, "Fire" was placed in front of "BALLS" to placate those few who had a problem with the name. Currently, "Fire" is not used when referring to the launch in casual conversation.

Fireballs was traditionally held the Monday after LDRS (q.v.), but it has never been a Tripoli launch.

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, launch controller, a prep table, etc. Less obvious examples are payload support stuff like receivers and tape recorders if you're flying a broadcasting type data collection payload.

Hang Fire Terms which refer to abnormal ignition. With hang fire, the motor Misfire 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.

HEUP High Explosives Use Permit. A license required when buying, transporting, storing and using very energetic materials such as dynamite and nitroglycerine. Sometimes mistakenly required by uninformed officials for the use of Thermalite (q.v.). See also "LEUP"

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 0 power (40,960 N-Sec total impulse) and have a limitation of 81,920 N-Sec total impulse.

HPR is governed by NFPA 1127 which formalizes this description.

HMR The Handbook of Model Rocketry. The official NAR handbook for the hobby. Originally written by G. Harry Stine (NAR #002) in the mid '60s (the first edition came out in 1965) and was last updated for the sixth edition (1994). It expanded its scope with the hobby by adding computer programs (not always the best sorted out) in the fourth edition and giving a nod towards the existence of HPR in the last (sixth) version.

Hobby Rocket A general, collective term used to describe both model and HPR rockets to differentiate them from amateur/experimental rockets.

HPR Magazine An independent magazine, formerly *The Tripolitan* (q.v.), dealing with all aspects of consumer rocketry, but with a definite emphasis on high power, advanced and experimental consumer rocketry. Published nine times a year. A subscription is included with membership in Tripoli, but can be had separately. Also available on newsracks in larger hobby stores. Current editor: Bruce Kelley.

Note: an earlier periodical with the same name was published in the mid '80s by Mike Nelson from Cuba, OH. It has no relation to the current publication.

Hyperterminal Velocity A situation where a rocket is traveling faster than terminal velocity (q.v.) for a given motor. This is possible, for example, on a staged model with grossly mismatched motor combinations such as an F100 staged to a B6. 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 motor burn and approaches terminal velocity from above.

Igniter An expendable device used to ignite a rocket motor.

Impulse Force times the amount of time that force is applied. Used in rocketry to evaluate rocket engine performance. See additional definitions below.

Impulse (Relative) A measure of the efficiency of a rocket engine. 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" which 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. An intuitive way of thinking of it (which makes sense with regard to the unit) is that it's the number of seconds that one lb/N of propellant will produce one

lb/N of thrust.

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 See "Cato"

Kicked A motor which is ejected from the rocket while in flight. This often results in the failure of the recovery system. It is usually caused by not restraining the motor in the motor mount properly. See also "Prang"

Kitbash Taking two (or more) kits and combining ("bashing") them into a new design. Often used as a contest event (Team Kitbash, where teams compete, Kitbash Duration, Scale Kitbash, etc) where the idea is to be creative in a limited amount of time.

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.

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. Very damaging; it almost always destroys the lower body tube beyond use. Named for Richard Krushnic, the rocketeer who characterized the effect in the late '60s. Not to be confused with "Suction Lock" (q.v.).

Land Shark Worm Burner A rocket which has failed in such a way that it ends up on 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. See "Chuff"

Landis Loop A ring used in a tower launcher to keep the back end of a egglofter centered during launch. Invented by Geoff Landis and named for him by Bob Kaplow.

Large Model Rocket (LMR) An official designation used by the FAA to refer to model rockets with a liftoff weight over the old FAR 101 limit (1 lb) but under the new NFPA 1122 limit of 3.3 lbs (1,500 grams), or with more than 113 grams of fuel but less than 125 grams. This replaced the informal "Medium Power" and "HPR Lite" in common usage. See also "FAR 101"

Generally used to describe rockets using motors in the "E," "F," and "G" motor classes. Rockets in this range 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.

LCO Launch Control Officer: the individual responsible for the safe launching of the rockets on the range. In addition to "pushing the button," he must make sure the air is clear of aircraft, that no one is in the safe zone around the active pads, the downrange area is clear, and watch for any other hazardous condition. For competition launches, he must also verify that the timers and/or altitude tracking stations report ready.

LDRS The annual national high power sport launch sanctioned by Tripoli. LDRS stands for "Large 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.

LEUP Low Explosives Use Permit. A license required by the BATF (q.v.) and other agencies for the purchase, transport, storage and use of Thermalite (q.v.) fuse and (in some cases) Class "B" composite motors with AP or other advanced oxidizers. See also "HEUP"

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. The theory 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 lower body's higher drag decelerates *it* more quickly) putting tension on the nose-body joint. The condition is exacerbated by any nose weights added for stability (which raise the momentum of the nose) and/or a loose fit of the nose in the body.

Origin:

The term (and theory) is said to have originated with Bernie Biales of the MITRS at NARAM-18 to explain the large number of C SD models that lost nose cones and went unstable at burnout. He also suggested that recovery systems rushing forward added to this failure mode. This was proven by a differential drag study conducted by Charles Rogers and published in California Rocketry magazine (q.v.) in 1982, which stated that on a typical 4" diameter model the differential drag can be 15 to 25 pounds, far exceeding the 10 pound fit force commonly used by hobbyists in the nose-body joint.

Another contributing factor is the denser air trapped in the body tube from ground level exerting pressure on the nose cone once the rocket reaches a higher altitude. This only becomes significant for rockets with large diameters (giving a larger "piston" for the pressure to work on) which ascend quickly enough to have the pressure differential be significant over a short time. In other words, a typical HPR bird.

The term is named after an early '70s movie actress

who, ahh, um...well, go ask your dad.

Magnelite (tm) 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 bridgewire dipped in a magnesium based pyrogen which burns *very* hot (~6000F), aiding in the ignition of stubborn composites, such as a "Blue Thunder". They come both single and double dipped, depending on how much "oomph" you need. The head is quite large so they work best in 29 mm and larger motors.

Midwest
Qualified 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"

Misfire See "Hangfire"

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 N-Sec 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, breakable plastic or similar material and without substantial metal parts. See also "FAR 101," "Large Model Rocket" and

"NFPA 1122"

Model Rocketeer The original NAR newsletter with a very checkered publishing history. The first issue was published with a cover date of February 1958 with G. Harry Stine as editor/publisher. It was published as a freestanding newsletter from 1958 to 1960 after which it was published as an insert in *American Aircraft Modeler* magazine. The last appearance there was in the July, 1969 issue after which it moved to the fledgling *Model Rocketry Magazine* (q.v.). After MRM folded it was again published stand-alone starting in June, 1972 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. In the Spring of 1995 it was restarted in newsletter format published in parallel to the magazine (which had been renamed *Sport Rocketry*). Current editor: Chuck Straka.

Model Rocketry Magazine (MRM) An early attempt at a "newsrack" 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. Notable on the staff was a young Jay Apt, who went on to join the astronaut corps and has made several Space Shuttle flights.

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.

It also incorporated *The Model Rocketeer* (q.v.) the NAR newsletter which 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 by Bruce Kelly. Including the new, completely independent *Extreme Rocketry*, we now have THREE rocket hobby magazines on the newsracks today!

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

Mono-propellant Most rocket propellants are a combination of a substance that burns (fuel) and an agent that promotes the burning (oxidizer). These are called "bi-propellant" systems. Monopropellants are highly energetic materials that can provide both functions in a single material; an example being nitroglycerine. Note that two or three monopropellants can be combined to form multiple "base" propellant systems, but that does not make them "bi" or "tri" propellant systems since any of them can function on its own. Similarly, if solid fuel and solid oxidizer are pre-mixed in a propellant grain, that does not make it a monopropellant,

but rather a "composite" propellant. See also "Single Base Propellant," "Double Base Propellant," "Triple Base Propellant" and "Composite Propellant"

- Motor Something that imparts or produces motion, such as a machine or engine. A device that converts any form of energy into mechanical energy (from *American Heritage Dictionary*). See discussion at the end.
- 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. Last known editor: Matt Steele.
- 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. Founded in 1958 by G. Harry Stine as the "Model Missile Association" the name was changed shortly after so as to avoid any apparent conflict of interest with his company "Model Missiles, Inc."
- NARAM National Association of Rocketry Annual Meet. The NAR national championships competition, held in late July or early August each year at different locations.
- NARCON National Association of Rocketry 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.
- 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, books and other items of interest to rocketry enthusiasts.
- Newton (N) Metric unit of force used to measure thrust. One lb = 4.445 N.
- Newton-second (N-Sec) Metric unit used to measure Impulse (q.v.). It is calculated multiplying thrust in Newtons by the burn duration in seconds.
- NSL National Sport Launch. An annual, national, non-competition sport fly sanctioned by the NAR. It is usually scheduled such that it is midway between the NARCON and NARAM national meets.
- 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 Marshall). 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 160 N-Sec total impulse in all motors (no individual motor having more than 80 N-Sec of total impulse).
- NFPA 1127 The NFPA regulation defining High Power Rocketry. NFPA 1127 defines HPR as having no total weight limits, but having a single motor limit of no more than "O" power (40,960 N-Sec total impulse) and have a limitation of 81,920 N-Sec total impulse.
- 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.
- Olympic Torch A rocket that power prangs (q.v.) with the motor still burning. Coined by Cheri Chaney after someone almost impaled NAR President Mark Bundick with an RMS (q.v.) powered model that suffered a nozzle failure which dropped the thrust to zero even though the motor kept burning. See also "Roman Candle"
- 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 (think of a feather). 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 which defines Optimum Mass.
- For very low impulse motors (say "B" and below) this "knee" is right around the mass of the motor itself, so the rule of thumb is "the lighter the better." The higher impulses, though, have more leeway, and careful calculations should be made to determine the optimum mass for altitude attempts.
- In a multi-stage rocket with no staging delays, only the dead mass in the upper stage participates in coasting. Extra dead mass in lower stages cannot enhance coast distance, and so lower stages should be as light as possible. Strictly speaking, an undelayed staged rocket has no optimum liftoff mass, but the mass of the last stage may be optimized with respect to the (sub-optimal) lower stages. In dense atmosphere, the best single stage configuration is more efficient than the best multi stage configuration, provided all the propellant can be contained in one stage. Indeed, there are many instances when cluster rockets out perform staged rockets.

The opposite is true for rockets operating in the thin atmosphere of high altitudes. In that environment, staged rockets are more efficient (propellant-wise) than single-staged rockets, and lighter rockets always perform better. There is no optimum mass in a complete vacuum.

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.).

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

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 (except insects).

Phenolic A heat-resistant plastic. One of the oldest synthetic plastics, it is made by a reaction of phenol and formaldehyde. When mixed with carbon black, it is used to make casings for single use composite propellant rocket motors. It is also used to reinforce the kraft paper body tubes for competition rockets. Phenolic body tubes are stiffer and stronger (for their weight) than ordinary tubes, but are also more brittle so that extra care must be taken to avoid damage during construction, transportation and recovery.

PMC Plastic Model Conversion. 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. See pular in Britain since at least the '30s where the expression "Prang his Kite" was equivalent to the U.S. "Auger in" or "Buy the Farm."

Prototype 1) An initial, development design used to test out principles and concepts but never intended to be a finished or production design. 2) 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"

RASP The Rocket Altitude Simulation Program. 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 (up). 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
1) prearranged and 2) you play by *their* safety procedures.

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 WW I 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. 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.

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 E-15 sure re-kitted my Black Brant!"

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.

Carl Dowdy, a model aviator and aeronautical engineer, found it helpful to think of Rn as the "coarseness" of the air seen by a body. Move the body faster, and more particles will pass over it in a given unit of time, increasing Rn. Make the body larger, and there will be more particles over the body at any instant,

increasing Rn.

- R/G Rocket glider. A glider which is boosted to altitude by a rocket. No part of the model separates, as in a boost glider; the entire model glides down together. Technically, an R/G is a particular form of B/G.
- RMS (tm) Reloadable Motor System. The trademarked name of the AeroTech/ISP reloadable motors. Often used (incorrectly) as a generic name for all reloadable technology.
- RocSim A rocket design and simulation program developed and sold by Apogee Components (q.v.). It uses graphics-based tools to allow modelers to both design and simulate the performance of their models. Due to its broad capabilities and relative ease of use, it has become the de-facto standard for rocket design on home PCs. The piece-parts from nearly every manufacturer have been encoded as RocSim files by either the manufacturers themselves, or other hobbyists creating a huge library of design elements.
- 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 the safe operation of a rocket range. He is the "boss" to which the SCO and LCO report, thus is the ultimate authority for any questionable safety situation such as a scratch-built model with wings in the middle, etc.
- 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.
- St. Louis Arch 1) The trajectory of a Prang (q.v) when viewed from a distance. Named for the famous monument whose shape it mimics. Popularized at NARAM 36 by Peter Alway who had driven through St. Louis on his way to Houston. 2) An exhibition stunt, introduced by Mort Binstock of Pittsburgh, in which a relatively heavy, slow model (such as a Big Bertha) trails a complete roll of crepe paper behind it, forming a similar shape.
- 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"
- SCO The Safety Check Officer, the individual responsible for ensuring that rockets presented for launch are properly constructed, prepped and balanced for stability. With small

groups, this job is performed by the RSO (q.v.).

- 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"
- Shred A model which has lost one or more fins due to aerodynamic loads and/or acceleration. Also used to refer to a model which has completely come apart during takeoff. Can be used as either a verb or noun. See also "Strip"
- Silver Streak(tm) A black powder motor, made by Rocketflite, Inc., which mixes magnesium particles into the propellant, thus producing a large plume of sparkling exhaust when ignited.
- Single Base Propellant A solid propellant based on a single monopropellant (q.v.). 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"
- SNI Slimy NAR Insider. A person who associates with (either professionally or casually) members of the NAR board of trustees, thus being privy to the "inner workings" of the organization. Said to have originated in the early '90s during "flame wars" on the CompuServe Sport Rocketry group.
- SNP Slimy NAR Politician. Coined by NAR President Mark "Bunny" Bundick, it refers to an SNI (q.v.) who actually manages to get elected to the NAR board.
- Solar Igniter(tm) Estes Industries brand of Igniter. Made from two wire conductors with a nichrome bridgewire at one end. The tip of the nichrome end of the igniter is dipped in a pyrogenic compound which flares to ignite the rocket motor.
- 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 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. Current editor: Tom Beach.
- 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 not 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.

String Test A simple method for testing the stability of a model. A string approximately 10 feet long is tied around 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.

The string test is not especially accurate since it introduces another component, namely radial acceleration, that is completely absent in normal flight. When you tie the string to the rocket at the CG, it's not really at the CG but attached to the outer surface of the body tube *above* the CG (which is usually inside along the centerline of the tube). In order for the rocket not to twirl, the projection of the string has to pass through the CG. This is fine as long as the rocket is moving in a linear fashion. But when you start swinging it, it's no longer moving linearly, but being constrained to a circle. This forces the rocket (if it's stable) to assume a slight angle of attack in order to keep pointing into the "relative wind". This angle means that the projection of the string no longer passes through the CG, but slightly behind it. You have to move the string slightly forward for the string to point through the CG while you swing it.

Strip Terms describing a parachute that has had one or more shroud lines 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"

Stripped

Suction Lock See "Bernoulli Lock"

SuperRoc An NAR competition based on high aspect ratio (i.e. large length-to-diameter) rockets. The length of the rocket is dependent on its motor size with the smallest (1/4A) having a minimum length of 25 cm. The minimum length goes up 25 cm for each motor class (e.g. 1/2A is 50 cm, "A" is 75 cm, etc.) so that a "G" SuperRoc must be at least 225 cm long. Maximum length is twice the minimum and the scores are weighted in favor of longer rockets. In case your calculator needs recharging, this means that a "G" SuperRoc could be nearly 14 feet long!

Like many types of contests, SuperRoc has no real "point" other than to create a competition that is difficult to do. Some sanitized versions of SuperRocs have been issued as kits, such as the Estes "Mean Machine" (a D class SR) and the MRC "Big Ben" (a "B" or "C" class SR).

Terminal 1) In the powered phase, the speed where the motor thrust Velocity equals the combined forces of gravity and aerodynamic 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 drag with altitude. 2) During descent, the point 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 ft/sec.

See also "Hyperterminal Velocity"

Thermalite A material developed for setting off fuse type detonators when an accurately timed delay was needed. It burns at a controlled rate and high temperature, and is used with rocket motors as an ignition enhancement. It can be ignited electrically (nichrome), by flash bulbs or the exhaust of a previously started motor. It comes in three burning speeds color coded as pink (slow), green (medium) and white (fast). For a rough order of magnitude, slow is around 1/2"/sec and fast is 2 1/2"/sec in free air, but this can be affected by temperature, humidity, pressure and whether or not the fuse is sheathed in a tube.

Note: This material is classified by the BATF as a controlled substance and is subject to strict purchase, storage and transportation regulations. Contrary to popular belief, Thermalite is NOT class B, it is Class C material. See also "HEUP" and "LEUP"

Tiger Tail (tm) An igniter sold by Quest Aerospace consisting of two very thin copper foil leads separated by an 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.

Time Delay See "Delay Train"

Triple Base Propellant A solid propellant based on three monopropellants (q.v.) 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 bimonthly journal of the Tripoli Rocketry Association, published until July/August 1992. It became *HPR Magazine* (q.v.) with the Sept/Oct 1992 issue).

Through 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 (also known as TTW-GTMT for "Glued To the Motor Tube).

Wadding Any flame retardant material used to prevent the scorching of the recovery system do to the heat of the ejection charge. The material (usually tissue paper treated with boric acid)

is placed in the body tube between the engine and the recovery system. See also "Ejection Baffle"

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 1 pound to be flown into FAA controlled airspace. See also "FAR 101"

Woosh
Generator
(w.g.) The humorous, genderless, politically correct way to refer to the propulsion device in a hobby rocket; thus avoiding the great motor/engine debate (see discussion at the end).

YABAR Yet Another Born Again Rocketeer. See "BAR"

Zipper
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 and/or the piston comes all the way out of the body, 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.

And the final burning question: Is the proper term rocket "engine" or rocket "motor?" Some thoughts from Buzz McDermott:

I don't know. I don't really care. And neither should you! In this hobby "motor" and "engine" are taken to mean the same thing and both refer to "the thing in the rocket which makes it go "whoosh!!" (or "roar," if flying high power). If you want a sure way to start a fight with a fellow rocketeer, just argue that whatever term he/she uses is the wrong one!

While I think Buzz's response reflects the correct attitude to the question, the subject comes up often enough that a real definition is required. The difficulty comes since there are several "real" interpretations of the terms involved. The following discussion is intended for the purposes of education to clear up some of the rampant misunderstandings seen periodically. It should not be used to start flame wars. I think that by the end, you'll see that the subject is complicated enough that *either* term is perfectly acceptable. And, no, I'm not weaseling out on this one.

From a mechanical engineering standpoint, "motor" is the more general term. It is defined as anything that imparts mechanical motion (hence the name). "Engine" is more specific and despite its Roman origins (where it meant mechanical weapons of war and "Engineer" was a military rank) the commonly accepted definition today is "A device which creates mechanical force (rotary or linear) by means of a mechanism converting stored chemical energy through a thermal process." In other words, a heat engine. Look up Carnot.

Thus we have internal combustion engines (gasoline, diesel, etc) which do the thermal conversion right in the mechanism itself; external combustion engines (steam, Stirling, etc) where the thermal conversion takes place outside the mechanism and the heat is transferred by a working fluid; and continuous combustion engines (gas turbines) where the various cycle phases (mixing, compression, combustion and expansion) are separated by distance

along the engine rather than by time.

Electric motors are called such because even though they do an energy conversion by means of a mechanism and have a mechanical (rotary or linear) output, there is no consumption of fuel and no thermal component to the conversion.

Jets and rockets get into a gray area, though. Turbojets, such as used on airliners, helicopters, etc., are clearly engines. While they don't use a mechanical device for the thermal expansion (e.g. a piston) they do have mechanical compressors and power take-offs in major support roles. However, it is possible to make a jet with no moving parts, e.g. a ram jet.

Likewise, the "whoosh generators" we use in the hobby are clearly motors. While they do consume a chemical fuel and produce thrust by a thermal conversion, there is no mechanism, no moving parts at all except the exhaust itself. Liquid fueled rocket "engines" are less clear. True they have propellant pumps, valves and lots of other moving bits, but their support roles are much less central than the compressors on a turbojet. You can build a liquid fueled rocket without pumps at all, as Goddard and many amateurs have shown. This limits you to comparatively low propellant flow rates, however, and pumps are used to enhance the process. Generally, the sheer volume and complexity of the mechanism on a modern rocket (e.g. a Titan or the Space Shuttle) award it the term "engine."

The above discussion, though, is rooted in the past. In our modern, information society we have "compute engines" and "graphics engines" to reflect the expanded role these devices play in our daily lives. Accordingly, the term "engine" has been broadened considerably and a current definition is "a device to effect a desired outcome" which pretty much covers everything. From this point of view, "engine" is the superior of the term "motor." If you consider that the "desired outcome" of flying our rockets is to put them high in the air then a "rocket engine" is the device to effect it.

I think that you should find enough information here to defend either position!