Glossary

Ablative materials. Special materials on the surface of a rocket that can by sacrificed (carried away, vaporized) by the heat produced by air friction flowing over a fast-moving rocket. Kinetic energy is dissipated and excessive heating of the main structure of the rocket is prevented.

Abort. Failure of an aerospace vehicle to accomplish its purposes for any reason. An abort may can be caused by human, technical or meteorological errors, miscalculation, or malfunction.

Abrasive. Natural or artificial materials used for grinding or polishing. Natural abrasives include diamond, emery, sand, crushed garnet, and pumice. Artificial abrasives are made from natural materials and, in general, are either silicon carbide or aluminum oxide.

Absolute pressure. The sum of the gage pressure plus the atmospheric pressure. The pressure used to determine the action of gasses according to the gas laws.

Acceleration. The rate of change in velocity with time. Typical units of linear acceleration are meters per second per second (m/sec^2). Negative acceleration is commonly called *deceleration*.

Acceleration due to gravity. Any acceleration due entirely to gravity, e.g., in a vacuum a freely falling body falls toward the earth's center at a velocity of 32.2 feet (9.81 m) the first second, with an increase in velocity of 32.2 feet (9.81 m) per second the second second. Velocity at the end of the second second is 64.4 feet (19.62 m) per second, etc. In air the rate of acceleration is modified by the force due to air resistance. A freely falling body will finally reach a speed at which the force of gravity and air resistance are equal and no greater speed is gained.

Accelerometer. An instrument that measures change in velocity, or measures the gravitational forces capable of imparting a change in velocity.

Acetate butyrate dope. A solution combining the fire-resistant qualities of acetate dope with the toughening properties of nitrate dope. See *Aircraft Dope*.

Acetate dope. Dope manufactured from cellulose and acetic acid.

Acetone. An inflammable liquid prepared by special fermentation of grain, forming butyl alcohol and acetone. A general solvent used as an ingredient for the thinning of dope, lacquer, and epoxy.

Acoustics. The science or study of sounds, including the generation, perception, measurement, reproduction, and control of material vibrations.

Acrobatics. Unnecessary flight evolutions voluntarily performed with an aircraft requiring or resulting in an abrupt change in its *attitude*, an abnormal attitude, or operations in excess of the aircraft's design level flight speed.

Acrylic resin or plastic. A thermoplastic resin resembling glass. Used in making transparent parts, such as lenses, windows, clear fins, etc.

Actuator. A mechanical, electrical, or pneumatic device that sets some mechanism into operation, throws a switch, or performs some other intermittent operation.

Adapter. The external part of the rocket that acts to smooth the transition between body tubes of different diameters. Adapters are made from a variety of materials, paper and balsa being the most common.

Adapter ring. A flat disk-type centering ring for joining two tubes of different diameters.

Additive. A substance added to a propellant to achieve some purpose, such as a more even rate of combustion.

Adhesive. Material applied between components to bond the components together structurally.

Advanced model rockets. Model rockets constructed of exotic materials, or capable of performing some function that differentiates them from traditional model rockets. High-powered rockets are not necessarily advanced model rockets.

Aerial photograph. Any photograph made from a vehicle in flight.

Aeroballistics. A term derived from *aerodynamics* and *ballistics*, dealing primarily with the motion of bodies, such as guided rockets, whose flight path is determined by applying the principles of both sciences to different portions of the path.

Aerobrake recovery. A form of recovery where the rocket deploys rigid panels called air brakes to increase the surface area of the rocket exposed to the airstream. This differs from *Drag recovery*.

Aerodynamic center. A point located on the wing chord approximately one-quarter of the chord length back from the *leading edge*, about which the moment coefficient is practically constant for all angles of attack.

Aerodynamics. The science that deals with the motion of gases (especially air) and with the forces acting on solid bodies when they move through gases or when gases move against or around the solid bodies.

Aerodynamic drag. See *Drag*.

Aerodynamic heating. The rise in the skin temperature of a rocket due to the friction of the air at high speed.

Aerodynamic twist. See *Washin* and *Washout*.

Aeronautics. A general term applied to everything associated with or used in any way in the study, design, construction, or operation of aircraft.

Aerosol. A mixture of fine liquid or solid particles and the gas or air in which they are suspended.

Aerospace Vehicle. A vehicle which functions both in the sensible atmosphere and in the space equivalent.

Aft closure - The rear threaded portion of a reloadable motor casing that holds the nozzle into the assembly.

AGL - Abbr. Above Ground Level

Aileron. Hinged flap or movable portion of an airplane wing, the primary function of which is to impart a rolling or banking motion to the airplane about the *roll axis* or *longitudinal axis*.

Air brakes. Any system on an airplane of air speed retarding devices that serve to increase the resistance of the airplane during a glide, landing, or maneuver.

Aircraft. A generic term applied to all airborne vehicles and without regard to the method by which lift in flight is created.

Aircraft dope. The liquid material applied to the cloth, paper, or wooden surfaces of airplanes to increase strength, to produce tautness by shrinking, and to act as a filler for maintaining air and water tightness.

Air density. A measure of the number of molecules in relation to volume of air. Abbreviation: ρ.

Airflow. The relative flow of air past or around a body.

Airfoil. Any surface, such as a *fin*, *wing*, *aileron*, or *rudder*, etc., designed to obtain a useful reaction from the air through which it moves.

Airfoil section. The *cross-sectional* shape of an *airfoil*, parallel to the plane of symmetry or to a specified reference plane.

Airframe. The airplane's outer structure. In rocketry it is the name given to the *Body tube*.

Air launch. See *Airstart*.

Air scoop. See *Scoop*.

Air speed. The rate or speed at which an aircraft is traveling through the atmosphere (air) entirely independent of any distance covered on the surface of the earth. Its symbol is V (velocity).

Airstart. An act or instance of starting a rocket engine while in flight, especially after a short delay following the burnout of a booster engine.

Alignment. The act of bringing into a straight line, usually referring to the fins being attached parallel to the *longitudinal axis* of the body tube.

Aliphatic resin. A type of carpenter's wood glue that penetrates into the pores of wood and paper. Once this glue has dried, it will not soften when exposed to water.

Altimeter. An instrument for measuring or indicating the height of an aircraft above a given datum line (such as sea level or ground level).

Altitude. The height above a given reference point, such as the earth's surface.

Aluminum angle. A long metal extrusion where the two legs form a right-angle. This makes a useful tool for drawing lines down the length of a *body tube*.

Amateur rocketry. A classification of rocketry where the participant uses home-made motors that are not safety certified by the NAR, CAR, or Tripoli.

Anemometer. An instrument for indicating or measuring the speed of an airstream.

Angle-of-attack. The angle measured between the chord line (i.e., the straight line joining the centers of curvature of the leading and trailing edges) on an *airfoil* and the relative airflow, normally the immediate flight path of the rocket or aircraft. It is also called the "*angle of incidence.*" As the angle-of-attack increases (the front of the wing becomes progressively higher than the rear), the amount of lift increases—up to the stall, at which point the wing produces zero lift.

AOA. Abbr. *angle-of-attack*.

Apogee. The peak altitude that a model rocket reaches in flight.

Aspect ratio. A ratio between the wing *span* to the average wing *chord* length. Typically, the larger the aspect ratio, the lower the drag force is on a wing. It is found with the formula:

$$Aspect\ Ratio = \frac{(Wing\ Span^2)}{Avg.\ Chord\ Length}$$

Assembly. A group of objects which collectively form a structural unit. Assembly may mean the process of putting aircraft sections together.

Asymmetric fins. Lack of evenness or symmetry in size, shape, location, spacing, or orientation of the fins on a model rocket.

Asymmetric thrust. A difference in thrust about the centerline of the rocket. It only occurs in rockets that use multiple motors in either a cluster or having strap-on boosters.

Atmospheric pressure. The pressure at any point in the atmosphere due solely to the weight of the atmospheric gases above that point.

Attitude. The position or orientation of a rocket or glider, either in motion or at rest, as determined by the relationship between its axes and a reference line or plane (such as the horizon) or a fixed system of reference.

Attitude control system. A system within the flight control system that directs and maintains the desired attitude in the aerospace vehicle.

Average Thrust. A measure of the relative power of the rocket motor. It is found by dividing the rocket motors *Total Impulse* by its *Burn time.*

Autogyro. An aircraft or *helicopter* whose fall is retarded by *drag* created by a propeller whose axis is parallel to the ground. The propeller is driven only by the air forces and not by any mechanical or electrical means.

Axis (of an aircraft). Three fixed lines of reference, usually centriodal and mutually perpendicular. The first, the *longitudinal axis,* is parallel to the axis of the *thrust line.* The second, about which the plane rotates in *yawing,* is known as the *vertical axis*; and the third, the axis perpendicular to the other two, is called the *lateral axis.*

Azimuth. Angular measurement in degrees, clockwise from 0° to 360°. True azimuth is taken from true north. In two station tracking, the 0° reference line is defined as the baseline between each tracking scope.

Backslider Recovery. A form of glide recovery where the long body of a rocket descending in a horizontal orientation creates sufficient lift forces that the rocket body glides backwards (fins first) for a safe landing. Patented by Peter and Robert Alway (US Patent 6,926,576).

Baffle. See *Ejection baffle.*

Ballast. An object used as a counterweight to maintain the balance of an airplane or rocket.

Ballistic missile. Any missile which does not rely on aerodynamic surfaces for *lift* and which utilizes reaction propulsion as a power source. Such a missile, normally guided by external means during the first portion of its flight, follows a ballistic *trajectory* determined by gravitational and atmosphere *drag* forces after launch power is cut off.

Ballistic parachute. A parachute that descends vertically by producing drag only. See *Parachute recovery.*

Ballistic recovery. An unsafe recovery method where the rocket follows a simple Ballistic trajectory to the ground. Also called a *Lawn dart.*

Ballistics. The science or art that deals with the motion, behavior, appearance, or modification of missiles or other vehicles acted upon by *propellants,* wind, gravity, temperature, or any other modifying substance, condition, or force; the art of designing missiles or other vehicles as to give them efficient motion and flight behavior within the limitations set up by their purpose. See also *Exterior Ballistics*; *Interior Ballistics.*

Ballistic trajectory. The path followed by a rocket being acted upon only by gravitational forces and the resistance of the air through which it passes. A rocket without lifting surfaces describes a ballistic trajectory after its propulsive unit stops operating.

Balsa fillercoat. See *sanding sealer.*

Balsa wood. A tropical wood that is strong but low in density. It is used extensively in rocketry because it is easy to work with and because of its low mass.

Bank, to bank an airplane. To incline the airplane so the lateral axis makes an angle with the horizontal.

B.A.R. Abbr. Born Aging Rocketeer. A modeler that flew rockets as a youngster, and recently return to the hobby as an adult.

Barrel Roll. A rocket or glider which makes a complete rotation on its longitudinal axis while following a helical path, approximately maintaining its original direction.

Barrowman Method. A set of equations used to find the Center of Pressure of a model rocket. Named after James Barrowman who derived the method.

Base drag. That portion of pressure drag resulting from reduced air pressure aft of the rear end of a rocket. Base drag can be reduced by *streamlining* the rocket with a *boattail,* but this drag cannot be completely eliminated.

Baseline. The distance measured between a tracker and the launch pad for single-station tracking, or the distance between two trackers in dual-station tracking.

Basswood. A type of hardwood with very tight grain. Useful in making very smooth fins because the grain is easily filled.

Bates grain. A specific geometry of rocket propellant that produces a flat thrust curve. It is characterized by being a cylinder of propellant whose length is approximately 1.5 times the outer diameter. It also has a hollow core that runs concentrically through the cylinder. During operation, it burns on three surfaces: front, back, and core cylinder. By the time the central cylinder burns outwards to the wall, the front and back ends have burned in toward the center. The surface area stays relatively constant, which is why the thrust stays fairly uniform. Named after: Ballistic Test and Evaluation System. Bates grains are common in composite propellant motors.

Batten. A strip or bar secured to a wing or tail to prevent movement of the *control surface.* Used primarily on *Rogallo* wing gliders to prevent the fabric wing from fluttering.

Bay (body parts). Any specific compartment of the body of an aircraft or rocket, such as a payload bay.

Bay (wing). The structure included between two *ribs* on a wing or fin.

Beacon. A light or other signaling device, indicating a location or direction.

Beam; structural. A rigid body designed to transmit transverse loads in shear and/or bending to its point of support.

Beefed Up. Strengthened. Beefed up parts are strengthened at indicated points of failure of a structure.

Beeper. An electronic device that may be placed inside a rocket that emits an auditory siren. This aids in the location and recovery of the rocket after it has landed.

Bernoulli's Theorem. A theory of *aerodynamics,* which states that fluid pressure is inversely proportional to its velocity squared, i.e., increase the speed and decrease the pressure, or decrease the speed and increase the pressure. One common application of this important law is that the airflow over the upper surface of an airfoil causes a low-pressure area (suction) because the air stream has been speeded up, while the speed of the airflow over the lower surface of the airfoil remains constant; so the pressure is higher below the wing than above.

Biplane. An airplane with two wings placed one above the other.

Birch. A heavy, hard, strong, tough wood, often used to protect other woods.

Bird. A figurative name for a rocket, airplane, or other inanimate object that flies.

Black powder engine. A type of inexpensive model rocket engine that uses a pressed propellant composed mainly of potassium nitrate, sulfur, and carbon.

Blade twist, helicopter. Blade pitch-angle variation from root to tip.

Blast deflector. Any object used to divert the flame of a rocket fired from a vertical position. The object is usually made from metal or ceramic clay to withstand the intense heat so it can be used repeatedly.

Blind nut. The name given to a female-side of a threaded fastener that is mounted on the backside of a bulkhead, such that you cannot see it when you insert the male portion of the fastener.

Blister, paint. An air bubble formed under the skin of the paint. Causes may include oil residue on pre-painted surface or outgassing of solvent in paint from overexposure to high heat.

Blockhouse. A building, usually heavily reinforced to withstand blast and heat, that houses equipment for preparing and launching a rocket.

Blow down tunnel. A *wind tunnel* that operates by releasing stored air from a reservoir tank.

Blow through. A name describing the condition of a motor failure in which the *propellant* is ejected out the front end of a motor.

Boattail. The cylindrical section of a rocket's body that continually decreases in diameter. See also *Shoulder,* and *Adapter.*

Body tube. A specially wound and treated cardboard or lightweight plastic cylinder used to make the *fuselage* (main body) of the rocket.

Boosted dart. An unpowered upper stage in a multi-stage rocket. The dart stage is designed to have a lower coefficient of drag than the lower stage. Because of this, the lower stage drag separates from the dart. The momentum of the dart allows it to coast significantly higher than the whole rocket could on its own.

Boost engine. A special rocket engine without a delay element, used in staged models to ignite the top stage. The stage that contains the boost engine is commonly called a "booster."

Booster. A lower stage in a multi-stage rocket. See also *Boost Engine.*

Boost glider. A type of rocket-launched, free-flying glider that separates into two or more pieces after engine burnout. Parts may separate from the glider (usually by ejecting an engine pod) to change its mass distribution, creating stable glide. See also *Rocket Glider.*

Boost phase. The portion of flight when the engine burns, creating *thrust.*

Boundary layer. A layer of fluid (or air) close to the surface of a body part in a moving stream.

BP. Abbr. Black Powder.

Bridle. A length of line or cable attached to two parts of something to spread the force of a pull. It is another name for a parachute *riser line* that has been folded in half and secured at a ring creating a *confluence point.* Each of the free ends being attached to the suspension line confluence point.

Bristol board. A type of thick paper where the fibers are laid down in a random direction. This type of paper does not easily take a sharp crease when folded. It is useful in rocketry when making paper *shrouds.*

Buckle. A bend or kink in the surface of a structural member.

Buffeting. The repeated aerodynamic forces experienced by any part of an aircraft, caused by unsteady flow arising from a disturbance set up by any other part of the aircraft. See *flutter.*

Built-up fin. A strong and lightweight fin, created by making it hollow, with judicious placement within the structure of high-strength materials.

Bulkhead. A structural reinforcement around the inside perimeter of a fuselage or body tube in the form of a disk or tube. It may consist of a variety of materials, commonly paper or wood.

Bungee. A rubbery device or cord designed to limit forward movement of the nose cone at recovery device deployment. See *Shock Cord.*

Burn. The chemical reaction that takes place inside a rocket engine which releases high-pressure gases at high temperatures.

Burnout. The point at which *propellant* is exhausted, ending combustion of fuel in the rocket engine.

Burnout velocity. The velocity of a rocket at the termination of thrust (i.e., at *burnout*).

Burn rate. The rate at which the burning surface of a solid-propellant grain recedes when the *propellant* is consumed within a *combustion chamber.*

Burn string. A thin string that is used to hold down

part of a rocket, such as a helicopter blade. A portion of the string passes in front of the rocket engine. The ejection charge gases burn through the string, releasing the part of the rocket that was held down for the boost phase.

Burn time. The amount of time, measured in seconds, that it takes for a rocket motor's propellant to be completely consumed during its normal operation.

Butt joint. The method of attaching the fin to the rocket by gluing the *root edge* directly on the outside of the *body tube*.

Caliber. The ratio of the body tube's diameter to its length. Most commonly used in determining stability: a rocket is stable if the *center of gravity* is one or more body tube diameters or one Caliber, ahead of the center of pressure.

Camber. The rise in the curvature of an *airfoil* from its *chord*, expressed as a percentage of the wing chord length.

Camouflage paint scheme. A paint pattern used to disguise or conceal a rocket from view.

Canard. A small *horizontal stabilizer* located forward of the main wing on a glider.

Canopy. See *Parachute Canopy.*

Canted nozzle. A rocket nozzle whose center line does not lie on, or parallel with, the center line of the of the main body tube, but is tilted (canted) at some angle.

Cantilever beam. A projecting member with one end rigidly fixed and the other end projecting from the point of support, free to move vertically under the influence of vertically applied force between the free end and the fixed end. A fin or a wing *spar* is an example of a cantilever beam.

Cap strips. The longitudinal members at the top and bottom of a beam, rib, or spar, which resist most of the bending loads.

Capsule. A small, sealed pressurized cabin with an acceptable environment, usually for containing a man or animal for extremely high-altitude flights.

Captive test. A test conducted while a rocket is secured to the launch stand, primarily to verify proper operation of the propulsion and flight control subsystems under full thrust conditions.

CAR. Abbr. Canadian Association of Rocketry.

Cardboard cutout method. A procedure of locating the rocket's *Center of pressure* by finding its center of lateral area. It is found by making a silhouette of the rocket on a piece of cardboard and balancing that on a knife edge. This is the rocket's CP point when flying at a 90° angle-of-attack. Because the cardboard cutout method is overly conservative and requires excessive amounts of nose weight to the rocket, the method was replaced by the *Barrowman method*, and finally by the RockSim stability method.

Cascade riser system. A way of attaching two or more parachutes in a cluster arrangement, where there are multiple *confluence points* in the parachute cluster. Each of these confluence points are attached together via *riser lines* to create a lower confluence point of the riser lines.

Case rupture. Splitting of the rocket engine caused by the failure of the case to hold the high pressures inside the engine.

Casting resin. A two-part liquid-chemical system that when mixed together creates a solid plastic. Used in molding systems to create parts for the rocket.

Cast propellant. Solid propellant fabricated by pouring a soft propellant mixture into a mold and permitting it to solidify into the desired grain configuration.

CATO. Abbreviation for CATastrOphic failure. Usually refers to a rocket engine that has exploded. See also; *Blow through* and *Case rupture.*

Centering ring. A *bulkhead* or structural reinforcement in a rocket that aligns and holds one body tube inside of another.

Center of gravity. The balance point of the model, about which the model will always rotate. Abbreviation: CG.

Center of pressure. The point on the model where all the aerodynamic forces balance. Also called the *Aerodynamic Center.* Abbreviation: CP.

C.H.A.D. staging. (CHeap And Dirty) A method of multi-staging for a single stage model in which a booster engine is taped to a sustainer engine. Rockets with C.H.A.D. staging do not have *boost engine* sections or fins on the lower engine.

Checklist. A written list of items that have to be performed prior to launching a rocket.

Chord. The length of the line that joins the leading and trailing edges of a wing or fin.

Chuffing. The intermittent burning of a rocket engine accompanied by an irregular puffing noise. Usually caused by improper ignition technique or insufficient chamber pressure inside the motor.

Circumference. The distance around the perimeter of a circle.

Class B Motors. Rocket motors that contain 62.5 grams or less of propellant and or produce less than 120 N-s of total impulse.

Class C Motors. Rocket motors that contain more than 62.5 grams of propellant, and/or produce more than 120 N-s of total impulse.

Clean (design). An expression meaning that an aircraft or rocket is particularly free of external projections and is well *streamlined*, i.e., aerodynamically clean.

Clip whip. A short extension on the ends of launch controller wiring with multiple *micro clips* attached for clustering two or more rocket engines.

Closure. A *bulkhead*; either fore or aft, in a rocket motor to contain the internal pressure created by burning propellant.

Cluster ignition. The simultaneous ignition of two or more rocket engines to operate as a single unit, attaining a higher liftoff thrust. The total thrust and impulse of a cluster configuration is equal to the sum of thrust and impulse of the individual rocket engines.

Clustered parachutes. The use of two or more parachutes simultaneously to bring a rocket to the ground. The advantage is that it adds redundancy to the system in case one parachute fails to open properly.

Coasting phase. The period of time immediately following propellant burnout and preceding the ignition of the *ejection charge* of the engine, during which the rocket coasts on its own momentum.

Coefficient of drag. A dimensionless number calculated by:

$$C_d = \frac{\textit{total drag force}}{\textit{½ x air density x frontal surface area x velocity}^2}$$

Allows a direct performance comparison of two different models. Abbreviated C_d

Cold Power. A type of non-burning rocket propellant; usually a CFC refrigerant. Discontinued in the mid Seventies as concern over the ozone layer grew.

Combustion chamber. A cavity inside an engine where *propellant* is burned.

Competition model. Model rockets used in games or contests designed for a specific type of mission profile (ie. maximum altitude for a given engine classification).

Component. Individual part of a mechanical assembly or system.

Composite engine. A model rocket engine using a chemically cured *propellant* to achieve a higher ratio of total impulse to mass ratio compared to black powder engines, which have a lower ratio of total impulse to mass. The principal ingredient of a composite rocket propellant is the oxidizer, typically ammonium perchlorate (AP). The "glue" that holds the AP together and acts as the propellant fuel is a long carbon-chain molecule called hydroxyl-terminated polybutadiene (HTPB).

Composite materials. A structural material made up of two or more separate materials, usually to create a new material of greater strength but with lower mass. A fiberglass/epoxy sheet is one such material.

Complex cluster. A mixing of multiple diameter rocket engines within the same body tube in a *cluster ignition* arrangement.

Concentric. Having a common center.

Cone. A geometric configuration having a circular bottom and sides tapering off to an apex.

Cone stability. The inherent stability, without the need of fins, of a model with the general shape of a cone. The CG must still be placed forward of the CP for stability.

Confluence point. The point where all the suspension lines on a parachute meet and are attached to the rocket.

Conformal launch lug. A molded launch lug that includes fairings that form to the curvature of the *body tube*. This increases the bonding surface area of the lug, making it stronger, and also lower drag because of the fairings act as *fillets*.

Coning. Description of a model in flight where the nose precesses about the thrust axis of the model. It looks like the nose tip remains fixed, while the tail swings in a circle. This condition greatly increases drag and reduces the altitude of the rocket.

Configuration. The arrangement of parts on a rocket or glider.

Contact cement. A flexible adhesive applied to both surfaces of the parts being joined together. Most useful on paper-to-paper bonds.

Continuity. The condition of a launch system having a complete electrical circuit to allow ignition.

Control surface. *Flaps*, tabs, or movable panels on wings, elevators, canards or rudders used to set the glider to some predetermined *attitude*.

Conventional boost glider. The generic name given to a configuration of rocket-launched *boost gliders* where the engine is attached to the nose of the glider and the wing is in front of the horizontal tail.

Copperhead™ Igniter. The trade name given to Aerotech's igniter for small composite propellant motors. A copperhead looks like a single strip of copper with a pyrogen on the tip. But it is actually two very thin strips that are glued together. The glue acts as an insulator so that a complete electrical circuit can be achieved when the *igniter clips* are attached.

Core ejection. Occurs in rear engine boost gliders when the *engine mount* tube is forced (or ejected) out the rear of the model, so the CG of the glider moves aft over the wing.

Core sample. Slang description of a model rocket that separated at ejection. The body tube, without the nose cone, becomes stable and crashes into the ground and penetrates the soil. This soil becomes lodged in the tube. See *Lawn dart.*

Countdown. The step-by-step process leading to a rocket launching. It is performed in accordance with a pre-designed time schedule, measured in terms of T-Time (T minus time prior to initiation of engine start and T plus time thereafter).

Coupler. A tube or cylinder used to connect two body tubes of the same diameter.

Covering, aircraft. The material covering the framework of an aircraft structure.

CP. Abbr. Center of Pressure.

Craze. Cracking of paint into a rough surface texture caused by incompatibility of paint underlying paints or primer.

Crepe paper. A flame proof paper used primarily for birthday parties. Because it is flame proof, it can also be used in rocketry as *recovery wadding*.

Cross section. The surface that would be exposed if a part were to be cut in half.

Curved fin. A fin *planform* where one or more of the edges is not a straight line.

Cutting pattern. A template placed on top of something that is used as a cutting guide for the material being removed from the sheet.

CyA glue. See *cyanoacrylate.*

Cyanoacrylate. Chemical name given to a type of adhesive that hardens very rapidly. Sometimes called instant or super glue. Abbreviated: CA or CyA.

Dart. See *Boosted dart.*

Death dive. A non-recoverable, near vertical downward trajectory of a glider.

Decal. Preprinted artwork applied to the outside of the model for decoration.

Decalage. The relative angle between the wing's *angle-of-attack* and the stabilizer's *angle-of-attack* on a glider. This difference in angle allows the glider to pull out of a dive.

Deceleration. The retarding or slowing down of an object, i.e., the decrease in the rate of change of velocity. Negative *acceleration.*

Deflection. The bending or displacement of the neutral axis of a structural member from the position it normally occupies, due to an external load.

Deflector. See *Blast deflector.*

Delayed staging. A variation of *series staging* where the upper motor does not start immediately following the *burnout* of the motor below it. The rocket coasts for a short length of time before the upper stage motor fires. This lowers the velocity of the rocket, thereby minimizing *drag* and allowing the rocket to fly higher.

Delay element. Slow-burning *propellant* that initiates the burning of the *ejection charge* after a predetermined time following termination of engine thrust.

Delay phase. See *Coasting Phase.*

Delta wing. A triangular wing having a low aspect ratio, tapered *leading edge*, and a straight *trailing edge.*

Density. The ratio of the mass of an object to its volume.

Deployment. That portion of a rocket's operation from the moment of *ejection charge* initiation to instant of inflation of the canopy for a parachute, or the complete extension of the rotor blades in a helicopter.

Deployment bag. A fabric container that houses the parachute, often made of a heat resistant material. It protects the parachute from the heat of the ejection charge, and it prevents the parachute from opening prior to the suspension lines completely unfurling. That lowers the opening stresses on the parachute and reduces the chances of the lines tangling.

Deployment charge. See *ejection charge.*

Design constraints. Factors that limit the size, shape, or configuration of a particular design.

Dethermalizer. A device on a glider that triggers (at a certain time) a retrimming of the glider to bring it to the ground at a faster rate.

Differential aileron linkage arrangement. *Ailerons* interconnected so that the upward displacement of one aileron is greater than the downward displacement of the other.

Diffusion tip wings. The wings on a type of *tailless airplane.* The wing tips are cut diagonally across the span and bent downward at the cut line, providing washout for the wing.

Dihedral. Raising of the wing tip upward relative to the wing root, thus giving the glider *yaw* and *roll* stability.

Directional stability. The tendency of an airplane to immediately return to its original direction of flight after being thrown off its flight course.

Direct staging. A method of multi-staging in which the lower engine ignites the upper stage engine without assistance from other devices.

Disk-type centering ring. A *centering ring* made from a flat sheet of material, such as cardstock or plywood.

Display launcher. A static base for holding a rocket that is not intended to be used for actual launching, although it looks like it could.

Dive. Condition of a glider that noses down rapidly.

Dog barf. Slang term for the shredded cellulose insulation that is used as *recovery wadding.*

Dope. A liquid lacquer paint used on balsa wood to seal the pores of the wood grain.

Doppler effect. Apparent change in frequency of sound or light due to motion.

Downdraft. A downward moving body of air.

Downrange. In a direction away from the launch site, usually in direction of the relative wind in the area of the launch site.

Downwash. The air deflected perpendicular to the direction of motion of an *airfoil*, i.e., it is the bending down of the air column upon which the wing acts while in flight.

DQ. Abbr. Disqualification.

Drag. The resistance or friction force experienced by any moving object through air.

Drag recovery. A method of returning a model to the ground in which the large frontal area of rocket provides sufficient resistance to bring the model down slowly.

Drag separation (nose cone). A phenomenon where the nose cone is apparently sucked out of the rocket after engine burnout. The theory is that the rear part of the rocket slows down faster than the nose because of its higher drag. The momentum of the nose cone wants to continue going fast, and it separates from the rear of the rocket. This can be eliminated by the use of shear pins holding the nose cone to the body tube. See also *Nose cone pop-off.*

Drag separation (multi-stage rockets). The name given to the situation when the upper stage of a multi-stage rocket separates from its booster stage after engine burnout. This occurs if the booster stage has a larger diameter than the upper stage and the drag forces on it pull it away from the upper stage. Because of this, electronics for igniting the upper stage should be positioned in the upper stage. This will prevent the igniter in the sustainer motor being yanked out at separation.

Drogue parachute. A smaller canopy deployed to slow and stabilize the load, usually prior to main *parachute canopy* deployment.

Drone. A pilotless aircraft operated by remote control.

Dual deployment. Recovery technique for high power rockets where a *drogue parachute* or *streamer* is deployed near apogee of the trajectory. The model then descends quickly until the main parachute is deployed at a lower altitude.

Dullcote. A brand name of clear paint that has a nonreflective finish when dry.

Dynamic Stability. How a rocket or aircraft responds over time when disturbed from a given angle-of-attack, slip or bank. One with a positive dynamic stability will come back to a predictable path after being hit with a disturbance such as a gust of wind.

Dziedzic cut-outs. Relatively large rectangular slots cut in a *minimum diameter rocket* body tube. Tape rectangles of the approximate size of the slot is placed in the slots and affixed to the rocket motor to prevent it from moving fore or aft during the flight. This motor retention system is named after its inventor, Norman Dziedzic.

Effective drag coefficient. A constructed number used to make a comparison between descent rates of *paragliders* (which relies on lift forces to slow the falling object) to *ballistic parachutes* which use drag forces.

Egglofting. The launching of a raw hen's egg, the purpose of which is to return it to the ground without breaking the shell.

Ejection baffle. Any device or system forward of the rocket engine that slows and cools the *ejection charge* gasses before they reach the parachute. It also deflects and traps any large particles resulting from the ejection charge.

Ejection cannon. A small tube mounted to a bulkhead in a rocket that holds the ejection charge.

Ejection charge. A chemical substance that produces a large volume of gas in a model rocket when ignited by the *delay element.* This gas pushes the recovery device out of the rocket or activates a deployment sequence of rotors, pistons, flaps, wings, etc.

Ejection gases. The hot rapidly expanding vaporous gases created by the burning of the deployment charge in a rocket.

Elevation. Angular measurement in degrees, clockwise from 0° to 180°. In two station tracking, the 0° reference is the horizon line, 90° being straight up.

Elevator. The movable control surface on the *horizontal tail* used to make the glider pitch upward (to pull out of a dive) or downward about the *pitch axis.*

Elevon. A horizontal aerodynamic *control surface* that combines the functions of an *elevator* and an *aileron.*

Empennage. The rear part of an airplane, usually consisting of a group of stabilizing planes (horizontal and vertical stabilizers). Sometimes this portion of the airplane is referred to as the airplane tail assembly, tail group or tail unit.

End burner. A propellant grain geometry typically used in black powder propellant rocket motors. Only one end of the propellant cylinder burns during normal operation. The thrust level on this type of grain is constant during the burn because the burning surface area remains constant.

Energy. The capacity for doing work.

Engine (model rocket). A miniature solid fuel rocket motor that contains *propellant*, a *delay element*, and an *ejection charge*; composed of nonmetallic substances. Designed to impart force to accelerate the rocket during flight. A machine or thermodynamic device that converts energy, especially thermal energy, into useful work.

Engine Block. A hollow frame or *bulkhead* placed directly in front of a rocket engine to keep it from sliding forward into the rocket. See *Thrust Ring.*

Engine hook. A bent piece of metal with a small angle at one end, which holds the engine securely in the engine mount.

Engine hook retainer ring. A ring of paper or plastic that holds the engine hook securely to the engine tube.

Engine mount. An apparatus that holds the engine firmly in place so it is aligned with the centerline of the model.

Engine tube. A *body tube* that is part of the engine mount into which the engine is inserted for flight.

Epoxy. A high-strength, two-part adhesive for bonding parts or for creating *fillets.*

Epoxy Clay. A synthetic clay that has been impregnated with epoxy adhesive. The advantage is that the adhesive stays in one place without running.

Equipment pods. *Capsules* or compartments mounted on the outside of the vehicle in which equipment is stored for the flight.

Erosion, nozzle. A wearing away of the throat of a nozzle from the action of the hot exhaust gasses of the rocket engine.

Escape velocity. The speed an object must reach to leave the pull of Earth's gravity.

Estes dent. Slang term to describe the damage to the front of a body tube due to *nose cone snap back.*

Excessive drag. A large amount of aerodynamic drag that could otherwise be easily reduced.

Exhaust clearance. On front-engine *boost gliders*, the distance the engine must be placed upward so the gaseous plume does not impinge on other parts of the glider.

Exhaust velocity. The velocity of gasses exiting through the nozzle of an engine.

Expansion ratio. The ratio of the section area of

the nozzle exit to the section area of the *nozzle* throat.

Expended Engine. The empty engine casing after the *propellant*, *delay element*, and *ejection charge* have been completely burned.

Exterior ballistics. That branch of *ballistics* concerned with the behavior of a missile during flight, influenced by conditions of air density, temperatures, velocity, etc.

External force. Force applied to a structure or body from some outside source.

Fantasy rocket. Name given to the type of *sport model* rocket that evokes feelings of mysticism.

Fairing. Rigid material shaped to streamline a part to reduce drag.

Featherweight recovery. Rocket recovery system in which a very lightweight model falls slowly because it has low mass relative to its size. The *drag* force easily counteracts the force of gravity.

Fiberglass. A man-made flexible cloth material known for its strength and low mass. The individual fibers are solidified into a rigid sheet by placing a liquid epoxy resin onto the sheet.

Filler putty. A paste or liquid used for filling the pores of wood prior to applying paint.

Fillets. A fairing of glue or *epoxy* along the root edge of fins or wings (where they attach to the body tube) providing additional fin strength.

Fin. An aerodynamic surface projecting longitudinally from the rocket body to give it directional stability. Fins are the rocket's stabilizing and guiding unit.

Fin attachment. The mounting of the stabilizing fin to the *body tube* of the rocket.

Fin can. A preassembled fin unit made from a short body tube and fins. The unit is slid over a body tube and glued in place.

Fin span. The distance from a fins root edge to the furthest point on the tip edge.

Fineness ratio. The ratio of the length to the maximum diameter of a streamlined body. See *Caliber.*

Fin flutter. An oscillation of a fin caused by buffeting of air flowing over it. Fin flutter will cause a rapid rise in drag, and if it gets too excessive, the fin can be stripped completely off the rocket. See also *Buffeting.*

Finishing. The art and practice of creating a smooth and attractive appearance on a model rocket.

Finless rocket. A model rocket that does not have flat external fins protruding from the body tube. Cone shaped rockets are an example of a finless rocket.

Firewall. A fire-resistant *bulkhead.*

Flame bucket. An opening built into the launch pad into which the hot gasses of the rocket pour. The flame bucket is directly under the rocket positioned for launch. One of its sides turns inward to form the flame deflector; the opposite side is open. See also *Blast Deflector.*

Flame Deflector. See *Blast Deflector.*

Flap. A movable *control surface* that deflects air. On the wing the flap is called an *aileron*, and on the horizontal stabilizer it is called an *elevator*. On the vertical stabilizer the flap is called a *rudder*. Flaps can also be used for brakes.

Flaperons. Missile control system, either differentially or integrally operated, which combines the attitude control of *ailerons* with the increased lift and braking effect of *flaps*.

Flat spin. A flight condition of rotation about the vertical axis while the longitudinal axis is inclined downward less than 45 degrees with the horizontal or level plane. Ailerons and tail surfaces are ineffective because the airplane is in a stalled condition; the downward path of the airplane and the rotation carries the tail control group away from the slip stream.

Flat trajectory. The path described by a rocket flight that does not have a high arch.

Flex wing. A glider that uses thin, flexible plastic sheeting for a main lifting surface. This reduces the mass of the glider and allows the wings to be folded for launch so higher altitudes are reached. Flex wing gliders are sometimes called "Flexies". See *Rogallo.*

Flexie-glider recovery. A type of *glider recovery* that uses a *flex wing* instead of a rigid wing.

Flight-critical item. A component that is absolutely necessary to the success of the vehicle's mission. A fin is an example of an item the might be considered a flight-critical item.

Flight path. The line connecting the continuous positions to be occupied by an aircraft or rocket as it moves through the air.

Flight path angle. The angle between the *flight path* of the aircraft and the horizontal.

Flight profile. A graphic portrayal on a computer of a rocket's flight as seen from the side, indicating the various altitudes along the route.

Flight simulation. A computerized flight test of a rocket launch that will predict the approximate performance of the rocket, such as altitude, maximum speed, and duration aloft. From a flight simulation, a *flight profile* can be generated.

Flight test. A test of a component part of a flying vehicle to determine its suitability or reliability in terms of its intended function, done by making the component endure actual flight conditions.

Flight test vehicle. A test vehicle for the conduct of flight tests, either to test its own capabilities or to carry equipment requiring flight test.

Flightworthy. Of a aircraft or rocket, ready and sufficiently sound in all respects to meet and endure the stresses and strains of flight.

Flutter. An oscillation of definite period but unstable character set up in any part or an aircraft by a momentary disturbance, and maintained by a combination of aerodynamic, inertial, and elastic characteristics of the member itself. See also *Buffeting.*

Fluid. A state of matter such that it adjusts itself to its container. Fluid may be either liquids or gases. Air is considered a fluid.

Fly-apart launch lug. A two-piece launch guide that slips around the outside of the body tube of the rocket. It splits apart as the rocket leaves the launch rod, lowering the drag on the rocket.

Flying plank. A type of *tailless aircraft* that does not have a swept wing but uses a *reflexed airfoil* to achieve longitudinal stability.

Flying wing. A special shape of glider, designed and balanced for a stable glide, that has no horizontal tail or canards.

Foam board. A sandwich material typically used for poster backing. It consists of thin paper or plastic skins that surround a foam center. In rocketry, it is useful for making thick lightweight fins and centering rings.

Foam core. A construction method for fins and wings in which a sheet of plastic foam is sandwiched between two skins made from stronger materials (balsa wood, fiberglass/epoxy, paper, or plywood).

Force. Any action changing the state of motion or position of a body. A force is a quantity and may be represented by a straight line, called a *vector*. A force has three characteristics, (1) magnitude, (2) direction, and (3) point of application.

Forced landing. Any landing of a aircraft or rocket due to structural failure or any other condition that makes continued flight either impossible or inadvisable.

Fore. Forward or in front of a designated position.

Form drag. The *drag* due to the vehicle's shape. For example, rounded and streamlined shapes have less drag than blunt shapes.

Former, or false wing rib. Any incomplete rib, frequently consisting only of a short section extending from the *leading edge* to the front *spar*, used to help maintain the form of the wing where the curvature is sharpest.

Forward closure. The threaded portion on the front end of a reloadable motor casing that holds the internal pressure inside the casing.

Framework. A structure used to create a strong yet hollow wing or fin.

Free fall. The fall of a body without being guided and without being retarded by parachute.

Free flight. Unconstrained or unassisted flight of a glider.

Freeform fin shape. A flat fin *planform* that does not have the shape of a parallelogram or ellipse. Used to describe custom fin shapes in the *RockSim* software.

Friction. The resistance a body encounters in moving across the surface of another with which it is in contact.

Friction fit. A tight joining of two coaxial parts in which the inner part's outside diameter is equal to the outer part's internal diameter. The force of friction between the two surfaces in contact keeps the parts from moving.

Frontal area. The surface of the rocket that faces directly into the airstream.

Fuel. Any substance which, combined with oxygen will burn and produce heat.

Functional display launcher. A type of rocket pad with aesthetic qualities that give it an appearance of a real military or scientific *launch pad.*

Fuselage. The structure, of approximate streamline form, that houses the crew, passengers, or cargo.

Futuristic rocket. *Sport model* rockets that look like they actually belong in outer space or on some distant worlds.

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 timers to control activation of events like staging or parachute ejection.

Gantry. A crane rolling on rails, used for the erection and general servicing of large missiles. Sometimes also called a "Mobile Service Tower" (MST)

Gas. A fluid that tends to expand indefinitely.

Gimballed motor. A rocket motor mounted on gimbal, which is a mechanical device for permitting an object to incline freely in any direction, so that it will remain level when its support is tipped.

Glide. The controlled descent by a heavier-than-air vehicle under little or no engine thrust, in which forward motion is maintained by gravity and vertical descent is controlled by lift forces.

Glide path. The flight of a glider in an unpowered glide, seen from the side. See also *Flight path.*

Glide phase. The portion of a glider's flight after engine burnout when the model glides like an airplane.

Glide ratio. The ratio of distance covered horizontally to height lost vertically.

Glide recovery. Rocket recovery system in which the engine's ejection charge causes it to convert into a glider and which creates lift as it flies through the air. See also Backslider recovery, *Boost Glider*, *Rocket Glider,* and *Flexie-glider recovery.*

Glider pop pod. See *Pop Pod.*

Gliding booster. A lower stage of a *multi-stage rocket* that returns to the ground by using aerodynamic lift produced by the fins instead of other recovery methods.

Glosscote. A brand name of a type of paint that dries with a shiny and reflective finish.

Glue rivets. A method of increasing the bonding surface area of *butt joint* fins. Small holes are pricked into the root edge of the fin and the body tube before the wood glue is applied. As the glue penetrates the parts, it forms tiny rivets that increase the strength of the joint.

Gore (parachute). The triangular portion of fabric between two adjacent meridian seams.

Grain (propellant). The propellant inside a solid fuel rocket. The grain is defined by its dimensions and surface shape.

Grain. See *Wood Grain.*

Gravitation. Force of attraction that exists between all particles of matter everywhere in the universe. The law of gravitation is: Every particle of matter in the universe attracts every other particle with a force that varies directly as the product of their masses, and inversely as the square of the distance between them.

Gravity. The force that pulls down on any object near the surface of the earth.

Ground effect (floating or cushioning). An apparent increase in lift while flying an airplane close to the ground, within an altitude which varies from zero to a height approximately equal to the wingspan. There is no simple explanation, but there is a compressive force between the ground and the wing and also a decrease in the *downwash* angle of the air from the trailing edge of the wing, causing a reduction in *induced drag.*

Ground loop. An uncontrollable violent turn of an airplane while taxiing, or during the landing or takeoff run.

Grow foam. A two part polyurethane resin system that bubbles up and hardens as the chemical reaction takes place. It is useful in rocketry for filling large cavities inside the rocket.

Ground speed. The velocity of an aircraft relative to the earth.

Guidance, inertial. A guidance system which does not depend on information obtained from outside the rocket or missile, and which contains elements sensitive enough to operate on the principle of Newton's second law of motion.

Guidance system. A system that measures and evaluates flight information, correlates it to the expected destination, and converts the results into parameters necessary to achieve the desired flight path. A guidance system may be self-contained within the rocket, or the guidance function may be performed by various combinations of ground and airborne components.

Gusset. Any generally triangular brace used to strengthen the corners of a structure.

Gyroscope. A gyroscope consists of a well-balanced flywheel, universally mounted, and having three degrees of freedom about its center of gravity, which always remains in a fixed position. A gyroscope exhibits the characteristics of rigidity as long as the wheel is revolving at a high speed-it tends to remain in the same position and plane of rotation.

Hand-launched glider. A glider that is thrown into the air.

Hatch. A door in the side of a spacecraft.

Headwind. A wind that blows approximately parallel to the line of flight of an aircraft and retards the ground speed of the airplane.

Heat shield. Any device that protects something else from heat.

Helicopter recovery. Rocket recovery system in which vanes on the rocket are activated by the engine's *ejection charge.* The vanes are *airfoil* surfaces mounted on the rocket in such a way that air flowing over them generates lift, causing the rocket to rotate (like a helicopter) safely to the ground.

High power rocketry. Model rockets that use engines (or combinations of engines) that are rated higher than 20 Newton-seconds (D engine or higher).

Horizon. The line where the earth and sky apparently meet.

Horizontal-spin recovery. A unique form of recovery where the spinning tube creates lift via the *Magnus effect* to slow the rocket for a safe landing.

Horizontal stabilizer. A structural component of an aerodynamic vehicle consisting of a fin mounted on the vehicle so that its largest surface is parallel to the plane of the *horizon.*

Hot melt glue. A form of thermoplastic adhesive that is commonly supplied in solid sticks designed to be melted in a special gun. Hot melt glue should NEVER be used to attach fins to a rocket. The heat of the rocket engine could melt the glue, and the fins could fall off during flight.

HPR. Abbr. High Power Rocketry.

Hybrid rocket motor. A rocket motor that uses a solid fuel and a gaseous oxidizer. The solid fuel is usually a paper or plastic cylinder, and the oxidizer is *nitrous oxide.* The advantage is there is no flammable substances so there are no BATF regulations against using them.

Hypersonic. *Supersonic* velocities having a Mach number of at least 5.

Ignite. To begin the combustion process of a rocket engine.

Igniter. An electrical device that initiates the combustion process in a rocket engine.

Igniter clips. The common name given to the alligator clips on the ends of the wire from the launch controller.

Igniter plug. A specially shaped plastic piece that holds the *igniter* securely into the *nozzle* of the rocket engine.

Impact area. The area where an errant rocket lands.

Impulse. The product of a force and the brief time during which the force is applied.

Impulse, total. The product obtained by multiplying the thrust from the motor by the burning time in seconds.

Indirect staging. Any staging technique in which the hot ejection charge gasses of the booster engine do not ignite the *sustainer engine.* This usually requires an onboard ignition system to ignite the *sustainer engine.*

Induced drag. That part of *drag* that results from the generation of lift of the wing.

Inertia. That property of matter by which a body at rest tends to stay at rest and a body in motion tends to continue in motion unless acted upon by some external force.

Infinite-span wing. In aerodynamic theory, a wing of endless span, thus having no tip vortices nor *induced drag,* assumed for purpose of simplification.

Inherent stability. Stability of an aircraft due solely to the disposition and arrangement of its fixed parts, i.e. that property which causes it, when disturbed, to return to its normal attitude of flight without the use of controls.

Instability. The opposite of *stability.*

Interference drag. When two parts of an object or parts of an airplane are in close proximity to each other their combined *drag* is greater than their respective drags if tested individually.

Interior ballistics. Deals with the rocket's behavior in reaction to gas pressures inside the rocket, escapements, and the shift in the center of gravity as propellants are consumed.

Interlock. Any safety device inserted in an electrical circuit that must be correctly positioned or removed for the circuit to be completed. Used in launch control systems to prevent accidental ignition. An example of an interlock is a *safety key.*

Interstage section. A hollow section of a rocket that lies between stages.

JATO. Abbreviation for "jet-assisted-takeoff"; an auxiliary rocket device for applying thrust to an aircraft to help it take off with heavier loads, shorter runs, and greater accelerated speeds.

Jet. The high-velocity, hot gas stream that rushes out from the rocket *nozzle* at *supersonic* velocity.

Jet Aircraft. An airplane which breathes air and is propelled by the thrust of exhaust gases.

Jig. An accurately constructed framework used as an aid in assembling and aligning.

Joint. The point where two parts meet. A fin joint is where the fin meets the body tube.

Kaplow clip. An engine retention method where a small rigid piece of metal that hooks over the end of a reloadable motor. The clip is held in place by a small screw that must be loosened to install/remove the motor. Named after Robert Kaplow who first popularized the retention technique.

Keel length. The distance between the furthers suspension line attachment points on a parawing. Measured from the leading edge to the trailing edge.

Kicker. A liquid applied to *cyanoacrylate* adhesives to make them harden quicker.

Kinetic energy. Energy due to the motion of a mass. It is equal to one-half the mass times the velocity squared. Kinetic Energy = $^1/_2mV^2$

Kitbash. The act of taking parts out of existing rocket kits and creating a new and unique model.

Kraft paper. A type of inexpensive brown paper.

Kushnerik effect. A loss of engine thrust and total impulse caused when a rocket engine is recessed inside a rocket's body.

Laminar flow. Smooth flow of air in which no cross-flow of fluid particles occur between adjacent stream lines; hence, a flow conceived as made up of layers—commonly distinguished from *turbulent* flow.

Laminated wood. A product formed by gluing or otherwise fastening together a number of laminations of wood with the grain substantially parallel. (Differs from plywood in that in the latter the grain of alternate plies is usually crossed at right angles; also the plies of the latter are usually made up of veneer.)

Land Shark. Slang term to describe the *trajectory* of a rocket that goes *unstable* and hits the ground and then skimming along the ground until the propellant is exhausted.

Lariat Loop. An engine retention method used on *minimum diameter rockets* where a slip knot in the *shock cord* is passed around the rocket engine and up through the body tube to the nose cone. The engine is effectively tied to the rocket and cannot come down by itself. Used mostly on *competition model rockets*

Lateral axis. An imaginary line running through the *center of gravity* of a model, parallel to the wing span of a glider. The model will pitch up or down about this axis.

Launch. To send off a rocket vehicle under its own rocket power.

Launcher. A mechanical structure for controlling the initial flight path of a rocket without providing any propulsion in itself.

Launch angle. The angle between a vertical plane and the *longitudinal axis* of a rocket being launched.

Launch controller. An electrically operated device used to *ignite* rocket engines from a remote location.

Launch lug. A round hollow tube that slips over the *launch rod* to guide the model during the first few feet of flight until stabilizing velocity is reached.

Launch lug standoff. A pylon on which the launch lug is attached. Used on models where the diameter of the nose is larger than the rest of the rocket.

Launch pad. The load-bearing base or platform from which a rocket is launched.

Launch rail. A type of *launch rod* that, instead of a circular cross section, has a cavity that will accept a post attached to the rocket. Launch rails are stiffer than launch rods and won't flex as much.

Launch rod. A cylindrical rod used to guide a rocket in its first few feet of flight.

Launch tower. See *Tower Launcher.*

Lawn Dart. A type of ballistic crash where the rocket lands nose-first into the ground.

LCO. Abbr. Launch Control Officer. The person on the launch field that controls the site.

Leading edge. The front edge of a wing or fin.

Lift. The force that occurs when air moving over the top of a moving object travels faster than the air under it, producing uneven pressures. The pressure on the top of the object (wing) is lower

than under it, sucking the object upward. That component of the total aerodynamic force acting on a body perpendicular to the undisturbed airflow relative to the body.

Lift coefficient. A dimensionless number found by:

$$\frac{Lift}{Coefficient} = \frac{Total\ Lift\ Force}{\frac{1}{2} \times Air\ Density \times Velocity^2}$$

Abbreviated by C_L. It allows direct performance comparison of two different airfoils.

Lifting-body recovery. A type of *Glide recovery* where the body of the rocket creates enough lift to slow the model for a safe landing.

Liftoff. The action of a rocket as it separates from its launch pad in a vertical ascent.

Liftoff mass. The entire mass of the model at the moment of ignition, not including the small mass of the *igniter* or *igniter plug*.

Lift-to-drag ratio. The lift generated by a wing divided by the drag produced, expressed as a ratio. Abbreviation: L/D.

Lightening holes. Holes cut into *disk-type centering rings* or *bulkheads* to reduce material and make the rings lighter weight.

Line stows. Fabric or rubber band loops on the outside of a parachute *deployment bag*. The *suspension lines* of the parachute are tucked into these loops so as to keep them from getting tangled and to provide a mechanism for the lines to unravel in an orderly fashion so the parachute inflates properly.

Lite-ply. The name given to a low-density plywood. Sometimes also called "wop-pop".

LMS. Abbr. *loadable motor system.*

Loadable Motor System. A single use motor that comes as a kit that must be assembled prior to flight. It is like a *reloadable rocket engine*, except that the case is only designed to be used a single time.

Longitudinal axis. An imaginary line through the *center of gravity* of a model parallel to the fuselage or boom. The model rolls left or right about this axis.

Low power. The name generally given to rockets that use 1/4A to C size motors.

Mach number. The ratio of the velocity of an object to the velocity of sound under the same atmospheric conditions. A speed of Mach 1 means the speed of sound, regardless of altitude.

Magnus effect. The name given to the physical phenomenon whereby a spinning object creates a whirlpool of rotating air or liquid about itself. The overall behavior is similar to that around an airfoil with a circulation which is generated by the mechanical rotation, rather than by airfoil action.

Magnus-rotor recovery. A recovery method that uses a rotating set of blades, each independent of the others, to create lift and drag to slow the rocket to a safe descent speed.

Maneuverability. That quality of any vehicle that determines the rate at which its *attitude* and direction of movement can be changed.

Marginal Stability. The condition where the distance between the *Center of gravity* and *Center of pressure* divided by the tube diameter is in the range of 0-to-1. Because the CP position can change during flight (as a function of *angle-of-attack*), it is desirable to have a stability margin that is greater than 1.0 so that the rocket can never become unstable during flight.

Margin-of-stability. See *Stability margin.*

Mass. Quantity or amount of matter of an object. *Weight* depends on mass.

Mass-burning rate. The rate at which a mass or bulk of solid *propellant* is consumed per unit time while enclosed in a combustion chamber under known conditions of pressure, ambient grain temperature, and gas-flow velocity.

Mass flow rate. The rate at which exhaust gases travel through a rocket *nozzle* measured in kilograms per second.

Mass ratio. The ratio of the liftoff mass to the final burnout mass. The larger the number, the higher the rocket will go.

Maximum thrust. See *Peak thrust.*

Mean Aerodynamic Chord. The chord of an imaginary rectangular *airfoil* that has pitching moments throughout the flight range the same as those of an actual airfoil or a combination of airfoils under consideration; calculated to make equations of aerodynamic forces applicable to nonrectangular wings.

Micro balloons. A powder or paste made from microscopic, hollow glass spheres. Typically used as a finishing putty for filling gaps in a rocket or as a thickener for *epoxy*.

Micro clips. Small spring-loaded clamps for connecting the electrical launch system to the igniter inserted into the rocket motor. Also called *igniter clips.*

Mid-body ejection. A method of ejecting the *recovery system* out of the rocket near the middle of the body tube. The tube is separated at that point instead of near the nose cone as a drag reduction technique and to reduce the chances of the *zipper effect*.

Mid-power rockets. The name given to rockets the use D to G size rocket motors.

Mini-engine. The name given to 13mm diameter rocket engines. The range from "1/4A" to "A" size.

Minimum diameter rocket. The smallest diameter rocket than can be built for a given type rocket engine. Minimum diameter rockets are designed to achieve the highest possible altitude.

Minimum safe lift-off speed. The slowest speed that a rocket can safely exit the launcher. Based on 50 years of rocket flights, the minimum safe lift-off speed is approximately 13.4 m/s (30 miles per hour).

Model rockets. Small unmanned rockets that fall into a category that don't require special waivers from the FAA in order to launch.

Module. A combination of components contained in one package or so arranged that together they are common to one mounting, which provide a complete function or functions to the subsystem in which they operate.

Moment. A tendency to cause rotation about a point or axis. The object will rotate around a point called the "center-of-mass," or "*center of gravity*." The measure of this tendency is equal to the product of the force and the perpendicular distance between the point of axis of rotation and the point of application.

Momentum. The property of a moving object which is the product of its mass multiplied by its velocity.

Monocoque (mo'-no'kok') construction. A type of construction in which the skin or shell carries all the bending and sheer stresses. Monocoque construction has vertical bulkheads as its only reinforcement.

Monocopter. A type of bodiless helicopter rocket that ascends into the air by spinning. It can be propelled (spun) by a rocket motor or small propeller driven motor.

Monokote®. Brand name of heat-shrinkable plastic used as a covering for built-up wings on airplanes.

Motion. Movement of an object in relation to its surroundings

Motor. See *Engine.*

Motor adapter. A temporary and removable *engine mount* that allows a smaller diameter motor to be used in a rocket that is designed for larger diameter motors..

Motor hook. A piece of spring steel that is bent to shape to retain the *engine* in the rocket.

Motor mount. See *Engine mount.*

Motor retainer. A generic description of the type of device that holds the rocket motor in the rocket preventing it from being kicked out at ejection. A *motor hook* is one example of a motor retainer.

Multi-stage rocket. A rocket vehicle having two or more rocket units, each firing after the proceeding unit has exhausted its propellant. Normally, each unit, or stage, is jettisoned after completing its firing. Also called a multiple-stage rocket or, infrequently, a step rocket. See also *series staging.*

Music wire. A high grade, uniform variety of steel used for the manufacture of springs. It is known for its great stiffness. Also called "piano wire."

Mylar®. A type of sheet plastic known for its high strength. It is optimal for making strong *parachutes* and *streamers.*

Nacelle (na-sel'). An enclosure fastened to the wing for fairing an object that is larger than the boundaries of the airfoil section.

NAR. Abbr. National Association of Rocketry.

NARAM. Abbr. National Association of Rocketry's Annual Meet. The yearly contest to crown the national rocketry champion in the USA.

NARCON. Abbr. National Association of Rocketry Convention. The yearly conference of the *NAR* to teach modelers different aspects of rocketry.

Neutral point. The center of pressure point on a glider.

Neutral stability. A neutral stable airplane is one that if disturbed from a state of steady flight will not return to its original flight *attitude* but may seek any new flight attitude and state of steady flight.

Newton. A force or measurement of force. The amount of force needed to move a mass of one kilogram with an acceleration of one meter per second per second; one Newton is equal to 0.225 pounds of force. Abbreviation: N.

Newton-second. Metric measurement of a rocket engine's total impulse. The metric equivalent of "pound-second." Abbreviation: N-s.

Nitrous Oxide (N_2O). A gaseous oxidizer used in hybrid rocket motors. Also called "laughing gas."

Nose cone. The foremost surface of a model rocket. Generally tapered in shape for streamlining. Smooths the airflow around the rocket.

Nose cone eyelet. On a plastic nose cone, the molded loop to which the *recovery system* and *shock cord* can be attached.

Nose cone pop-off. The description given to the event where the nose cone prematurely releases from the *body tube* of the rocket. It is caused by a build-up of pressure inside the rocket because the outer air pressure is reduced from an increase in altitude. A *vent hole* can be used to eliminate the pressure build-up inside the rocket.

Nose cone snap back. Condition describing the path of a nose cone that is attached to a rubber shock cord. When he rubber cord is fully extended, the rubber will contract quickly, bringing the nose cone with it. The snap-back may bring the nose cone in contact with the front edge of the body tube. If it is deformed, it is commonly referred to as the z

Nose block. A solid cylinder of balsa or plastic used to connect two body tubes and prevent ejection charge gasses from passing through to the upper tube. See also *Tube Coupler.*

Nose blow recovery. A type of *streamer* recovery, where the *shock cord* acts as the streamer so no other recovery device is needed. This method is only used on small and low mass models.

Nose heavy. The condition of an airplane in which the nose tends to sink when allowed to seek its own *attitude*.

Nose weight. Mass that has been added to the forward part of the rocket in order to make the rocket more stable (by shifting the center of gravity forward).

Nozzle. Carefully shaped aft portion of the thrust chamber of a rocket engine that controls the expansion of the exhaust products so the thermal energy produced in the combustion chamber is efficiently converted into kinetic energy, thereby imparting thrust to the vehicle.

Nozzle erosion. The wearing away of one or more edges of the nozzle's throat. Typically by friction of the hot combustion particles flowing over the edge of the throat material. This condition could result in *vectored thrust*.

NSL. Abbr. National Sport Launch. A yearly event held by the *NAR* to celebrate rocketry.

O-ring. A circular rubber gasket. In rocketry, they are used to contain gasses in *reloadable rocket engines*.

Oblique nose cone. A nose cone where the tip does not lie on the centerline of the part. It is off to one side. An example would be the noses cones on the solid rocket boosters of the Ariane V rocket.

Oddroc. Slang term for a highly unique looking rocket.

Off-axis thrust. A imaginary thrust line extending forward from the rocket engine but that does not pass through the centerline of the motor. It can be a result of a canted motor, or a motor that is intentionally mounted off to the side of the centerline of the rocket.

Ogive. The shape commonly given to nose cone of a rocket. In geometrical terms, it is the surface of revolution generated when a line segment and the arc of a circle are rotated about the axis parallel to the line.

One-caliber stability. A rocket which has the characteristic that the distance that the *center of gravity* is ahead of the *center of pressure*, divided by the maximum diameter is equal to 1.0. This is the minimum amount of *static stability* a rocket should have in order to be launched.

Optimum weight. The ideal mass of a model rocket, which will yield the maximum altitude for a given rocket engine. It is related to the velocity and the inertia of the rocket, which overcome gravity and aerodynamic drag. Factors that determine optimum weight are the thrust curve of the rocket engine, the size of the rocket, and the *coefficient of drag* of the model.

Orange peel. A defect in the paint finish where the surface texture resembles the bumpy surface of the skin of an orange (fruit) hence the name.

Oscillation (parachute). The swinging of the suspended load under the parachute.

Outboard. The direction perpendicular to the centerline of an airplane and parallel to the airplane's *lateral axis*.

Over Stable Rockets. The condition where the distance between the *Center of gravity* and *Center of pressure* divided by the tube diameter is greater than 2.0. Overstable rockets is not bad. It just means the rocket will *weathercock* more during breezy conditions.

Oxidizer. A rocket propellant component, such as oxygen, that supports combustion when in combination with a fuel.

Pad. See *Launch pad*.

Parabola. An open curve, all points of which are equidistant from a fixed point, called the focus, and a straight line. *Nose cones* are often shaped like parabolas, which yield lower drag in rockets flying at subsonic speeds.

Parabolic. Pertaining to, or shaped like, a parabola.

Parachute. A flexible fabric, umbrella-like device, used to retard the descent of a falling body by offering resistance to its motions through the air.

Parachute canopy. The plastic sheet or fabric top of a *parachute*.

Parachute sub-cluster. A single group of *clustered parachutes* in a larger group of clustered parachutes.

Paraglider. A flexible-winged, kite-like vehicle designed for use in a recovery system for model rockets.

Parallel staging. Similar to *cluster ignition*, but some of the motors are ignited while the rocket is already under power. After the propellant is expended, the motors fall away from the rocket.

Parasheet. A type of *parachute* made from a single sheet of plastic or fabric that will lay completely flat when laid out.

Parasite drag. The total *drag* minus induced drag. Consists of *form drag* (due to shape) *skin friction drag*, *interference drag*, and other drag not associated with the production of lift.

Parasite glider. A small glider that is mounted on the outside of a stable model.

Parawing Recovery. A type of recovery where the model descends in a gliding manner using a fully-flexible *paraglider* canopy that is stowed internally inside the rocket like a parachute.

Pattern development. The creation of 3D shapes from a flat piece of material. For example, a box is a simple pattern development. Another example is a paper *shroud* or cone.

Payload. The cargo of a rocket or airplane.

Payload section. The section of the rocket that carries the cargo. Often constructed of clear plastic so that the payload is visible.

Peak altitude. The highest elevation reached by a rocket; its *apogee*.

Peak thrust. The maximum thrust level that a rocket engine produces.

Pendulum stability. Stability such as is due to a pendulum's center of mass acting at a considerable distance below the pivot point. In an airplane, pendulum stability is achieved by positioning the center of mass below the main wing.

Performance. A measure of the ability of a rocket to accomplish some specific task.

Perigee. The lowest point to the center of the earth in a satellite's orbit. Opposite of *apogee*.

Permeability. The measure of the rate of diffusion of gas through intact fabric. Used in rocketry to determine how fast a parachute will fall, because the lower the permeability, the slower it will fall. Plastic sheet has a very low permeability, while any woven fabric will have a higher permeability.

Phenolic. A type of plastic resin that has high heat resistance. Often used in composite rocket engines and to stiffen and strengthen *kraft paper* tubes.

Pilot parachute. A small auxiliary parachute attached to the apex of the main parachute, designed to pull the later out of its pack or compartment.

Piston. A closely fitting disk moving to and fro inside a hollow cylinder.

Piston ejection. The method of ejecting a recovery device from a rocket with a solid, sliding *bulkhead*. This bulkhead protects the recovery device from the heat of the ejection charge without the use of *recovery wadding* or *ejection baffles*.

Piston launcher. A special apparatus used to increase the liftoff velocity by increasing the pressure at the base of the rocket at liftoff. Usually used with a *tower launcher* or *launch rod* until stabilizing velocity is reached.

Pitch. The up or down rotation about the *lateral axis*.

Pitching moment. Force applied to an aircraft that causes a tendency to rotate up or down about the lateral axis. A positive pitching moment causes an upward rotation, or an increase in *angle-of-attack*.

Planer. A device used to shave thin layers off the surface of a piece of wood.

Planform. The geometric shape of a wing or fin, as seen from above.

Plastic model cement. A type of adhesive used to join parts made from styrene plastic.

Plastic model conversion. A reconfiguring of a static plastic model into one capable of being flown as a model rocket.

Plugged engines. Special rocket motors that have a solid *bulkhead* in the front end, which prevents the release of *ejection charge* gases into the rocket.

Plywood. A board made up of two or more thin layers of wood (called veneer) cemented together with the grain direction of each layer perpendicular to the adjacent layers.

Polygon. A plane figure having more than four sides or angles.

Polyhedral. A form of *dihedral* in which the wing is cut into more than two panels to give the upward tilt of the wing tips.

Pop-lug. A *launch lug* that detaches from the rocket as the model leaves the launch rod. Since launch lugs produce a lot of *drag*, eliminating the lug for most of the flight allows the rocket to fly higher into the sky.

Pop pod. An engine mount, for forward-engine *boost gliders*, that detaches from the fuselage so that the *center of gravity* of the glider moves rearward over the wing.

Porosity. Usually refers to what is technically known as permeability. The ratio of void or interstitial area to total area of cloth expressed in percent. Refers to the amount of air that will pass directly through the cloth of a *parachute canopy*. See also *permeability*.

Potential energy. A form of stored energy that can be fully recovered and converted into kinetic energy.

Powered flight. See *Boost phase*.

Power prang. Slang for a rocket that crashes into the ground while still in the thrust phase of its flight.

Prang. Slang term for any flight that crashes into the ground.

Pressure. The normal or perpendicular component of force per unit area exerted by a fluid on a surface.

Pressure relief hole. A small hole to equalize the internal pressure inside a body tube with the external air pressure. Used on *higher-powered rockets*.

Primer. An underlying paint applied directly to the surface of a part. It allows successive layers of paint to adhere better to the part.

Probe. Any thing used to explore, examine, and test the nature of something.

Profile. The outline of an object as viewed from a side or the outline of any *cross section*.

Profile drag. The sum of the surface *friction drag* and the *form drag*, usually associated with a two-dimensional *airfoil* section.

Projectile. A body accelerated to a velocity by the application of mechanical forces, which continues its motion along a ballistic *trajectory*.

Propellant. A material carried in a rocket vehicle that releases energy during combustion and thus provides thrust to the vehicle.

Propellant mass fraction. The propellant mass of the rocket engine, divided by the initial mass of the engine.

Propulsion. Act of driving forward or propelling.

Prototype. An original model from which copies are made at a later time.

Pseudo scale model rocket. A fantasy-type model rocket loosely resembling a real military or scientific rocket vehicle.

Pylon. A stand-off that mounts part(s) of the model away from the main body tube. Useful for glider *pop-pods* and for *launch lug stand-offs*.

Pyrogen. The flammable substance on the tip of an *igniter*.

Quick Link. A metal loop with a captive nut, which is used to connect recovery system components to the rocket.

Rail button. A replacement for a launch lug that is used with a *Rail launcher*. The button resembles a head of a screw, and is set off from the body of the rocket by a short cylindrical pylon. The pylon slips into the slot in the *Rail launcher*.

Rail launcher. A launch guide that is stiffer than a launch rod because it has a larger cross section. Typically, the cross section resembles a "C" or an "X" to accept a *rail button*. They are generally used on high power rockets since they are stiffer and prevent the rocket from swaying in the wind.

Range box. A container used to store the tools, supplies and equipment that may be needed when

prepping a rocket at the launch field.

Reaction. A movement in the opposite direction of an action. Also used to describe a chemical combustion process such as that occurring in a rocket's combustion chamber.

Rear ejection or deployment. A type of recovery method in which the parachute exits out the back end of the rocket. Is useful as a drag reduction technique eliminating the small gap at the base of the nose cone. See also *Core Ejection.*

Red baron. The name given to a non-flying, falling glider when the *pop-pod* doesn't fully release from the glider, or when the recovery device wraps itself around the glider.

Recoverable. Of a rocket vehicle or one of its parts, so designed or equipped as to be located after flight and recovered without damage.

Recovery. The procedure or action that occurs when the whole rocket or other part of a rocket vehicle is recovered after a launch.

Recovery device. The primary means for returning the model rocket safely to the ground. For example, it might be parachute, streamer, helicopter, or glider recovery. See also: *recovery system.*

Recovery pod. A tube attached externally to a model rocket or glider that carries the *recovery system* for the rocket engine.

Recovery system. A device incorporated into a rocket for the purpose of returning it to the ground safely by creating drag or lift to oppose the acceleration due to gravity.

Recovery wadding. A flame retardant, biodegradable paper that prevents the hot ejection charge gases from damaging the parachute or *streamer recovery* system in a model.

Reducer. See *Boattail.*

Redundancy. Having an extra backup part or system that can be used after the primary part or system fails. Many *high-powered rockets* use an extra deployment system as part of a redundant system for the primary engine *ejection charge.*

Reefed parachute. A parachute mechanically restrained so it won't open fully, usually by tying the *shroud lines* together near the bottom of the *parachute canopy.*

Reflexed airfoil. A specific type of *airfoil* on which the *trailing edge* is permanently bent upward. This airfoil is used mainly on *flying wings.*

Regular polygon. A class of *polygons* with equal sides and angles.

Reinforce. To add strength to a part so it can withstand greater forces.

Reliability. Dependability; probability that a device will perform as intended.

Relative wind. The motion of air in relation to an object. It may be caused by an object moving through still air.

Reloadable rocket engine. A model rocket motor designed to be reused. Typically, the *propellant grain, nozzle,* and *ejection charge* must be replaced prior to each flight.

Reload kit. Those parts and materials that are replaced after each flight in a *reloadable rocket engine.*

Remote control. Control of an operation from a distance, especially by means of telemetry and electronics.

Rest. The absence of movement of an object in relation to its surroundings.

Retainer. A device for keeping the rocket motor from being ejected by the force of the deployment charge.

Retro rocket. A rocket *engine* that gives thrust opposite to the direction of an object's motion slow it down or separate a section from the remaining body.

Reynolds number. A nondimensional coefficient used as a measure of the dynamic scale of a fluid flow. It is a correction factor that takes into account the linear dimensions of the model and the speed at which the tests are run. It allows for increasing the density of the air in the *wind tunnel,* so the results of the wind tunnel tests compare favorably with those that would be obtained if the tests were run with full-sized models at air speeds equal to flight speeds.

Rib. A fore-and-aft structural member of an *airfoil* used for maintaining the correct covering contour of a built-up-wing or *built-up-fin.*

Right angle channel. See *aluminum angle.*

Rigid wing. A type of glider that uses a stiff airfoil instead of flexible fabric one. This *airfoil* may have *ribs* for support of the airfoil covering.

Ring tail. A configuration of stabilizing fins for a rocket where a rocket's body tube is centered within a hollow tube. The outer tube acts as the *fin* of the rocket.

Rip-stop nylon. A type of nylon fabric that has larger fibers of nylon woven in. This reduces the chances of a small rip in the fabric from becoming a large tear.

Riser line. A cord that extends from the confluence point of a parachutes suspension lines to the payload attachment point. The purpose is to extend the distance from the canopy to the payload to minimize the chances of the canopy descending in the *wake effect* of the payload.

Rocket engine. One that carries its own oxidizer and fuel and operates according to the principles of jet propulsion.

Rocket glider. A type of rocket-launched free-flying glider that does not separate into two or more pieces after engine burnout. The glider changes its mass distribution to create a stable glide by moving parts of itself or by changing its shape. See also *Boost Glider.*

Rocket launcher. A device used for launching rockets.

Rocketry. The art and science of designing, developing, building, testing, and launching rockets.

RockSim. Apogee Components' design and simulation software that aids modelers when designing rockets.

RockSim Stability Method. A derivative of the *Barrowman method* used to find the *Center of pressure* of a model rocket. The Barrowman method has many assumptions to simplify the mathematical equations. The RockSim method removes these assumptions to get a more accurate approximation of the rocket's CP position.

Rod whip. The flexing of a rod during lift-off, which may cause the rocket to head off at an undesirable angle.

Rogallo. Term used to describe almost any flexible wing glider using a delta configuration. Named after Dr. Francis Rogallo, whose experiments in the 1950s lead to the modern flexwing.

Roll. Movement about the longitudinal axis of a rocket or glider.

Root edge. The edge of a fin or wing that is attached to the main body of the model.

Rotachute recovery. A type of parachute recovery where the canopy is designed to spin as it descends. Not only do they create drag, but the air flowing over the canopy also creates lift to slow the descent of the rocket.

Rotafoil parachute. A specific type of *Rotachute recovery* where shaped cut-outs are made in an ordinary parachute canopy. Air flowing through the cut-outs induces a spin in the chute.

Rotasail parachute. A specific type of *Rotachute recovery* where specially shaped gores are attached together only at the apex and at the skirt of the chute. This creates slots between adjacent gores through which air can flow. This flowing air induces a spin in the chute.

Rotation. The turning of a body about its axis.

Rotor blades. The lifting surfaces on a *helicopter recovery* model that slow the descent of the model and cause the model to spin.

Rotor disc (helicopter). The plane described by the route taken by the tips of the rotor blades.

Rotor hub (helicopter). That portion of the support to which the rotor blades are attached.

RSO. Abbr. Range Safety Officer. The person on the launch range that has the ultimate responsibility to insure safety of the launch.

Rudder. A *vertical stabilizer* on a glider used for yaw control. It may be totally fixed or it may have a hinged section to control direction of flight.

Ruddevator. One of a pair of control surfaces set in a V, each of which combines the function of both *rudder* and *elevator.*

Rupture. See *Case rupture.*

Rule-of-Thumb. General guidelines used as an aid to design rockets or airplanes. These guidelines are flexible, and can be changed or adjusted to fit the specific situation.

Sabot. An expendable spacer placed around the rocket to center it up while it is in a launch tube.

Safety key. A special removable key used to arm a launch system. No power can get to an igniter without the use of a safety key in the launch controller.

Safety factor. An intentional, added increase in strength or stability of a rocket beyond expected flight requirements. This increase improves the chances for a successful launch and to accommodates unexpected conditions during the flight.

Sailplane. A performance type glider.

Sanding sealer. A paste applied to the surface of wood to fill the pores and other irregularities. It is sanded smooth after it has dried. It may also be called *balsa filler coat.*

Sandpaper. A paper or cloth coated with glue and then sprinkled over with a gritty substance, used as an abrading agent for smoothing wood.

Satellite launch vehicle. The rocket vehicle used to place an earth satellite in orbit.

Scale data. Documentation, including size, details, and markings, of a full-size rocket from which a scale model is created.

Scale model. An exact miniature replica of a real flying rocket or missile.

Schematic. A diagram of an electrical circuit.

Scissor wing. A position-changing, *variable geometry* wing, consisting of a single wing that rotates at its centerline.

Screw eye. A threaded piece of metal shaped in a loop.

Scoop. Any opening to allow entry of the airstream flowing over the vehicle.

Scrub. To cancel a scheduled rocket firing, either before or during the countdown.

Sealer. Any substance applied to wood or other porous material to fill any voids, yielding a smooth surface.

Section. A cross sectional view at a certain point.

Semi span. Half of the whole span of a wing.

Semi-monocoque construction. A variation of the *monocoque* structure in which stiffening members are attached to the skin to assist in resisting stresses.

Separation; aerodynamic. The phenomenon in which the flow past a body placed in a moving stream of fluid becomes detached from the surface of the body.

Series Staging. A multi-stage rocket where each stage fires in succession, one after the next.

Servo or servomechanism. A small proportional electric motor used in *remote control* systems to operate the *control surfaces* of an airplane.

Shear pin. A low-strength, small-diameter plastic dowel that holds the nose or payload bay on to the body of the rocket to prevent *Drag separation.* The dowel breaks when the ejection charge forces the nose cone off the rocket.

Shell. The outside covering or wall of a thin-walled structure. See also *Skin.*

Shims. Thin pieces of paper, metal, wood, or plastic placed between loosely fitting parts as an emergency method of achieving a tight fit.

Shock cord. A rope or ribbon that absorbs the *kinetic energy* of a nose cone forced from the

rocket by the ejection charge. This cord prevents the nose from falling to the ground separate from the rest of the model.

Shock cord mount. A paper or mechanical fastener used to attach one end of the *shock cord* to the inside of the *body tube*.

Shock cord anchor. Another term for the method that describes the type of attachment system is used to attach the shock cord to the lower portion of the rocket.

Shoulder. An adapter that is oriented with the smaller diameter toward the front of the rocket. Sometimes called a *Reducer*. See also *Boattail* and *adapter*. Also part of the nose cone that fits into the body tube.

Shred. The ripping or tearing of the *recovery system* during parachute deployment. Term is also applied to the nose cone, wings, or fins being stripped off the rocket during boost.

Shroud, transition. An adapter made from paper or other stiff but flexible material.

Shroud line. The strings on a parachute that attach its canopy to the payload, often the nose cone of the rocket. These lines may also be called *suspension lines*.

Silo. A missile shelter that consists of a reinforced vertical hole in the ground with facilities for launching the rocket.

Sink rate. The vertical downward component of velocity that a glider or parachute has while descending in still air.

Skin. The outward sheet covering of a wing or fin.

Skin friction drag. Resistance, tending to slow the vehicle, which is caused by air particles in the airstream being slowed down by surface roughness of the vehicle.

Sleeve tube. A body tube that slip-fits over the top of anther tube. Used to reinforce a specific area of a tube, such as over a long *stuffer tube* directly in front of a *engine mount*.

Slenderness ratio. A dimensionless number expressing the ratio of a rocket vehicle length to its diameter.

Snap back (nose cone). A sudden reversal of direction of the nose cone as it fully extends the length of shock cord.

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-style *reloadable rocket engines*, and an outer ring is usually used as a thrust ring

Snap swivel. A latching device for the *screw eye* to which the shroud lines of a parachute are attached. This makes interchanging parachutes quick and easy.

Snuffer tube. A small metal tube into which a *dethermalizer* wick is inserted. When the wick burns down inside the tube, it is extinguished by a lack of oxygen.

Soar. To fly without engine power and without loss of *altitude*.

Soft landing. A landing on a spatial body at such a slow speed as to avoid a crash or destruction of the landing vehicle.

Solar igniter™. The name of the Estes brand of igniters for rocket motors using black powder propellant.

Solid propellant. A rocket *propellant* in solid state consisting of all the ingredients necessary for sustained chemical combustion. They burn on their exposed surface, generating hot exhaust gases to produce a reaction force.

Sonic barrier. A term for the large increase in drag that acts upon a aircraft approaching the speed of sound. Also called the "Sound barrier."

Sonic boom. A concussion-like sound heard when a shock wave generated by a aircraft flying at supersonic speed reaches the ear.

Sonic speed. The speed at which sound propagates through the air.

Sounding rocket. Term used for research rockets that obtain data on the upper atmosphere. These rockets fly on suborbital trajectories.

Spacer. A gap-filler between parts. For example, a spacer tube is used to fill the gap between a short-length engine and the *thrust ring* in the *engine mount tube*.

Spackle. A type of filler paste used in home construction that can be used on model rockets to fill gaps and seams or to make *fillets*.

Span. The maximum distance, measured parallel to the *lateral axis*, from tip to tip of an airplane wing.

Spar. A rod or beam that is the main loadbearing structural member in a wing or fin.

Specific gravity. The ratio of the density of some substance to that of water.

Specific impulse. The ratio of the thrust to the propellant mass flow in a rocket engine. Used for determining relative performance of a rocket engine.

Speed. The rate of change of position of a body or mass.

Spill hole. A hole cut in the top of a *parachute canopy* to allow for a quicker descent or for decreased parachute *oscillation*.

Spinerons. Small angled tabs added to the base of fins to cause rotation about the *lateral axis* of a rocket. Used to increase the *stability* of the rocket.

Spin stabilization. A method of rotating the rocket during the boost phase of the flight by canting the fins or creating a cambered airfoil so the spinning evens out the forces acting on the rocket. This allows the rocket to fly in a nearly straight line.

Splashdown. The term used for a water landing of a rocket.

Spool rocket. A rocket made from a wire spool. It is characterized by a single tube with a large ring on either end.

Split Airfoil. A type of *airfoil* section used on helicopter recovery models. The long blade is cut on a diagonal and glued back together at an angle. The tip edge is angled downward, while the root edge remains flat. This induces a spin into the rocket as it descends.

Sport model. A typical model rocket that is built primarily for the fun and enjoyment of the hobby. Compare with *Competition Model*.

Spot landing. A landing by a model airplane or rocket at some predetermined location.

Spruce wood. A high-density hardwood of very great strength. Commonly used to make *fuselage* booms of gliders.

Spun woven. A method of making a synthetic cloth or paper where the fibers are laid down in random directions. An example is Tyvek® envelopes. In rocketry, the synthetic fabrics make good hinges for glider ailerons or helicopter blades.

Stability. The property of a glider or rocket to maintain its *attitude* or resist displacement; if displaced, to develop forces to restore the original condition.

Stability Margin. A relative measure of how stable a rocket will be. It is defined as the distance that the *Center of gravity* is ahead of the *Center of pressure*, divided by the maximum body tube diameter. A rule of thumb is that the rocket should have a minimum stability margin of 1.0.

Static Stability. The calculated stability of a rocket using numeric methods, such as the *Barrowman stability method*. A positive value for static stability means the rocket will most likely follow a predictable flight path. However, the static stability changes as a function of *angle-of-attack* and flight speed. Therefore there is no guarantee that statically stable model will fly as predicted if there are disturbances in flight, such as a gust of wind. The rocket's *dynamic stability* should also be confirmed using the *RockSim* software or with *flight tests*.

Stabilizer. A fixed (horizontal or vertical) tail *control surface* on a glider, whose primary function is to increase the stability of the aircraft.

Staging. Separating a stage or set of stages from a spent stage of a launch vehicle. See *Multi-stage rocket*.

Stall. The condition of an *airfoil* or airplane in which it is operating at an *angle-of-attack* greater than the *angle-of-attack* of maximum lift. It is a loss of flying speed and in many cases temporary loss of lift and control of the airplane.

Standoff. See *Launch lug standoff* or *Pylon*.

Static firing. The firing of a rocket engine in a hold-down position to measure thrust and accomplish other tests.

Step rocket. A rocket with two or more stages.

Stick-and-tissue construction. A term given to a built-up wings and fuselages of an aircraft, covered with tissue paper.

Stick fins. Dowels used on the back of the rocket in place of flat-panel fins. Stick fins work by creating drag instead of lift, and are therefore not as effective at providing much restoring force to correct any disturbance in flight.

Stiffeners. Any slender rod added to a large, relatively flat part as a reinforcement to make the part more rigid.

Stow loops. See *line stows*.

Streamer recovery. Rocket recovery system in which a paper or plastic streamer is attached to the top of the rocket. When deployed by the engine's *ejection charge*, the streamer creates enough drag to return the rocket safely to the ground.

Streamlining. The act of reducing aerodynamic drag by adding or removing parts to give the model a slim, teardrop shape.

Strength. The ability of a material to resist stress without breaking.

Strength-to-weight ratio. Ratio of the strength of a member to its weight.

Stress. A resultant internal force in a body that resists the tendency of an external force to change the size or shape of the body.

Strap-on boosters. A cluster configuration of rocket motors which are mounted externally to the main airframe of the rocket. It is also called *parallel staging*.

Structural design. The process of determining the arrangement and sizes of parts of a structure required to carry loads imposed upon it.

Structure. The load-carrying components that are designed to resist the external loads acting upon the structure as well as to transmit local loads due to weight items.

Stuffer tube. A smaller tube inside a larger body tube that leads the *ejection charge* gases to the recovery device section of a *higher-powered rocket*.

Styrofoam®. A brand name of expanded polystyrene foam. A lightweight material that is easily cut or shaped, but does not have a lot of bending strength.

Sub-orbital trajectory. The flight path of a rocket that lifts off from the ground but does not reach sufficient velocity to attain orbit about the earth. The flight path will have a parabolic shape and will touch down at some point on the earth.

Subsonic. Slower than the speed. A speed having a *Mach number* less than 1.

Super glue. See *cyanoacrylate*.

Superroc. A classification of rocket that has a extremely high length to diameter ratio.

Supersonic. Faster than the speed of sound. A speed having a *Mach number* greater than 1.

Suspension lines. The strings on a parachute that attach its canopy to the payload. The payload is suspended from the canopy of he chute. They may also be called *shroud lines*.

Sustainer. The topmost stage in a *multi-stage* rocket, or the core vehicle in a rocket that uses *Parallel staging*.

Sustainer engine. A model *rocket engine* that sustains or increases the velocity of the rocket. Sustainer engines usually have a longer delay than

typical engines. They are used for models that coast for long periods of time (ie. the top stage in a *multi-stage rocket*, or an ultra-streamlined, low drag, and low-mass model rocket).

Sweepback. A wing or fin design in which the tips slope backward from the longitudinal centerline of the airplane or rocket.

Swing test. An experiment used to gauge confidence in a model's flight stability. It involves attaching a string to the model's CG location and rotating it at high speed in a large circle around the modeler. A stable rocket assumes a streamline position, with the nose pointed in the direction of rotation.

Swing wing. A position-changing, *variable-geometry wing* consisting of two airfoils pivoting independently from each other.

Symmetrical airfoil. A type of airfoil where the sides have identical curvature with respect to the centerline.

Tab. An auxiliary *airfoil* or similarly shaped surface attached to a *control surface*.

Tail boom. A *spar* or outrigger connecting the tail surfaces and the main supporting surfaces of an airplane.

Tail-heavy. The condition of an airplane in which the tail tends to sink when the longitudinal control is released. Tail heaviness is dangerous because the airplane will likely *stall* when the wing is flying at too high an *angle-of-attack*.

Tailless airplane. An airplane in which the devices used to obtain *stability* and control are incorporated in the wing. The term is used with the same meaning as *flying wing*.

Tail skid. A skid for supporting the tail of an airplane on the ground.

Taper. To narrow gradually toward one end.

Tapered fins. Fins on a rocket where tip edge that is shorter or thinner than the root edge.

Taper ratio. The ratio of the root *chord* length to the *tip* chord length.

Target drone. An unmanned aircraft or rocket used as a target for testing interception equipment.

Telemetering. Technique of recording data associated with some distant event, usually by radioing the instrument reading from the vehicle to a recording machine on the ground.

Temperature. The degree of hotness or coldness measured on a definite scale based on some particular system or phenomenon.

Template. A flat pattern sheet used to construct multiple parts very quickly and accurately.

Terminal velocity. The equilibrium speed at which a body falls through the air when resistance to air equals the pull of gravity.

Test stand. A platform at which some mechanism or engine is tested.

Test vehicle. A rocket or aircraft used in testing components of proposed aerospace systems.

Theodolite. An instrument used for measuring angles during *tracking* operations to determine how high a model flies.

Thermal. A rising current of warm air.

Throat. In rocket and jet engines, the most constricted section of an exhaust *nozzle*.

Through-the-wall. The strongest method of attaching fins to the rocket. A tab on the root edge of the fin fits through a slot cut into the wall of the body tube.

Thrust. The propulsive force created by the *rocket engine* during the burning and expulsion of gasses through the rocket engine's *nozzle*.

Thrust curve. A chart showing the thrust force of a rocket motor versus the time of the engine burn. The area under this curve is the *Total impulse* of the rocket engine.

Thrust decay. When a rocket motor burns out or is cut off, propulsive thrust does not fall to zero instantaneously, but progressively declines over some fraction of a second. This graduated reduction and loss of thrust is known as thrust decay.

Thrust phase. See *Boost phase*.

Thrust ring. A *bulkhead* with an open center mounted within the engine tube, just in front of the engine. Used to transfer the force of thrust to the structure of the vehicle. It also prevents the engine from moving forward in the engine mount, but still allows the ejection charge gases to pass through the engine tube.

Thrust stand. A device that measures the force created by a rocket motor while it burns. It records the thrust force as a function of time, so that a thrust curve can be created.

Thrust-to-weight ratio. A quantity used to evaluate engine performance. Obtained by dividing the thrust output by the engine weight, less fuel or propellant.

Tip. The edge of a fin or wing the farthest away from the main body of the model.

Tip dihedral. A bent wing, in which a glider's wing describes two straight planes at different vertical angles, with the tip pitched at a steeper angle than the root.

Tip-off. A errant direction change produced by the launcher. Tip-off can be produced by flexing of the launch rod or by a sudden gust of wind as the rocket leaves the launch rod.

Torsion rod. A spring that works (stores mechanical energy) by torsion or twisting. The amount of force it exerts is proportional to the amount it is twisted. In rocketry, they are often used as the actuator to deploy helicopter blades or flaps on a glider.

Toss test. A method of performing testing on a parachute or glider by throwing it up in the air to see how it deploys and descends to the ground.

Total impulse. The product of thrust and the time that an engine is firing.

Touchdown. The (moment of) landing of rocket or other aerospace vehicle on the surface of the earth.

Tower launcher. A mechanical structure with guide rails inside that hold the model centered. The rocket does not need a *launch lug* because the rails guide the rocket, preventing it from shifting in any direction while it is accelerating after ignition. Removing the launch lug lowers the aerodynamic *drag* on the model.

TRA. Abbr. Tripoli Rocketry Association.

Tracker. The person taking angular measurements from which the *apogee* of a rocket is determined.

Tracking. Following the flight of a rocket to determine position, *altitude*, and possibly velocity and distance traveled.

Tracking powder. Any nonflammable powder substance placed inside the rocket to help increase the visibility of the rocket at *apogee* when the *recovery device* is deployed.

Trailing edge. The rear edge of a fin or a wing, opposite the direction of travel.

Trajectory. The curved flight path (ballistic portion) of the model rocket prior to the deployment of its *recovery device*.

Transfer tube. A hollow cylinder that directs ejection charge gases from one location to another. Useful in direct staging rocket engines that are separated by a large distance. See also *Stuffer tube*.

Transonic. The region of a rockets flight when the model's speed is just below that of the speed of sound. This region is marked by a sharp rise in aerodynamic *drag*.

Trigonometry. The branch of mathematics that deals with the sides and angles of triangles and the relationships between them. Trigonometry is used to help determine a rocket's altitude.

Trim. Adjustment of an aerodynamic vehicle's controls to achieve *stability* in a desired flight condition.

Trimming. The act of balancing and setting control surface angles on a glider to achieve a straight, stable glide.

Trim tape. A pre-colored, adhesive-backed tape used to decorate the outside of a model.

TTW. Abbr. *Through-the-wall*.

Tube adapter. See *Adapter*.

Tube coupler. A hollow cylindrical tube for joining body tubes of the same diameter.

Tube fins. Hollow cylindrical tubes attached to the *body tube* that act as fins to guide the rocket during its trajectory.

Tube slots. Rectangular openings cut into a body tube to allow the tab of a fin to extend through the wall to increase the fin attachment strength.

Tumble recovery. Rocket *recovery system* in which the balance point of the rocket is moved, causing it to become *unstable* so it tumbles end over end, creating drag to slow its descent.

Tunnel. A covered channel running longitudinally along a rocket.

Turbulator. Any device used to trip the airflow boundary layer from *laminar flow* to *turbulent flow*. Typically used on small *glider* wings.

Turbulent flow. A type of fluid flow in which there is an unsteady flow of particles. The motion of the particles at any given point varies in no definite manner.

Two stage recovery. See *Dual deployment*.

Two station tracking. A method of increasing the accuracy of determining the maximum height a rocket ascends by having two observers taking angular measurements simultaneously.

U-bolt. A rod that has been bent into a "U" shape, where each end has been threaded so that a threaded nut can be mated to it. In rocketry, they are attached to a *bulkhead* and used as an attachment point for the parachute or shock cords.

Umbilical mast. A tower placed next to the *launch rod* that supports the wire leading to the top of the rocket. These wires may be for igniting the engine (as in the case of a front-engine boost glider) or for some payload that needs to be activated just prior to launch.

Undercarriage. The main landing gear of an airplane.

Unbalanced force. A net force in excess of any opposing forces. An unbalanced force, according to Newton's second law, causes a change in a body's inertia, causing it to accelerate.

Unbalanced thrust. See *Unsymmetrical Thrust*.

Unpowered. Without any means of *propulsion*.

Unstable. The opposite of *Stability*.

Unsymmetrical thrust. A flight condition arising from either a failure of one engine or an unbalance of engine types, resulting in thrust loads transmitted mainly on one side of a rocket's plane of symmetry.

Updraft. Rising current of air. See also *Thermal*.

Upper stage. In general the second, third, or later stage in a *multi-stage rocket*.

Upscale. To make a larger version of a rocket.

Vacuum. A region of exceedingly low pressure, more specifically a region in which the gas pressure is a great deal lower than atmospheric pressure.

Vacuum formed wraps. Plastic sheets with a lot of surface texture that have been thermoformed on a machine called a vacuum former, which can be wrapped around a tube.

Vanes. A long set of fins used to straighten the *airflow* before it reaches the main fin unit at the aft end of the rocket.

Variable geometry. When all or a portion of the glider's lifting surfaces change shape or position (i.e., *swing wing* and *scissor wing* gliders).

Vectored thrust. Condition where the thrust axis of the *rocket engine* does not pass through the *center of gravity* of the model. This usually results in the rocket going unstable. It could also occur due to *nozzle erosion* if the engine is mounted correctly in the rocket.

Vehicle. In general an aerospace structure (such as a rocket) designed to carry a payload through the atmosphere.

Velocity. The rate of motion or speed in a given

direction measured in terms of distances moved per unit time with a specific direction.

Veneer. Thin sheets of wood.

Vent hole. A small hole made in the body tube to allow the internal pressure to equalize with the atmospheric pressure outside the rocket. It is used to prevent *nose cone pop-off*. Also called a *pressure relief hole*.

Ventral fin. A short *airfoil* mounted on the belly, or the underside, of an aircraft.

Vernier engine. An auxiliary rocket engine, smaller than the main thrust unit, used to obtain precise adjustments in velocity and trajectory of a missile.

Vertical axis. An imaginary line that runs through the *center of gravity* of a model and is perpendicular (out the top) of the fuselage or boom of a glider. The model will *yaw* left or right about this axis

Vertical stabilizer. A structural component of an aerodynamic vehicle consisting of a fin and rudder assembly.

Voltage. Electromotive force or potential difference.

Von Karmon nose cone shape. 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..

Vortex-ring parachute. A specific type of *Rotachute recovery* where specially shaped gores are attached together only at the apex of the canopy. The suspension lines attached to the skirt corners are each a different length. This creates slots between adjacent gores through which air can flow. This flowing air induces a spin in the chute.

Wadding. See *Recovery wadding*.

Wake effect. When flying through turbulent airflow, there is a reduction in the efficiency.

Warp. A twist in the wing or fin of a rocket.

Washin and washout. A permanent warp of the wing tips of an airplane. Washin increases the angle of incidence toward the tip, and washout is a decrease. Washout is incorporated in both wing tips for the purpose of delaying tip *stall*.

Weathercocking. The tendency of a rocket to turn into the wind, away from a vertical path.

Wedging. A *fin* attachment method for models with a cluster of two or more body tubes, where the fins are glued into the gaps between the tubes.

Weight. The force that results from the earth's gravitational attraction of the mass of an object. An object's weight is found by multiplying its mass by the acceleration due to gravity.

Wind. Moving air, especially a mass of air having a common horizontal direction and motion.

Wind tunnel. A tube like structure or passage in which a high-speed movement of air is produced, as by a fan, and within which objects are placed to investigate the *airflow* about them and the aerodynamic forces acting upon them.

Wing. The main lifting surface of a glider.

Winglets. Small, nearly vertical aerodynamic surfaces mounted at the tips of airplane wings.

Wing loading. The total mass of the flying glider divided by the *planform* area of the wing. It represents the average force per area that is exerted on a wing.

Wing tip. The outer end of an airplane wing.

Wood filler. See *sanding sealer* or *filler putty*.

Wood grain. The arrangement of particles or fibers of wood which determines its roughness, markings, or texture.

Wood grain direction. Having an orientation parallel to the fibers in a piece of wood.

X-form parachute. AA parachute that is formed by connecting together two rectangles of material, forming an 'X'.

Yaw. Rotation (nose to the left or right) about the *vertical axis* of a glider.

Zipper effect. A slicing of the forward end of a rocket's body tube caused by the tendency of the shock cord and the nose cone to travel in a different direction from the main body.