

# GLOSSARY OF AEROMODELLING TERMS, ABBREVIATIONS AND JARGON

**35 MHz (35 Meg)** - prior to the introduction of 2.4GHz (2.4 Gig) radio equipment, this was the most common radio control wave band used for model aircraft flying in the UK (not other countries). 2.4GHz has now almost (but not entirely) superceded it. 35MHz is still allocated exclusively to model aircraft in the UK, and is still current and and legally useable. It is more subject to radio interference than 2.4GHz, especially when used in electric-powered models.

**3D** - a generic term for extreme aerobatics, often involving manoeuvres virtually impossible in full size aircraft due to inadequate power-to-weight ratio or the stresses of G-forces acting upon the airframe or the pilot or both. This includes such manoeuvres as prop-hanging and high angles of attack (sometimes called high-alpha), tight bunts and snap rolls.

**Acro** - the term commonly used in transmitter computer menus to indicate a normal fixed-wing aircraft

**Adhesives** - many different types of adhesives are used by model builders, and they all have their uses and their pros and cons. Beware of solvent-based adhesives and always use them in a well-ventilated area as they emit fumes which can be dangerous. Other glues (eg. Superglue) can also trigger allergic reaction to their fumes and/or skin reaction, and some can stick fingers or eyelids together so always use eye-protection when using them. Some bond instantly while others can take considerable time to cure or harden, requiring the work to be clamped while it sets. Many adhesives will attack and melt certain forms of plastic and foam, and some (eg. epoxy-resin) are not recommended for EPO foams as they do not provide a sufficiently permanent bond. Old-fashioned Balsa-cement should never be used in the construction of powered flying models. Check the suitability of each adhesive for its purpose before you purchase, and do read the warnings on the packaging.

**Adverse Yaw** - the situation when, on rolling into a bank prior to a turn, the up-going wing yaws in the opposite direction to the turn. i.e. the aircraft is rolling and turning one way but yawing the other. This is usually caused by an increase in drag brought about by the down-going aileron. High-wing models are often more prone to this than others, as are models with heavily cambered aerofoil sections. Use of rudder in the same direction as the turn counteracts this tendency but does not resolve the underlying drag issues. An effective solution is to arrange for the "up" aileron to deflect upwards further than the "down" aileron deflects downwards, (aileron differential). This can be achieved mechanically via the control linkage, but is more commonly addressed these days using computer transmitters, most of which can be programmed to introduce aileron differential automatically when banking.

**Aerobatics** - deliberate manoeuvres that involve significant deviation from normal flight through any or a combination of the three axes - eg. loops, rolls, skids, spins, stall-turns etc. and stunts of any kind. Many aerobatic manoeuvres are specifically defined and named.

**Aerotight® Nut** - a locknut similar in purpose to a Nyloc® nut but which can be reused if it needs to be removed (a Nyloc® nut should not be reused if it is removed as the effectiveness of its internal nylon threadlock is compromised by removing it). The Aerotight® nut has a vertical split through the upper part of its depth and this tightens the nut on to the bolt or shaft as it is screwed on. Resistant to loosening via vibration, it is useful for bolting electric motors on to motor mounts and for threaded wheel axles. See Locknut.

**"A" Certificate** - the first level of the BMFA achievement scheme. A basic test of ability to safely operate and fly a model aircraft solo (ie. not under supervision). There are separate A-certificate ratings for powered/non-powered fixed wing, helicopter models, multi-rotors and FPV. See the [BMFA website](#) for more info on this and the B and C certificates. The Scottish Aeromodellers Association (SAA) operates a similar three-level achievement scheme - Bronze, Silver and Gold ratings. See SAA.

**Aerofoil** - (aerofoil section or wing section) the cross-section shape of a wing. Aerofoils can be very varied depending on many factors including the wing-loading, speed and nature of the aircraft and its intended purpose. There are some common types which are designated by name.

**Aileron** - a moving section of the trailing edge of each wing. They function as a pair (left and right) and work in opposite directions to each other (one up, one down). They control the model in the rolling plane to the left or right. Ailerons may be the full length of the wing trailing edge or quite commonly just the outboard section of it, especially when flaps are fitted to the model.

**Aileron Differential** - a system whereby the throws of an aircraft's ailerons deflect upwards further than they do downwards to counteract the effect of adverse yaw. It can be achieved mechanically via the push-rod linkage, but is more commonly achieved via a programming setting on a computer transmitter, most of which offer this as a standard menu option. See Adverse Yaw above.

**Airspeed** - the speed of the aircraft relative to the airflow over its wings. (This is NOT the same as its speed over the ground). A fixed wing aircraft depends upon the flow of air over and under its wings to generate the lift needed in order to fly. Airspeed is therefore a critical issue for keeping a fixed wing aircraft in the air, and is the primary reason that aircraft take off facing into the prevailing wind. When the airspeed becomes insufficient to sustain the aircraft in flight the wing will suddenly lose its lift (stall) and the aircraft will immediately nose down and rapidly lose altitude. If this happens close to the ground the model is likely to crash as there will not be sufficient height for the wing to recover its lift. See Stall.

**Air-Tow** - this refers to a glider being towed to altitude by a larger model. The glider incorporates a mechanism for releasing the towline once the desired height is reached. The pilots of both models should stand close together on the flightline to coordinate the release.

**Aliphatic Resin** - this is a type of PVA wood glue. It is chemically similar to ordinary PVA glue but is stronger, more waterproof and quicker drying. It also sands better than ordinary PVA/white glue, but is a little more expensive. See PVA for comparison.

**Altitude** - The height of the aircraft - which in model flying usually refers to the models height vertically above ground, but may be in relation to sea level. In certain types of model flying - notably slope-flying - the altitude of the model from the ground vertically beneath it may be very different from the altitude above the launch point.

**Amphibian** - an aircraft of floatplane or flying boat design which also has a wheeled undercarriage so that it can take off from, or land on, either land or water.

**Amps** - See Ohms Law below

**AMT/All-Moving Tail** or "Flying Tail" - this is a configuration whereby the rear hinged control surfaces (elevator and rudder) are eliminated and the entire tailplane (horizontal stabiliser) moves to act as elevator and the entire tail-fin moves to act as rudder. The development of this control surface configuration was found to avert the severe buffeting and vibration experienced by full-size aircraft approaching the speed of sound and was a significant factor in enabling aircraft to break the sound-barrier.

**Anhedral** - where the wings on an aircraft are angled downwards from the fuselage outwards - the opposite of dihedral. This design is sometimes used on full-sized fly-by-wire fighter aircraft as it makes them less stable and therefore more manoeuvrable. See Dihedral.

**Angle of Attack** - the angle of the wing relative to the horizontal or air-flow.

**Angle of Incidence** - the angle at which the wing or horizontal tail of an aircraft is installed on the fuselage, measured relative to the horizontal axis of the fuselage.

**ANO** - Air Navigation Order. A numbered point of aviation law issued by the UK Civil Aviation Authority, some of which pertain specifically to model flying.

**Arming** - this is the act of installing and connecting the flight battery within an electric model. An armed electric model presents an immediate risk of unexpected start-up, which could result in personal injury and/or damage to property. An electric model should therefore never be armed unless it is properly restrained and facing outwards from the pits area. It is also important that the flight battery is securely installed.

**ARTF** - Almost Ready To Fly - a generic term applied to model aircraft which are supplied with the main airframe components largely pre-built. Some assembly and gluing is usually required however. Some ARTF models may also have servos and/or electric motor/ESC pre-installed too, but in many cases these will need to be separately specified and installed by the user. They rarely include a radio receiver.

**Article 16** is a CAA document and part of CAP722. It specifies a range of special rights and exemptions granted conditionally to members of the main UK model flying associations (BMFA/SAA/FPVUK and LMA). This special dispensation is conditional upon all members of these organisations formally confirming that they have read it and understand its provisions and conditions. See [Article 16](#)

**AS3X** - This is a Multiplex® brand of gyro-stabilised receiver designed for novice pilots - see Stabiliser

**Aspect Ratio** - the wing's length compared to its chord (width). High aspect ratio wings provide a lot of lift at the expense of additional drag, so they are very suited to slow-flying aircraft such as gliders. High speed aircraft wings generally have a relatively low aspect ratio wing producing less drag and less lift which is compensated for by the faster airflow delivered by the aircraft's speed.

**Attitude** - refers to the angle of the aircraft in relation to the horizontal plane, and refers to both pitch and roll angle.

**AUW** - All-up-weight. That is the flying weight of the model including the flight battery or fuel, and may be expressed in pounds (imperial) or kilograms.

**Barrel roll** - an aerobatic rolling manoeuvre which is not axial but follows a corkscrew pattern.

**Bank and Yank** - this is term applied to smaller models which have a fixed (non-moving) rudder. Turns are achieved by banking with the ailerons and pulling up elevator through the turn.

**Base Leg** - The last (short) leg of a rectangular circuit flown around a landing area immediately before turning onto finals in line with the runway. This leg is flown cross-wind and at right angles to the runway. As the landing will normally be into wind, in stronger winds the pilot must be careful not to allow the model to drift too far out from the threshold on this leg.

**Battery Checker** - a very important device for those flying electric-powered models. This is really a "must have" for every pilot of electric models, but thankfully they are inexpensive. By simply plugging the battery balance lead into one of these small gadgets the LCD displays the voltage and residual capacity of the battery, (useful to know both before and after a flight). It is used to ensure flight batteries are fully charged before flight and to see the residual capacity immediately after the flight. The latter is particularly important in determining the flight duration of a model so that a countdown timer can be set to provide a timely warning of the imminent loss of power in flight, and warn the pilot to commence the landing procedure before the battery is fully drained. Draining LiPo batteries beyond about 25% in flight is not recommended as it shortens the life of the battery and perhaps more importantly might mean that there is insufficient residual battery capacity to safely abort a bad landing approach to go around the circuit again for a second attempt at landing. The battery checker can also provide a couple of other very important items of information and these relate to the residual voltage of each individual cell within the battery. This is extremely important prior to recharging as to recharge when one or more cells has "died" can result in an explosion and fire. A battery checker will also indicate the difference in both voltage and percentage between the voltage of the highest and the lowest cell within the battery pack. If this varies by an amount greater than 10% the cells are seriously out of balance and should ideally be balanced using an off-line balancer gadget prior to charging or at least to balance the cells during charging, being careful not to leave the battery unattended during recharging.

**BEC** - Battery Eliminator Circuit - built into most Electronic Speed Controllers (ESCs) especially smaller ones (up to about 40A current rating). This is a device for smaller electric-powered models to eliminate the need for (and therefore the weight and space requirement of) a separate battery to power the receiver. It incorporates a voltage regulator to supply constant lower-voltage power to the receiver from the (higher voltage) main flight battery, and works in conjunction with the LVC (Low Voltage Cutout) system within the ESC to reduce the power available to the motor as the battery capacity is drained, to ensure that the receiver and servos have sufficient power to enable the pilot to retain control even if the motor stops, necessitating a deadstick landing. All larger models and others powered by more than 3 LiPo cells or using more than 4 servos should not rely on the ESC BEC but should power the receiver via a separate Receiver battery pack. In such cases the ESC BEC can be bypassed by removing the red wire from the ESC/RX lead, or alternatively by using an OPTO ESC which does not have a BEC.

**Belly Lander** - a model which does not have an integral undercarriage and which therefore must be hand-launched or launched from a dolly, and then landed on its belly.

**Bench-Testing** - the process of testing and checking any component before installation into a model, or the completed model as a whole. It applies to all forms of static setting, testing and checking the model - eg. for setting the control throws or wattmeter-testing the power-train of a model at home or elsewhere. Remember that an i/c engine will not spontaneously start, whereas this can happen unexpectedly as soon as the flight battery is connected to an electric power train. Therefore it is vital that an electric model is firmly restrained BEFORE it is armed (or i/c engine is started), and great care must be taken to avoid personal injury from the rotating propeller, including the possibility of the propeller flying off. With electric models control surface set-ups and checks should be done either with the propeller removed or using a separate receiver battery connected directly to the receiver rather than the main flight battery via the ESC.

**Binding** - a process that creates a link between a 2.4GHz receiver and a specific transmitter so that the two can operate together while preventing the receiver from responding to inputs from other transmitters. The actual process varies from brand to brand, and in the case of some brands the binding process limits the receiver response not only to the bound transmitter, but also to a specific model memory within the transmitter.

**Bind'n'Fly (BNF)** - A term used to describe models for purchase which come complete with all the electronics including a receiver already installed, and supplied complete with a dedicated transmitter. Bear in mind that the supplied transmitter may not be easily transferable to another model and may have quite limited functionality.

**Bipe** - slang abbreviation for biplane.

**BMFA** - British Model Flying Association, wholly owned and occasionally referred to as SMAE - Society of Model Aeronautical Engineers Ltd.

**Bronze Certificate** - the SAA equivalent safe flying accreditation to the BMFA "A" certificate.

**Brown Out** - a loss of operation (sometimes momentarily) of a receiver due to a drop in supply voltage below a minimum threshold. Since receivers have a minimum voltage requirement, a voltage drop below this minimum can cause unpredictable or erratic behaviour or loss of control.

**Brushless motor** - Brushless motors are 3-phase electric motors with no commutator brushes. They are much more efficient and more powerful than equivalent brushed motors, and have virtually completely replaced brushed motors for electric-powered flight. There are two primary types plus a hybrid type. These are: **Outrunner** - a motor in which the outer case of the motor rotates and acts as a fly-wheel, generating powerful torque. These are the less expensive and are the most commonly used for electric flight. **Inrunner** - the moving parts are encased within the motor "can" - these have less torque than the equivalent inrunner but are very smooth-running and can run at very high RPM making them especially suitable for EDF (Electric Ducted Fan) motors to simulate jet aircraft. The hybrid type is a "canned outrunner" - the higher torque characteristics of an outrunner, but encased in an outer inert can. - These tend to be used for models with very confined space in the nose of the aircraft (typically powered gliders) where the rotating case of an outrunner would be likely to chafe the wiring connecting the motor to the ESC.

**Buddy Lead or Buddy Box** - a term used to denote a dual-control training aid whereby the student's transmitter is attached via cable (or wirelessly with newer Spektrum transmitters) to the instructor's transmitter as master and slave (ie. 'buddied'). The student has control over the model, but the instructor can take control if necessary to avert a crash.

**Built-up Model** - a model of "traditional" construction in which the airframe consists of a framework or skeleton constructed from balsa and ply-wood and covered in a polyester film, or balsa sheeting. (See also - Foamie)

**Bulkhead** - the foremost former of an aircraft, on to which the engine or electric motor is mounted. In some cases, especially with electric power, a separate motor-mount or "stand-off" mounting is fixed to the bulkhead so that the propeller and spinner can be accurately positioned fore-and-aft in relation to the cowling.

**Bungee Launch** - a method of launching gliders. Normally a long cable of which the longest part is elasticated bungee cord. Usually used in conjunction with a foot-operated release mechanism.

**CAA** - UK Civil Aviation Authority

**C or C Rating** - this is marked on the label of a LiPo battery preceded by a number eg. 20C.

This expression relates to the capacity of the battery in mAh (milliamp/hours) and indicates the maximum safe continuous discharge rate of the battery expressed as a multiple of the battery capacity. 20C (which is really the minimum acceptable for electric powered flight) would therefore indicate that it could be discharged at a rate twenty times its capacity. For example a 2200mAh (ie. 2.2A) capacity battery specified as 20C could theoretically be safely discharged up to 44 Amp current drain. (Note that the battery C rating does NOT relate to recharging the battery. Most LiPo batteries should be recharged at no more than 1C. There are a few more expensive ones which are specified as being able to be recharged at up to 5C, but if in doubt never recharge above 1C).

**CG/Centre of Gravity/COG** - the plane's point of balance when placed on a fulcrum. This term usually and most importantly relates to fore-and-aft balance and should be determined carefully as an aircraft that is tail-heavy may be dangerously unstable and impossible to control properly. Most purchased models will specify the recommended CG point and this is usually based on a measurement taken backwards from the leading edge of the wing at the wing root where the wing joins the fuselage. It is usually approximately 1/4 to 1/3 of the way back from the leading edge of the wing at the root, and will be close to the main wing spar. When you buy a new model it is worth checking out relevant comments on the main model flying forums as it is not uncommon for manufacturers to amend the recommended CG even after shipping large numbers of models.

**Cabane** - the struts on a biplane used to support the upper wing over the fuselage.

**Camber** - this is the degree of convex of the upper surface of a wing. This can be changed dynamically in flight by the use of flaps which effectively droop the trailing edge of the wing to increase the camber. Small deflection of flaps increases the wing's lift with minimal increase in drag, and may be used for take-off and the early stages of the landing approach. Maximum flap deflection increases lift still further but with a greater increase in drag. This is used for the final stage of the landing approach where the increase in drag is actually useful to slow the aircraft prior to touchdown. Application of flaps often alters the trim of the aircraft resulting in a tendency to pitch downwards, so on computer transmitters it is common to mix in a little up elevator movement to compensate.

**Canard** - a horizontal control surface which performs similar function to a horizontal tailplane but is positioned near the nose of the aircraft instead of at the rear. They may be fixed, or incorporate a flying control like an elevator or the entire canard may be a flying control surface like a flying tailplane.

**Captive Nut** - a nut which is permanently fixed in place on the model to receive a removable bolt. The nut must be fixed in such a way that it cannot rotate when the bolt is tightened so is usually splayed at one end, with spikes to embed into the surrounding wood. Glue is usually carefully applied to keep it permanently in place.

**CAP722** - The document published by the CAA which governs the operation of all forms of unmanned aerial vehicles (UAVs). CAP722 Article 16 is a special subset of specific rights and exemptions granted conditionally to members of the main UK model flying associations (BMFA/SAA/FPVUK and LMA).

**Channel** - Every radio control transmitter and every receiver are designated as having a specific number of channels. Each channel is used to operate a different control element within the model, so for instance one channel is used for the throttle control, and in a simple model, one for each servo operating the control surfaces. In addition there could be a requirement for another channel to operate flaps and another to operate a retractable undercarriage, another for lights, and a myriad of other possibilities. The maximum number of elements which can be operated is determined by whichever has the lower number of channels - the transmitter or the receiver. So even if you have a 9-channel transmitter, if the receiver only has 6 channels it can only operate six control elements. Similarly, if the receiver has 10 channels, but the transmitter only has 6 channels, then 6 is the maximum number of control elements that can be operated. Sometimes one channel can be made to operate two servos by using a Y-Lead but in this case the servos must be mounted in the model correctly to ensure that each servo operates in the correct direction.

**Channel Mixing** - this is the use of computer transmitters to automatically combine the operation of more than one control channel. One of the more common of these would be to combine rudder movement with aileron control to make coordinated turns or to counter the effect of adverse yaw. Another would be to mix up-elevator with flaps to prevent the model pitching down when flaps are deployed. In some cases lightweight models may have a tendency to "balloon" upwards when the power is increased and this can be tempered by mixing some down elevator with throttle control - usually offset so that the mixing does not occur below 50% throttle.

**Chord** - the width of the wing from leading edge to trailing edge.

**Chuck** - the front part of a drill or pin-vice which holds the drill bit firmly in place. The chuck incorporates adjustable jaws so as to be able to fit and firmly clamp drill bits of different sizes. The jaws of the chucks may be adjustable via a special key, although many are keyless, relying on a firm manual twisting of the chuck barrel to secure and release the drill bit.

**Clampmeter** - A form of Ammeter device consisting of a pair of pincer-like jaws and a readout (eg. LCD) which when clamped around a wire will measure the current flowing through that wire. It is a relatively expensive measurement tool and not ideal for aeromodellers due to the limited space within most model airframes. A wattmeter connected between the battery and the ESC provides far more useful information and these are much less expensive.

**Clevis** - U-shaped fastener and pin used for connecting servo push rods to horns on control surfaces. They come in various designs. Some have a screw-thread to screw them on to the control rod, while others must be soldered on to the control rod before assembly into the model. On smaller models they are used less commonly these days having been largely replaced by "Quick-links" and "Nipple Grips" which are easier to fit and offer much larger and easier adjustment.

**Closed-loop** - type of control system in which two tensioned wires are used to connect between the servo and its control surface. This system is most frequently used for rudder control and typically it requires a control horn on both sides of the control surface. Movement is achieved by the servo pulling the wire to move one side of the control surface towards the servo, and re-centred by pulling the other wire. Opinions differ as to whether or not it is better for the closed loop wires to be crossed between the servo arms and the control horns, but either way it is important that the wires cannot chafe each other and they also must not be allowed to become entangled with servo leads or any other items which might impede their smooth operation.

**Cog** - gear wheel

**Collet** - A very thick washer or steel ring which can be fixed into position on a rod or axle via one or more grub screws at right angles to the centre hole. Often used to hold another object in position (eg. a wheel). A Prop-Saver is essentially a collet with two screw-holes opposite one another to tighten on to the motor shaft, but using standard screw bolts instead of grub screws so that the propeller can be attached to the protruding screw heads via a rubber "O" Ring. See Wheel Collet and Prop-Saver.

**Connectors** - Connectors are the physical means by which electronic components within a model are connected to one another. There are specific connectors for use between the motor and speed controller, between the flight battery and speed controller, and between the servos and the receiver.

**Connectors (Servo to Receiver)** - Servo connectors are usually prefitted to the servos and denoted by two main types - JR and Futaba. These are similar, except that Futaba types have a side-lug which may have to be carefully removed in order to fit a Futaba plug into a JR socket. Extension servo leads are available in different lengths and these have a male connector on one end and a female on the other end.

**Connectors (Motor to ESC)** - The most common standard is for the electric motor to have 3.5mm all male gold-plated bullet connectors with 3.5mm all females on the output side of the speed controller (ESC). Most motors come with the connectors already soldered on to the wires, but strangely most ESCs do not so you will probably have to source these and solder them on yourself.

**Connectors (Battery to ESC)** - The connection between the flight battery and speed controller is extremely important, not only because it carries a high current, but also because an accidental short current could result in an extremely dangerous fire. Please note that extremely large and extremely small (indoor) models may have their own type of specialist connectors. These days batteries usually come with a connector already attached, (although ESCs bought separately usually don't) so many aeromodellers decide to buy and fit a matching connector for the ESC. Unfortunately there is no standard for battery connectors but the two most popular types now are XT60 (or XT90 for higher voltage batteries) or EC3 (or EC5 for higher voltage batteries). New models which come with the electrics already installed will almost certainly come with one of these types already soldered to the speed controller (ESC) so when ordering new batteries be sure they come with the appropriate connectors. Multiplex® have their own unique and patented connectors. There are also Deans ("T") connectors (not recommended as they are not intended for repeated connect/disconnect applications), and JST connectors for small batteries. Then there's Molex and Tamiya - it really has become something of a "minefield" with arguably too much choice and no standardisation. Most of these connectors are designed as male and female in such a way that it is virtually impossible to short circuit the battery - a very valuable and important safety feature. It is suggested that the reader looks up the various types on a model supplies website to see illustrations of the various types available. For many years, before the above connectors became available, gold-plated bullet connectors were the standard for this connection, and are still widely used. The most common diameter bullet connector sizes are 4mm and 6mm depending on the number of battery cells in use. Where these are used it is important for the battery positive wire to have a female gold connector, with a male on the negative wire. (ESC connectors are obviously the opposite male/female to match). Because of the high currents drawn in electric-powered flight, only high quality gold connectors of a suitable diameter (amp rating) should be used for each specific application. Because there is such a plethora of different connectors available it is advisable for model flyers to standardise on one type for each primary connection role, but it is also a good idea to buy or make up adaptors for some types so that they can be interchanged to some extent. The most important criterion for all connectors is that they must be capable of handling the current that will pass through them, without failing or overheating. It is also desirable to minimise the number of joints/connectors, as each joint represents a danger of failure or sparking/short-circuiting with other nearby connections. Also remember that unlike most other connections, the battery/ESC connection is being broken and remade before and after every flight so connectors for this purpose need to be very robust and designed to prevent accidental short-circuiting of the battery.

**Contra-rotating/Counter-rotating** (propellers) - a system applied to models with two propellers whereby the propellers rotate in opposite directions. The propellers may be on the same axis and in many cases the same motor drives both propellers with the counter-rotation achieved via a gearbox. It is also quite often used on twin-motor models where each motor spins the propeller in a different direction. In both cases it is used to minimise or eliminate unwanted torque effect and prop-wash.

**Control Checks** - See Pre-flight Checks

**Control Horn** - See Horn

**Control-Line** - a model flying discipline (not radio controlled) whereby model aircraft are tethered to the pilot via a twin-wire light cable which is used to control pitch, and flown in a circle orbiting the pilot who must rotate his stance to follow the movement of the aircraft. Often flown by groups of pilots standing together in a kind of huddle. Models may be electric or i/c or even pulse-jets. Combat events are popular in this aeromodelling genre.

**Control surface** - term used to describe the moving part of any flying surface which is used to control the model in all its three axes. ie. rudder, elevator and ailerons are all control surfaces.

**Cooling Vents** - electric motors are generally much smaller than their i/c equivalents and this has made it possible for models to be more streamlined than was usually possible with i/c. However there is still considerable heat generated by the various components of an electric power-train and this needs to be effectively dissipated to avoid overheating - especially as ESCs usually incorporate a thermal cut-out to avoid fire. With i/c engines the necessary air-cooling is achieved via air flow over the vaned cylinder-head, so it is not normal for the airflow to enter the fuselage. With electric power it is still necessary for the motor, ESC and to some extent even the battery to be cooled by the airflow, but in electric-powered models the battery and ESC are usually situated inside the fuselage. Even the motor

may be completely covered by a spinner and the cowling in the case of a model replicating an in-line engined warbird etc. So it is almost always necessary for air-scoops to be incorporated near the nose of the model to duct the airflow into the fuselage and over the internal electronic components. However this creates an important additional requirement for exit vents near the rear of the fuselage to avoid a build-up of pressure inside the fuselage. If not adequately vented this would actually prevent the airflow over the components which the air-scoops were designed to achieve, and potentially cause other problems such as increased drag and might even cause the canopy to be blown off! As a rule of thumb it is recommended that the exit vents should be two or three times larger than the airflow entry vents.

**Coordinated Turn** - a turn in which the lift and centrifugal forces on the aircraft are exactly balanced and so there is no inward or outward slip or skid during the turn. Such turns often require the simultaneous use of ailerons and rudder working in co-operation. This also lowers the chance of stalling in slow turns. On computer transmitters it is possible to mix rudder with aileron movement to achieve more coordinated turns.

**Correx®/Proplex®** - a plastic material similar to corrugated cardboard, comprising two layers of thin plastic sheeting encasing a corrugated plastic core. Sometimes used to make tailplane (stabiliser), tail fin or control surfaces on lightweight model aircraft.

**Cotter Pin** - a pin (mostly metal) inserted into a hole (usually laterally) in another part to prevent undesired movement of the part.

**Count-Down/Count-Up** - See Timer

**Cowl/Cowling** - the part of an aircraft fairing that covers the engine or motor. In models this is often a one-piece plastic or fibre-glass moulding which may have air inlets to help cool the electric motor and other electric components.

**Cross-weave tape** - a strong, very useful semi-transparent adhesive tape which incorporates a woven polyester filament to give it particular strength.

**Crosswind** - this term is used to describe situations when the wind is blowing at 90 degrees to the runway or your line of flight, particularly take off or landing. The same term is also applied to the short leg of a circuit pattern beyond the downwind end of the runway and at 90 degrees to the runway, before turning into the downwind leg. On the crosswind leg of the circuit the prevailing wind will tend to push the model back (sideways) towards the runway so this should be resisted.

**Crow Braking/'Butterfly Braking'** - this is used almost exclusively on gliders. Like all aircraft, gliders require a flow of air over their wings to keep them airborne. As they have no power, they have to achieve this by trading height for speed. Of course they have to initially achieve operational height, and this may be via short bursts of power (if they have a motor installed) or by air-tow, winch-launch, bungee-launch or by slope lift which comes from launching from a hill-top into wind. The aerodynamics of gliders are designed to then sustain them in the air as efficiently as possible and with as shallow a glide-path as possible in order to retain height as long as possible. However this creates something of a problem when it comes to landing, because in simple terms they don't want to come down, because they are designed to stay up! Some gliders can also be very fast - indeed the world speed record for a model aircraft is held by a glider! For this reason gliders are usually programmed specially with the transmitter to use their control surfaces to slow them down and reduce their lift during the landing approach. Crow braking works by combining full downward flap movement creating maximum drag, and simultaneously almost full upwards aileron movement of BOTH ailerons (retaining just enough aileron control movement to keep the aircraft level). In this situation the upwards deflection of both ailerons disrupts the smooth flow of air over the wings thereby acting as spoilers, reducing the wing's lift capability.

**Crystal** - these are a vital small component of 35MHz radio control systems. They are numbered to indicate a specific frequency channel within the 35MHz band, and both the TX (transmitter) and RX (receiver) must be identically numbered so that they match perfectly. 2.4GHz radio systems do not require crystals in the TX or RX. The TX and RX crystals are not interchangeable.

**Cuban Eight** - an attractive aerobatic manoeuvre when flown well. It begins with a loop which is not completed, as the model is half rolled as it descends from the top of the loop and then looped again when it reaches the same altitude as the previous loop start point. It has the appearance of a horizontal figure eight with a half-roll at the intersection.

**Curve** - this is a term used in the programming menus of computerised transmitters, and relates to the way the control sticks provide output to the receiver channels they operate. This function is used whenever it is desirable for the output to be non-linear, such as softening the effect of control surface response to input close to the central or neutral point. The most commonly used curve is exponential for control surface movement, and most transmitters have a dedicated programming function to provide this facility.

**Cyanoacrylate/CA/Cyano** - often called Superglue, this is a very powerful glue often used in modelling. Standard CA will attack and instantly melt most forms of styrene foam but EPO/Elapor are not affected by it and it is a very useful adhesive for this material and for balsa and ply construction and repair. (There is a "foam-safe" variant and a so-called odourless variant, but these are more expensive than the standard type). There is also a thin CA which is commonly used to fix control surface hinges which are designed to "wick" - ie. to soak up the thin superglue as it runs into the hinge. CA Superglue acts very quickly, especially where there is moisture present and it should never be used without full eye protection. It can also stick fingers together so vinyl gloves are advised and be aware that it can remain runny and wet for quite a while after application so be careful when handling the model for some time after application. You should always keep some CA debonder handy when using superglue and ensure that the debonder is still useable. Superglue is very difficult to remove from a model and even its vapour can leave a white residue which can be very unsightly on coloured film so it should be used sparingly and with great care. In some cases it is desirable to speed up the curing process and a "Kicker" spray may be used. Be aware that allergic reaction to CA vapours is common and may build over time. Always use in a well-ventilated area and if necessary use a suitable face mask to avoid inhaling the vapours. Be especially careful of the vapours if a "Kicker" is used to rapidly harden the glue as the combination of the two chemicals produces highly toxic cyanide vapours.

**Dead-Stick** - this is when the motor or engine of the aircraft cuts out unexpectedly in mid-air leaving the model powerless. Whenever this occurs the pilot must shout "Deadstick" loudly so that other pilots on the flightline can give him landing priority for an emergency landing. A simulated deadstick landing is an integral part of both the the BMFA "A" test and the SAA "Bronze" test, and it is good practice for all pilots to simulate a deadstick situation from time-to-time to maintain their ability to manage a deadstick occurrence safely. In the event of an unexpected dead-stick situation, the safety of persons and property on the ground must be given priority over salvaging the model.

**Depron** - this is the commercial name for a type of styrofoam sheeting. Depron comes in various thicknesses and is extremely light. It is reasonably rigid for its weight and can be easily worked - i.e. cuts cleanly, glues and sands well. It can only be used for very lightweight model such as those flown indoors or for airframe parts which are not subject to great stress.

**DfT** - UK Department for Transport - Ministerial Department which oversees all aspects of transport in UK, and is the managing department overseeing the Civil Aviation Authority (CAA).

**Dihedral** - the upward angle of the wings when viewed from the front. This design makes the aircraft more stable and is commonly designed into trainers and also model warbirds and models of civilian passenger aircraft. Highly aerobatic models typically have no dihedral in order to maximise their manoeuvrability but are therefore more challenging to fly.

**Disorientation** - when you are unable to determine the attitude and/or direction of your model. This may be because it's too far away to see properly or because you've just flown into the sun or over your head. Orientation is more difficult on overcast days when models are just silhouettes in the sky.

**DLG** - Discus-launched glider. A glider which is launched by being thrown into the air by hand holding just one wingtip.

**Dolly** - a wheeled cradle or set of self-detaching wheels used to help larger belly-landing models to take-off without having to be hand-launched. After take-off it is desirable to have a helper to retrieve the dolly from the runway so that it is clear for landing.

**Down Thrust** - a deliberately built-in small downwards offset to the thrust line of the engine or motor intended to compensate for the torque effects and other forces which could pull the model off track. Usually combined with Side Thrust.

**Downwind** - this term is used in several different ways. It can refer to flying the model in the direction of the wind or refer to the position of anything located beyond the observer in the general direction of the prevailing wind. The Downwind Leg is the leg of the flying field circuit which is flown in the same direction as the wind and parallel to the runway on the opposite side of the airfield to the flightline.

**Drag** - the retarding forces that are created by the resistance of the air to the aircraft flying through it. There are several types of drag, but the easiest to understand is called Form Drag which is created by the frontal surface area of the aircraft, and this is minimised by streamlining. Induced Drag is caused by the different paths taken by the airflow under and over the wing causing air turbulence and vortices - especially around the wing-tips. Skin Friction is a type of drag caused by roughness in the surface of the aircraft and the viscosity of air. Many full size aircraft are routinely polished to minimise this type of drag. Models are sometimes described as "draggy" meaning that they have to work harder (consume more power) to cut through the air, and this usually refers to form drag. When an aircraft is flying straight and level at constant speed, its drag is exactly equal to its thrust and its lift is exactly equal to its weight.

**DRES/DMARES** - Drone and Model Aircraft Registration and Education Service operated by UK Civil Aviation Authority (CAA). All operators and flyers of model aircraft of 250g-20kg weight must register annually online and obtain an Operator ID which must be displayed on all their models. Flyers who do not hold a current (minimum) SAA Bronze or BMFA "A" accreditation must also complete a short free online test to demonstrate awareness of the law pertaining to this activity (valid for three years) - <https://register-drones.caa.co.uk>

**Drill Bit** - a steel shaft incorporating a hollowed twist and an angled sharp cutting edge at the point. Used for drilling holes via a power drill, hand drill or pin vice.

**Drone** - a term applied by the CAA and DfT to denote any and all forms of unmanned aerial vehicle (UAV). All model aircraft are defined as drones by these authorities. Within the aeromodelling community the term drone has a much narrower definition, being applied specifically to multi-rotor aircraft capable of hovering, and the more sophisticated of which are controllable entirely by computer software without human intervention. Small drones defined in this narrower way are flown manually and used in organised racing. Larger ones are sometimes flown using FPV.

**DSM/DSM2®** - trademarks of a type of spread spectrum technology developed by Spektrum for their 2.4GHz Radio Control systems. (This system was also adopted by earlier models of JR 2.4GHz radios). DSM and DSM2 have now been superseded by a system of frequency hopping which Spektrum calls DSMX. New transmitters using DSM/DSM2 can no longer be sold, but existing transmitters of this type can still be used legally. To retain backwards compatibility with their older transmitters, Spektrum's own brand receivers are compatible with both DSM2 and DSMX.

**DSMX®** - the trade-mark name of the Spektrum 2.4GHz frequency-hopping radio control system.

**Dual Rates/(Low Rates and High Rates)** - a feature of almost all R/C transmitters, whereby the control surface deflections (throws) can be increased or reduced relative to the same movements of the transmitter sticks. Computer transmitters allow separate dual rate setting for each of the three main control surfaces (elevators, ailerons and rudder). Low rates are most commonly used to help novice RC pilots who have a tendency to over-control their models, but they can also be used to "tame" models which have large control surfaces. It is also common to use low rates when flying a model for the first time (maiden flight) until the pilot is able to familiarise himself with the flying characteristics of the new model.

**Dynamic Soaring** - slope soaring from the back of the hill (standard slope soaring is from the front of the hill facing the prevailing wind). Models move in a tight circuit gaining energy with every revolution to reach very high speeds. It was by this means that the world speed record for a model aircraft was set by a glider.

**EDF/Electric Ducted Fan** – an electric motor-driven high-speed fan housed in a tube or duct used to simulate a jet engine in a model. Models powered in this way can require a long runway to take off as acceleration is very slow initially, but they can produce a very realistic simulation of a jet powered model, in both sight and sound, for a small fraction of the cost of a true model turbine engine.

**Elapor®** - a Multiplex trademarked name for the moulded EPO foam used for its models. As Multiplex was one of the first established manufacturers to mould all their models in this material the term is sometimes used erroneously as a generic term for EPO foam. Multiplex have always stated that this material should not be glued using epoxy resin and recommend Cyanoacrylate (Superglue and Kicker) for the assembly of their models.

**Elevator** - the moving control surface forming the rear part of the horizontal stabilizer, or tailplane, which controls the pitch attitude of the aircraft.

**Elevons** - delta aircraft and flying wings typically do not have a tailplane and therefore do not have elevators to control pitch. The ailerons therefore have to fulfil the function of both aileron and elevator and these control surface are then called elevons. This requires a specific set of control channel mixing on the transmitter, but most computer transmitters offer this mixing as a standard option in their main menu so that achieving this mix is relatively easy.

**EP** - an abbreviation to signify that a model is electric powered.

**EPO** - Expanded Polyolefin - a very tough foam used for moulding airframes, which has almost completely replaced the softer and less resilient EPS (Expanded Polystyrene) which is also more vulnerable to attack by solvent-based glues. Standard Superglue or UHU POR can be used to assemble models made of this foam although increasingly models made of EPO are designed simply to be assembled with a few bolts or screws and have all the main components pre-installed. EPO is sometime rebranded by manufacturers under different trademarked names such as Elapor, Z-Foam and others.

**Epoxy Resin** - a binary adhesive which is supplied in two separate tubes or plastic bottles containing the viscous resin and hardener. Only when the two are mixed does the compound harden to form a very powerful bond, and you can buy epoxies with various curing times, which can be helpful in different situations. Very useful for balsa/ply construction and repair, but not suitable for EPO foams because epoxy does not adhere well to this material. A particularly useful application for epoxy is to smear a thin surface-coating on to any surface on which you wish to stick self-adhesive Velcro® or "sticky-pad" to. Allow the epoxy to dry first to create a high-gloss surface before applying the self-adhesive pad or tape.

**EPP** - Expanded Polypropylene. This is a foam product which is exceptionally resilient to damage. It is a little heavier than EPO, and is more flexible with a rubber-like feel to it. It has a rougher surface texture and is used mainly where resistance to crash damage is a priority (eg. combat models).

**EPS Foam** - Expanded Polystyrene - the older traditional polystyrene foam. It is lighter, but softer and much more susceptible to damage than EPP or EPO foam. It cannot be glued using CA or solvent-based glues but UHU POR works well with it, as does Epoxy Resin and PVA glue. It is becoming much less common in model aircraft since the tougher more resilient EPO has replaced it.

**ESC** - Electronic Speed Controller - the electronic gizmo that delivers and controls the power delivered to the motor from the battery pack. It is connected between the battery and the motor and also has a lead to connect to the receiver where it receives and responds to the pilot's control signals from the transmitter. In smaller models it also powers the receiver from the main battery pack using an internal voltage regulator called a BEC (Battery Eliminator Circuit). ESCs can be either linear or switch-mode in operation. The latter is more efficient but both types can get hot and usually incorporate a heat-sink. Ideally they should be positioned in the aircraft in such a way that they can be cooled by the airflow coming through the fuselage from air intakes up front. There are speed controllers for brushed or brushless motors these are not interchangeable. All ESCs can be programmed in various different ways, and this can be done either from the transmitter, using a specified sequence of beeps and/or LED flashes, or more simply via a separately-purchased programming card designed for the specific ESC.

**Expo/Exponential** - this is a powerful and extremely valuable feature that has become available through the advent of computer transmitters. It is a means of softening or desensitising the control inputs of the transmitter stick movements around the centre or neutral point. By programming the transmitter accordingly the user can create a non-linear relationship between stick movement and control surface movement. This feature has made it possible to fly models with very large control surfaces which would otherwise have been impossibly "twitchy" to fly. It is very important to understand how your own transmitter implements this feature because some use positive exponential to soften the controls while other use negative exponential. Get this the wrong way round and the model becomes far **more** sensitive to stick movement rather than less so.

**Extension Lead/Extension Wire** - there is frequently a need to extend the length of a wire lead between various components, such as servo/receiver and ESC/motor or battery/ESC. Ready-made servo extension leads are available to purchase in various lengths, but when extending in this way it is important to ensure the the connection cannot come apart due to snagging or vibration, and special clips are available to hold the male/female connectors in place. Extension leads for power-train connections must be capable of carrying the high current which may be drawn, and where possible it is always preferable to extend between the ESC and the motor rather than between battery and ESC, as the latter can result in electrical "spikes" which may damage the ESC.

**FAI** - Federation Aeronautique Internationale - the world air sports governing body to which the BMFA is affiliated.

**Failsafe** - If a model aircraft radio-control system makes it possible to program failsafe settings (and virtually all do) it is now a legal requirement for the failsafe to be properly set. Failsafe settings are designed to avoid a fly-away model when radio control signal is lost for whatever reason. The minimum failsafe setting for electric models is that the motor should shut down promptly, and on i/c models for the motor throttle setting reduce to idling. Many computerised transmitters allow additional failsafe settings to be programmed and in these case it is possible, for instance, to set a small amount of rudder and/or a neutralise all control surfaces. The motor cut or engine idle failsafe settings fulfil the legal requirements however.

**Fairing** - a moulded panel or covering of part of an aircraft to protect or streamline the airflow during flight.

**FASST®** - this is one of Futaba's 2.4GHz system brand names and stands for Futaba Advanced Spread Spectrum Technology which uses frequency-hopping technology.

**Fin** - more often called the tail-fin or vertical stabilizer, it's the vertical surface at the rear of the aircraft used to stabilize the plane in flight. The rudder is the moveable control surface attached to the rear of the tail fin.

**Finals** - this is the last leg of the airfield circuit and is the final descending approach facing towards the runway for landing.

**Firewall** - the fuselage former to which the engine or motor is attached. (See Bulkhead)

**Fishtailing** - a flying trait whereby the aircraft tail waggles or shimmies along the yaw axis slightly as it flies. Although usually relatively benign if slight, it can be a cause of instability and looks disconcerting. There can be several causes including slop in the rudder control linkage. Sometimes enlarging the fin area or thickening the fin trailing edge can help to resolve the problem.

**Flaps** - moving sections of the trailing edge of the wing, usually inboard of the ailerons. Flaps deflect downwards and are used to increase the wing camber, creating more lift at slower flying speeds, and when fully deflected, to increase drag to slow the aircraft on the landing approach.

**Flaperons** - a single control surface on the trailing edge of each wing that does the job of flaps and ailerons. Used almost exclusively on gliders which do not have flaps, both ailerons are deflected upwards to act as spoilers to reduce lift in the landing approach and thereby to reduce the risk of overshooting the runway. Some aileron control must be retained to keep the model level. A transmitter with control mixing capability is needed for flaperons.

**Flare or Round-out** - gradually introducing small increments of up-elevator in the last few moments prior to touchdown to slow the rate of descent and allow the aircraft to settle softly on to the runway. It requires gentle stick control to keep the model descending and not suddenly climbing into a stall.

**Flight-Line or Pilot Stance** - this is a small area at the side of the runway where all the pilots who are currently flying should stand to control their models. The position of this may vary from time-to-time by agreement of those present, to take account of wind direction and/or the position of the sun or other factors. Ideally it should be positioned close to the landing threshold of the runway so that take-offs are always away from the flightline, and the landing touch-down point is easier to judge to avoid undershooting or overshooting the runway. It should always be sited with the pits area to its rear, and pilots must stand reasonably close to one another within this area to ensure that any warnings such as "Dead-Stick" or "Landing" can be heard by all the pilots who are flying.

**Flight Pack/Flight Battery** - the battery which powers the motor of an electric power train. In smaller systems it may also power the receiver at the same time via an ESC which incorporates a BEC, or occasionally via a UBEC. See BEC and UBEC and ESC.

**Flight simulator** - a home-computer-based training aid that lets you practice flying radio control from the safety and comfort of home. Several different ones are available and although the quality of the software is variable they are a useful training aid for novice RC pilots, and for more experienced pilots wanting to learn new and difficult aerobatic manoeuvres without the risk of crashing a model.

**Floater** - a type of slow-flying glider which is designed to fly in light wind

**Floatplane** - an aircraft equipped with pontoon floats instead of wheeled undercarriage, to enable it to take off from and land on water.

**Fly-Away** - This is when a model flies out of radio-control range under its own power and will only cease flying when its fuel or battery capacity are exhausted. This is a potentially dangerous situation as the model is not under control and may cause collateral damage or injury when it eventually crashes. To avoid this situation it is a legal requirement for all model aircraft (where technically possible) to have a failsafe setting actuated whenever it is flown, to ensure the the motor is cut (electric) or throttled down to idle (i/c) in the event of loss of radio signal by the model. See Failsafe.

**Fly-In** - this term is used to describe a social event hosted by a model flying club, whereby visitors from other clubs are invited to fly at the host club's site. Third-party insurance and holding a minimum of BMFA "A" or SAA Bronze certificate are almost always a prerequisite for participants.

**Flyer ID** - An identification number issued by CAA to flyers and operators of UAVs (including model aircraft) subject to successful completion of the CAA online competency test. The CAA has granted exemption to holders BMFA "A" Certificate who qualified prior to 31/12/2020 and also have declared to the BMFA that they have read and understood the conditions and restrictions that apply when operating within our Article 16 authorisation. (N.B. Certificates gained after 31/12/2020 cannot be used). The BMFA RCC (see below) is also a valid alternative to the Flyer ID. It is the intention that in future ALL flyers of UAVs must have a valid current Flyer ID and those who are exempted from the CAA competency test as specified above, will be issued a Flyer ID automatically by their Association. All flyers of UAVs must have their Flyer ID with them when flying and must be able to show it on request to any authorised person, including the police.

**Flying Boat** - an aircraft of which the fuselage is effectively a boat hull, to enable it to take off from and land on water. Almost all flying boats have an outrigger pontoon float positioned near the tip of each wing to provided lateral stability of the aircraft in the water.

**Flying Tail** - this is where the whole tailplane (horizontal stabiliser) acts as a large elevator and is movable by servo activation. In some cases the entire vertical tail fin is also moveable, acting as rudder. (Sometimes called AMT - all-moving tail).

**Foam Board** - a stiff lightweight composite sheet material comprising a soft plastic styrofoam sandwiched between two sheets of paper or card.

**Foamie** - a type of model airframe moulded from some form of expanded foam material. They originally came about during the earliest days of electric powered flights when motors were brushed and not very efficient, and batteries were large and heavy NiCds and NiMHs - both factors necessitating extremely lightweight models. Initially quite small and made from light EPS foam, they were transformed by the introduction of brushless motors and LiPo batteries. And as electric power has since virtually replaced i/c as the power train of choice for many RC flyers, they have really come into their own and become increasingly sophisticated. Nowadays they are made from resilient hard foam such as EPO, and due to their high moulding quality and smooth surface finishes incorporating panel lines, they produce fabulous scale and semi-scale models and fine aerobats. Many now even come with integral LED navigation lights, flaps and retractable undercarriage as standard.

**FPV/First Person View** - A system of R/C model flying enabling an RC pilot to fly a model aircraft as if he were actually sitting in its cockpit. A tiny video camera is fitted to the model along with a device that transmits real-time video back to a ground station. The camera may be fixed facing forward, or mounted on a servo-controlled gimbal to allow the pilot to scan side-to-side as well as forwards. The pilot wears video goggles which display the picture transmitted from the camera and flies the model as if he were actually in the model.

**Free-Flight** - a model flying discipline whereby models are not controlled from the ground once they are launched into the air. The models may be rubber-powered (twisted rubber band within the model) or electric-powered for a short burst of limited power and limited duration.

**Frequency** - all radio control gear works on modulation frequencies. The UHF wave band of 2.4GHz is now the most popular and used worldwide for radio control of models, including model aircraft, as it has been proven to provide a very strong radio link and is less susceptible to interference than the 35 Megahertz radio band which preceded it in the UK. The 35MHz frequency band is still available to model flyers and is allocated exclusively for use by model aircraft. Note that only 27MHz, 35MHz and 2.4GHz can be used for model flying in the UK with 40MHz reserved for surface vehicles such as cars and boats. In practice 27MHz is no longer used for model flying and beginners are advised to opt for the new 2.4GHz.

**Frequency hopping** - The 2.4GHz wave band has become extremely busy as it is used for a wide range of gadgets including computer WiFi. Older 2.4GHz systems (notably Spektrum's DSM2) used to locate two frequencies within the available bandwidth and then effectively "hog" them for the duration of the time they were switched on. This provided a robust radio link but was considered "anti-social" in that it reduced the number of frequencies available to other radio equipment, and thereby limited the number of items of radio equipment that could be used at one time within range of active DSM2 radios. Frequency hopping was adopted internationally as a more acceptable solution, still providing a robust radio link, without denying frequency channels within the bandwidth to other users. Frequency-hopping is now the only system permissible in new radio transmitters although Spektrum receivers are compatible with both systems so that the older DSM2 transmitters will still work with newer Spektrum (DSMX) receivers. Interestingly the concept of frequency hopping was originally conceived by the famous film actress Hedy Lamarr during the second world war to increase the accuracy of US Navy torpedoes.

**Full Chat** - slang for 'Full Throttle'. Same as WOT - Wide Open Throttle. Although originating in the parlance of internal combustion engines, these terms are often still used in relation to full power from an electronic speed controller (ESC) in electric powered models, even though a throttle as such is not part of an electric power train.

**Fun-Fly** - an event popular in many model flying clubs, in which the flying skill of participants is tested by numerous "fun" challenges, such as "Limbo" (flying under a tape), spot-landing, balloon-bursting, etc. Needless-to-say some of these challenges may pose the risk of damage to models.

**Fuselage** - the main body of a aircraft, excluding wings, tail etc.

**Glide Angle** - the minimum rate of descent of a model when the power is cut, without inducing a stall.

**Glitch** - a slang term which generally means a momentary failure of or interference affecting radio control of a model aircraft. It may often take the form of momentary twitches of the model in the air, or by uneven power and noise from electric motors.

**Greaser** - slang for a perfectly smooth landing with no bouncing.

**Ground speed** - Speed of an aircraft relative to the ground. Although easy for a pilot to observe and assess, this does not equate to the speed of the airflow over the wings (airspeed) so cannot be used to assess the proximity of a model to its stalling speed, especially when flying downwind.

**Grubscrew** - a small headless screw having a slot cut for a screwdriver or a socket for a hexagon key and used to secure a sliding component in a determined position on a shaft.

**Gyro** - See stabiliser.

**Hack** - a slang term for a general sport model - perhaps an older model that the owner will be happy to fly in winter and in poorer weather conditions.

**Hand Launch** - one way to launch a model aircraft without an undercarriage. The model should normally be held level at head-height and launched into wind, ideally with a straight throw like a dart.

**Hands-off** - a situation where the model is flying with no input from the pilot on the transmitter sticks.

**Hangar Rash** - damage to a model caused by clumsy handling of the plane at home or in transit between base and flying field. Often superficial, but sometimes requiring repair before the next flight.

**Headroom** - this is often used to describe the safety allowance between the maximum current rating of each component of an electric power train and the maximum "real-world" current it will ever draw in actual flight operation. Bench-testing using a wattmeter is the best way to ensure that sufficient headroom is given to every component.

**Heatshrink** - very useful rubber tubing which is used for insulating bare electrical connections and is sold in various diameters and colours. It is positioned over the bare connection or solder-joint and then heat is applied (usually via a heat-gun) to shrink the tubing so that it is fixed firmly in place.

**High Alpha** - a high angle of attack, a term often used to denote 3D or freestyle manoeuvres.

**Hook and Loop** - See Velcro®

**Horn/Control Horn** - a lever arm fixed to a control surface to activate movement of the control surface via a push rod or closed loop connected to a servo arm. See Servo Arm and Linkage.

**Horizontal Stabiliser** - sometimes called the 'stab' or more commonly "Tailplane" in the UK. The horizontal surface at the rear of the fuselage, to which the elevators are attached.

**Hot Glue** - a cheap and readily-available method of sticking or anchoring items together. It hardens swiftly and the hot nozzle can melt foam so the glue gun needs to be handled with care. It is a useful method for anchoring servos in foam models as, although quite strong, it can be "piggled off" in the event of needing to replace a servo.

**i/c or I.C.** - internal combustion. Usually refers to any engine that uses liquid fuel such as a two-stroke, four-stroke or petrol engines.

**Incidence** - the angle of a wing relative to the horizontal centre line of the aircraft. If the front of the wing is up relative to the horizontal, the angle is said to be positive, if down it is negative.

**Indoor flying** - usually taking place in sports halls this has become a major feature of the winter programme for many UK clubs, and was made possible only because of the development of electric-powered flight. The models can be tiny (micro) or quite large (eg. shockies) and sessions need to be carefully managed to give the two types separate time slots. Some clubs also allow time slots for small electric helicopters and multi-rotors.

**Inrunner** - a type of brushless motor where the permanent magnets and motor shaft rotates within the fixed stator can, as in a normal brushed motor.

**IWM** - Imperial War Museum - there are several sites but this often refers to the aviation museum at Duxford.

**Kicker** - an accelerant used to cause superglue (cyanoacrylate) to harden and bind instantly. Usually a fluid, it should only be used in very well-ventilated areas as the chemical reaction releases highly toxic cyanide gas. Baking powder can sometimes be used as an alternative.

**Kit** - See Model Aircraft Kit

**Knife-edge** - Flying the aircraft straight and level but on its side (wings vertical) for an extended duration.

**Kv** - The theoretical number of RPM per volt of electricity applied to an electric motor when not under load. eg. an unloaded 1000 Kv motor, supplied with 10 volts, will spin at 10,000RPM.

**Landing Gear** - also called the undercarriage or undercart (slang). Refers to all wheels and associated legs, axles and any other items protruding from the underside of an aircraft to support it on the ground. Landing gear can be fixed or retractable into the underside of the wing or fuselage during flight.

**Leading Edge (L/E)** - the front edge of the wing, tailplane or rudder.

**Lift** - the force created by the forward motion of an aircraft's wing or the rotation of a helicopter's rotor blades. Air pressure over the wing is less than the pressure below the wing and so the wing, along with the rest of the model to which it attached, is both pushed and sucked upwards.

**LiIo/Lithium Ion** - All lithium based cells are technically "Lithium-Ion", but this and the abbreviation LiIo is usually more specifically applied to cells of a particular solid-state chemistry and encased in a hard cylindrical shell. These have a lower power to weight ratio than soft cased LiPos and have a lower nominal voltage of 3.6V, and usually a much lower C Rating. Most commonly used in small portable devices such as mobile phones and laptop computers, they are more rugged and more expensive than LiPos. Rarely used for powering electric flight due to weight and low C Rating. They must not be charged using a LiPo charging regime but require their own specific charging regime. However many modern chargers do incorporate a LiIo charging regime which can be selected by the user.

**Linkage** - a term used to describe the mechanical arrangement of a servo arm connected to a control surface horn via a push-rod or closed loop. See Horn and Servo Arm.

**LiPo** - Lithium Polymer cell or battery of cells. Usually soft "pouch" rectangular shaped construction, with excellent power to weight ratio. Nominal voltage 3.7V per cell. The most common form of battery used in electric flight and available in a very wide range of sizes at reasonable prices. They need to be charged and used with considerable care to avoid potential fire risk, especially during charging.

**LiFePO<sup>4</sup>** - Lithium Ferro Phosphate. (Usually abbreviated to LiFe) Another lithium based cell, the most popular and efficient of which are known as A123 or M1 cells. They have a hard cylindrical casing, can be fast charged in under 15 minutes, and have a very low internal resistance meaning huge discharge current potential. They have a longer potential useable lifespan than LiPo but have a lower nominal voltage of 3.3V and a lower power-to-weight ratio. They are considered safer in use as they do not suffer from the thermal runaway risk of LiPos. LiFePO<sup>4</sup> batteries with low C rating are increasingly popular as receiver batteries and as replacement Transmitter batteries. From time-to-time higher C rated varieties have been available in a soft-case rectangular format similar in shape and size to LiPos, but they are relatively expensive and therefore the take-up has been low.

**LMS/LHS** - common abbreviation, (especially in forum postings), for Local Model Shop or Local Hobby Store.

**Locknut** - a generic term for a nut which incorporates some means of self-locking when tightened into position so that it does not loosen itself when subjected to vibration etc. See Aerotight® Nut and Nyloc® Nut.

**Loop** - used to be called "looping the loop" - an aerobatic manoeuvre whereby the aircraft flies a vertical circle in the air. The easiest stunt of all to pull off, and almost any model with an elevator can do them. It is important to avoid the model twisting during the loop which looks very untidy.

**LVC** - Low Voltage Cut-off - The electronic circuit within an ESC (see above) that cuts power to the motor should the main battery fall below a certain voltage. This is set to occur at a point where sufficient battery capacity is left in the flight battery to power the receiver and servos (via the BEC) to allow the pilot to make a controlled dead-stick landing. In most ESC's there is the option for the ESC to be programmed so that the LVC progressively reduces power to the motor when the battery is nearing depletion so that the pilot is warned of the impending loss of power by a reduction in performance of the model in the air rather than having a sudden motor cut-out.

**Mid-air** - as in mid-air collision, a term used to describe the unfortunate incident of two or more aircraft making physical contact with each other while in flight. Although rare, such incidents do not end well.

**Mixing** - when a computer transmitter is programmed to mix or combine two channels so that they are activated by a single transmitter switch or stick movement, translating into corresponding simultaneous response of the two control surfaces connected to the same mixed channels on the model receiver. There are some common mixes and these may be named and activated directly from the transmitter menus. However many transmitters also allow a number of user-defined mixes. See Channel Mixing above.

**Mode** - transmitters can function in a variety of ways, each being designated with a standard Mode Number. Some transmitters have the functionality to allow the user to alter the mode after purchase, but most do not, and in these cases the purchaser must specify which mode they want at the time of purchase. Newcomers to model flying are strongly advised to check which mode is most commonly in use at the Club they intend join before purchasing a transmitter, and to choose the same mode for themselves. Very few pilots are able to fly models with a transmitter of a different mode to the one they are used to, and this is very significant if the newcomer needs flying instruction and the benefit of dual-control buddy-lead assistance during the learning process.

**Mode 1** - refers to the set-up of the transmitter whereby the left stick operates the elevator and rudder, and the right stick operates the throttle and ailerons.

**Mode 2** - refers to the set-up of the transmitter whereby the left stick operates the throttle and rudder, and the right stick operates the elevator and ailerons. This is the most common mode in use in most (but not all) UK model flying clubs.

**Mode 3** - refers to the set-up of the transmitter whereby the left stick operates the elevator and ailerons, and the right stick operates the throttle and rudder.

**Mode 4** - refers to the set-up of the transmitter whereby the left stick operates the throttle and ailerons, and the right stick operates the elevator and rudder.

**Modes 3 and 4** are rarely encountered in the UK.

**Model Aircraft Kit** - a unbuilt model aircraft which is supplied in a box of component parts for assembly by the purchaser. Some kits contain everything needed to complete the model (except tools and adhesives) whereas others may require the separate purchase of numerous airframe and/or power train items and servos.

**Model Memory** - all computerised transmitters include the facility to record the programmed settings for several different models, each in its own "model memory". Before arming or starting the model, the pilot must remember to select the correct model memory for the model he is about to fly. Some transmitters go one step further in the binding process by binding not only the transmitter to the receiver, but actually binding the specific model memory to the receiver too. With this system a model simply will not respond at all when the wrong model memory is selected, and it is a really valuable

safety feature because it prevents the accidental take-off of a model with the wrong settings. The Spektrum trademark for this is "Model Match" although other brands are now adopting it too under various different names. Pilots with transmitters without this feature must take great care to select the correct model for the model they are about to fly, especially if they have flown a different model previously. A model flown using another model's settings may be totally uncontrollable and therefore dangerous. In the event of this happening the model motor or engine should be cut immediately and a safe deadstick landing attempted.

**Multi-rotor drone** - a term commonly used to describe a relatively new generation of UAV. These do not have a wing but rely on a combination of several small horizontally-mounted rotor blades driven by brushless electric motors to enable them to take-off vertically and hover. The coordination of the rotors is electronically controlled, and a gimbal-mounted camera is a common accessory used on these UAVs. They are available in many different sizes and the smaller manually radio-controlled ones especially are capable of high speeds. Larger and more sophisticated versions can have their flight pattern entirely pre-programmed and flown by computer software. These are now widely used commercially by the media (especially TV) and also increasingly in agriculture, forestry, livestock and wildlife monitoring and management, policing, and by fire and rescue services, and they have the potential for useful application in many other contexts. Unfortunately their potential has not gone unnoticed by the criminal fraternity and by terrorists and activists of various kinds, and their use in deliberate or unintentionally irresponsible ways and in various criminal activities has resulted in a draconian response by the aviation authorities which could threaten the very existence of model aircraft flying as a harmless and socially valuable hobby.

**Mylar®** - is a registered trademark owned by Dupont Tejjin Films for a specific family of plastic sheet products made from the resin Polyethylene Terephthalate (PET). Lighter than polyester film it is sometimes used for covering indoor models.

**Nacelle** - a term used to describe the motor or engine mounting and encasement of a multi-engined aircraft

**NiCd** - (pronounced "nicad") an abbreviation for a cylindrical metal-cased rechargeable battery using 'nickel cadmium' chemistry. Cadmium is a highly toxic substance and a NiCd battery case should never be physically opened. They have a very long life but suffer from "memory effect" - a tendency not to accept a full charge unless they are frequently fully discharged. Because of their toxicity they also present a recycling problem and are no longer sold in the UK or Europe. However, because of their long life they are still quite widely used in 4-cell AA size batteries to power receivers.

**NiMh** - abbreviation for a cylindrical metal-cased rechargeable battery using 'nickel-metal-hydride' chemistry. The chemistry is much less toxic than cadmium and they have a slightly higher power-to-weight ratio than NiCds. Before LiPos became available they were the main source of power for electric flight, but their heavy weight meant that the airframe that carried them had to be extremely light, and it was in this period that foam moulded airframes became popular. They are still very widely used in 4-cell AA size batteries to power receivers. They are less prone to memory effect than NiCds but a particular problem of NiMh batteries is their tendency to discharge themselves when not used for a few weeks. Recently a new type of NiMh has been available (the first was a Sony product trademarked "Eneloop" but there are other brands), and these are said not to suffer from the self-discharging problem.

**NiXX** - a generic abbreviation used denote either NiCd or NiMh batteries.

**Non-scale** - any model that is not modelled from a full-size aircraft.

**Nyloc® Nut** - a nut which incorporates a non-permanent nylon threadlock resin collar to give it resistance to accidentally unscrewing itself. Nyloc® is a registered trademark in Australia, but is often used as a generic term for nuts of this type.

**Ohms Law** - a basic law of physics which is important to keep in mind when designing or specifying electric power trains. The law simply states that:  $Watts = Amps \times Volts$  In model flying this simply translates to Watts being the power developed (thrust); Amps is the current drawn (from the battery and through the ESC and motor); and Volts is the determined by the type of cell used and the number of cells in the battery. It is important that a power train generates sufficient watts of power to provide the necessary airspeed to create the lift need to support the weight of the aircraft. The amps are also

critical, both in terms of not overloading the motor or ESC or battery as all these have an Amps rating ceiling which must not be exceeded. The amps drawn is also the main factor in determining flight duration of a model since it relates to the capacity of the battery specified in mAh. As stated elsewhere in this glossary, a wattmeter is the best way to see these three critical factors displayed when a model is powered up during bench-testing.

**Oleo** - a sprung undercarriage leg often used for larger, heavier models.

**Operator ID** - Everyone (individual or organisation) who owns a UAS in the United Kingdom must by law hold a CAA Operator ID which is obtained by registration with the CAA for a small annual fee. The minimum age for registration as a UAS Operator is 18, although younger people may fly UAVs on behalf of the operator, provided they personally hold a valid Flyer ID (see above) for which there is no minimum age. It is also a legal requirement that the Operator ID is clearly displayed on every UAV (including model aircraft) and must be clearly visible on inspection of the model without the need for any tools to access the interior of the UAV. As this is a legal requirement, failure to meet these obligations may result in prosecution, and may also invalidate the third-party insurance cover provided as a member of one of the major model flying associations.

**Oracover®** - a trademarked brand of polyester film used for covering model aircraft airframes.

**Overshoot** - to overrun the landing strip and end the landing run beyond the runway in the outfield.

**Outrunner** - a brushless 3-phase motor in which the outer case of the motor rotates and acts as a fly-wheel, generating powerful torque. These are the least expensive of the brushless types and the most commonly used for electric flight.

**OW** - Old Warden - the site of the Shuttleworth Aircraft Collection near Biggleswade

**PVA** - Polyvinyl Acetate, a water-based wood glue often used in wooden and styrene foam model construction and repair work (but not suitable for EPO/Elapor), and also in other woodworking and craft work. Also known as 'white glue', it is slow-drying and the work will need to be clamped. PVA sold for craft work is only intended for paper and card etc. so is not strong enough for aeromodelling.

**Park Flyer** - the generic name for a small, lightweight, electric-powered, relatively slow-flying model that can safely be flown in a small area such as a park. (Be aware however that many local authorities have by-laws which prohibit the flying of model aircraft within their public parks).

**Pattern Ship** - a type of model aircraft specifically designed to fly very precise aerobatic manoeuvres - especially for F3A competitions..

**Peg board** - a form of frequency control or monitoring used by some clubs. The system was designed to prevent two or more transmitters using the same frequency within the 35MHz bandwidth being switched on at the same time. The resulting clash of radio signals has the potential of very serious danger, both in the pits, (electric models suddenly and unexpectedly starting), and in the air through loss of control of flying models. For this reason they are still a vital requirement in clubs where several members still fly using 35MHz radio equipment which may share the same frequency. There are two main ways of using the peg-board system - "peg-on" and "peg-off", and anyone visiting another Club should enquire which system is in use and how it operates. The widespread use of 2.4GHz radio equipment for model flying has effectively made this system redundant as 2.4GHz transmitters are bound to specific receivers and cannot interfere with each other. Nevertheless some clubs have chosen to retain a pegboard system to monitor how many transmitters are being operated at the site.

**Piano wire** - named after the wire used in the hinges of long piano keyboard covers. A type of tough steel wire with a high degree of "springyness". Often used to fabricate undercarriage legs for models.

**Pilot Stance** - see Flight-line

**Pin Vice** - a small screwdriver-sized hand-tool incorporating several collets or alternatively a small chuck to enable small drill bits to be clamped into it for use by hand. Perfect for drilling small holes in soft materials such as balsa or light plywood, especially in confined spaces.

**Pitch** - the upward or downward rotation of the aircraft in relation to the horizontal. Pitch is controlled by the elevators. The same word is also used to signify the amount of twist in a propeller blade.

**Pits** - a designated area within a club flying field which is used to park models between flights and also to prepare models for flight. Because of the close proximity of models and people, and the very real danger of electric models suddenly and unexpectedly starting by accident or due to equipment failure, the pits is statistically the site of the most frequent and severe accidental personal injuries. For this reason a very disciplined attitude must be adopted and maintained by all model flyers within the pits areas, and no model should ever be armed (electric) or started (i/c) unless properly restrained and facing outwards from the pits. Clubs should impose rules and invoke sanctions where necessary to minimise dangerous practices and occurrences in the pits. Responsible clubs will also provide practical measures to increase pits safety, such as sufficient model restraining benches and protective barriers.

**Planking** - See Sheeting

**Play** - See Slop.

**Plug-N-Play (PNP)** - Ready To Fly models that are supplied without a transmitter or receiver, allowing (requiring) pilots to install their own radio equipment.

**Polyhedral** - a wing shape where the outward ends of the wing panels are at a different angle to the main panels. Most commonly used in slow-flying gliders known as "floaters".

**Power-Train** - a term more commonly applied to electric power systems, and is a combination of the motor, the ESC and the flight battery. Although not an electronic component the propeller is also a very important part of an electric power train since the diameter and pitch of the propeller can have a profound effect on the power it develop (watts) and the current it draws (amps), and an incorrect propeller specification can seriously overload an electric power train leading to sudden failure or even a fire.

**Power-to-Weight Ratio** - although the meaning of this term is obvious it is an important ratio when specifying a suitable electric power train for a model. The power is measured in watts and divided by the all-up-weight in pounds (lbs - imperial weight) or kilograms (Kg). In electric power, the choice of propeller is an important element in determining both the power produced and the current drawn, and the value of a wattmeter to validate these numbers via bench-testing cannot be over-emphasised. See Ohms Law. As a rough guide, the following table may be useful:-

Watts per lb	Performance	Watts per Kg
< 35	Not adequate	< 75
35 - 45	Slow Fly or Park Fly Models	75 - 100
45 - 65	Trainers, Multi-Engine	100 - 140
65 - 90	Sports Models, Scale Warbirds	140 - 200
90 - 135	Advanced Aerobatics	200 - 300
90 - 135	High Speed Models	200 - 300
135 - 200	3D Models, EDF Jets	300 - 440
200 +	Unlimited 3D Models	440 +

**Pre-flight checks** - essential checks that need to be carried out immediately before flight. Basically similar to the Cockpit Checks and Vital Actions of a pilot of a full-size aircraft prior to take-off. Before each flight the pilot should check for any sign of external damage to the model (especially after a hard landing). Before arming the model check the condition of the propeller and the security of the motor and make absolutely sure that the correct model memory is selected on the transmitter. Then **with the firmly model restrained**, arm it (ie. connect the battery), and then check that all control surfaces have full, free and correct (in the right direction!) movement.

**Procedure Turn** - Two of these (a right and a left) are included in the SAA Bronze test requirements. It consists of a 90° turn away from the flight line followed by a 270° turn in the opposite direction to bring the aircraft back downwind on the manoeuvring line. All parts should have the same radius and the aircraft should be continuously banked, rolling through to the opposite bank without hesitation and with no straight sections once the turn has started until lined up for the next manoeuvre.

**Prop** - abbreviation for propeller.

**Proplex®/Correx®** - a plastic material similar to corrugated cardboard, comprising two layers of thin plastic sheeting encasing a corrugated plastic core. Sometimes used to make tailplane (stabiliser), tail fin or control surfaces on lightweight model aircraft.

**Prop Adaptor** - a type of boss which enables the propeller to be fixed firmly to the electric motor shaft. There are several main types but the most common uses a split-collar clamping arrangement which tightens the prop adaptor on to the shaft as the propeller retention nut is tightened.

**Prop-Saver** - a type of prop-adaptor collet whereby the adaptor is tightened on to the electric motor shaft by two opposite screws, the protruding heads of which are used to secure the propeller with a rubber "O" Ring. The system is most common on belly-landers and designed to avoid breaking the propeller on landing as the flexibility of the rubber "O" Ring will allow the prop to be pushed sideways in the event of a landing which would otherwise cause a firmly fixed prop to break.

**Prop-Wash** - this is the spiral air turbulence flowing back from the spinning propeller and around the fuselage. It can affect the tail fin of the aircraft pushing it sideways and causing unwanted yaw. During the trimming process this is countered so that it has no effect at normal cruising speed, but may well arise again when the motor RPM is increased (or the slight yawing the opposite way when reduced). It is a particular issue when taking off at full power and may be accentuated by the torque effect, so it often needs to be countered by use of right rudder on take off

**PSS** - Power Scale Soaring. A particular model flying discipline involving the modelling and flying of unpowered slope soaring scale models of any powered full size aircraft.

**Pusher** - a power train configuration whereby the model is fitted with the motor and propeller pointed rearwards so that the aircraft is pushed through the air rather than being pulled by a front-mounted (tractor) power unit.

**Push rod** - a rigid rod that links the servo to a control surface horn so as to activate a control surface. Push rods are most commonly made of stiff metal wire, but some are made from carbon fibre rod and rarely they are made of wood.

**Pylon-Racing** - a model flying discipline whereby models are raced around a defined course marked by pylons. Models may be powered or unpowered (eg. slope gliders)

**Range check** - an essential pre-flight check to ensure that your model will respond to the transmitter controls under all conditions within visual range. Most transmitters incorporate a specific way of conducting this test by reducing the strength of the transmitter's signal. The pilot then positions the model approximately 30 metres away from the transmitter and checks that the model still responds properly to the transmitter in its reduced signal-power mode in all conditions. It is important that the motor should be running when the correct control surface movements are observed, so a helper may be needed to restrain the model safely during this test procedure. A range check must always be carried out before a maiden flight; whenever a new receiver is installed; after a crash or very heavy landing or any event which might have compromised the integrity of the installed receiver.

**RC or R/C** - common abbreviation for Radio Control.

**RCC** - BMFA Registration Competency Certificate. The RCC is basically an online quiz similar to the CAA Flyer ID quiz but more specific and relevant to flyers of model aircraft. It is recognised by CAA as a valid alternative to their Flyer ID quiz. All BMFA Achievement Scheme Examiners must hold a valid current RCC, and BMFA members who hold a current RCC are exempted from the mandatory questions when taking any of the BMFA Achievement Scheme tests. See: <https://rcc.bmfa.uk/rcc>

**RX** - common abbreviation for Receiver

**Receiver** - part of the radio control system that is installed inside the model and picks up the radio signals sent out by the transmitter. With 2.4GHz systems the receiver must be bound to the specific transmitter in order to function. In some systems the binding is not only to the transmitter, but to the specific model memory within the transmitter.

**Receiver Battery** - particularly in larger electric models a separate battery is used to power the receiver and servos, rather than relying on a BEC within the ESC. A common battery for this purpose is a 4-cell NiMH AA size battery since all receivers and servos will work on 4.8V. If a 2-cell LiPo or LiFe battery is used instead, a separate UBEC voltage regulator may be needed between the battery and the receiver to bring the voltage down to about 4.8V. If a receiver battery is used, it is of course vital to ensure that it is fully charged before each flight as a failed receiver battery will undoubtedly result in complete loss of radio control and subsequent loss of the model with the danger of collateral damage or injury.

**Reflex** - this is the opposite to camber and, when activated, the flaps and ailerons all move upwards slightly, in unison. Changing the airfoil in this way results in the model becoming more 'slippery' through the air, hence you get a slight increase in speed. Flying wings and delta models typically need a small amount of elevons reflex for normal straight and level flight.

**Restrainer Bench** - a bench used for arming/disarming (or starting i/c) models which incorporates upright members which restrain the wings of a model aircraft to prevent it from surging forward under power. It is important for the tail of the model to be manually held down if the restrainer bench is used deliberately to power up the model for a motor/engine check.

**Retracts** - slang abbreviation for 'retractable undercarriage', which is an undercarriage that folds up into the aircraft's wings or fuselage after take off. See Landing Gear.

**ROG** - Rise Off Ground - where a model takes off from the ground under its own power. This is a term peculiar to aeromodelling and is not used in full-size aviation.

**Roll** - the rotational movement of an aircraft about its longitudinal axis. Also an aerobatic manoeuvre whereby the aircraft is rolled about its longitudinal axis through 360 degrees.

**Rotate** - the motion of pulling back on the elevator stick to lift the nose during takeoff.

**Round-out** - See Flare

**RPM** - motor or engine revolutions per minute

**RTF** - Ready To Fly. RTF models require minimal assembly - often simply a matter of bolting or screwing together the main airframe components and hooking up the control push rods. They also have the servos and power train pre-installed, but may or may not include the receiver.

**Rudder** - the moving control surface on the rear of the tail fin. Used to control yaw.

**Rudder/Elevator (R/E)** - a term used to describe a model which does not have ailerons but which relies on just the rudder and elevator for attitude control. In this configuration it is normal to allocate the rudder to the aileron TX/RX channel when using a Mode 2 transmitter. This design configuration can be useful for basic training models because it reduces the likelihood of over-banking and obviates the difficulty many novices experience from having the rudder and throttle control on the same transmitter stick. In the early days of radio-control most transmitters had very few channels so at that time virtually all RC models were R/E.

**SAA** - Scottish Association of Aeromodellers is affiliated to the BMFA and although an independent organisation, operates closely in association with BMFA. See [SAA website](#).

**SBEC** - a type of stand-alone BEC which uses highly efficient switch-mode technology

**Scale** - any model that has been modelled on a real full-size aircraft.

**Scalpel** - a small surgical instrument with fine extremely sharp removable and interchangeable blades. A very useful tool for use in building or repairing model aircraft.

**Servo** - the part of the radio control gear that converts the radio signal into movement of the control surfaces. They have a small electric stepping-motor connected to a control arm via a system of internal gears. The servo arm is then connected to a horn on the control surface via a push rod or closed loop

system generically called a linkage. Servos may be analogue or digital and come in a very wide variety of brands and specifications to suit models of all sizes. When choosing or specifying a servo for a model it is important so consider how much power (torque) the servo will be required to produce in order to move the control surface sufficiently in flight. Clearly the power needed to move a large control surface on a fast model is much greater than a small control surface on a slow model, and it is important to specify a servo that can deliver the torque needed and without the danger of stripping the gears within the servo. Servos are available with either plastic/nylon gears or metal gears and metal geared servos should always be used on larger and faster models. See Linkage.

**Servo Arm** - a lever attached to the splined head of a servo which is linked to a control surface horn via a push rod or closed loop. Servos are usually supplied with several arms of different designs such as discs, and also double-sided arms and single-sided arms of different lengths. Each arm has a series of holes for the purpose of linking to the control surface horn via a push rod or closed loop. The servo arm is a lever, with all that that implies, so which of the supplied arms to install, and which of the holes to use is determined by its purpose and the amount of throw and the amount of torque (moving power) the lever needs to generate at the control surface. See Horn, Linkage and Closed Loop.

**Servo Reverse** - a feature on R/C systems whereby the direction of the servo movement can be reversed via a transmitter setting. Whether this is necessary for any given servo is dependent upon how it is mounted in the model and what it is intended to do.

**Servo-slower** - a device which is usually located between the receiver and one or more servos which causes the servos to move to their new command position in a much slower manner than normal. Often used for scale effect on undercarriage retract servos and on flap servos to make re-trimming with flaps deployed easier. In many cases this can now be programmed via the transmitter so that a separate device is not required to achieve this effect.

**Servo Tester** - a small, inexpensive electronic gizmo that can be used to centre and test the operation of one or more servos. They are powered by a 4-cell Alkaline or NiMh receiver battery and enable servos to be bench-tested and centred before installation into a model.

**Sheeting** - refers to covering all or part of an airframe with sheet balsa instead of polyester film.

**Shockie/Shockflyer**- type of model, often small and made from foam, used to fly extreme aerobatic (3D) manoeuvres, usually though not exclusively indoors.

**Side/Down thrust** - a deliberately built in offset to the thrust line of the engine or motor intended to compensate for the torque effect and prop-wash which could pull the model off track.

**Sideslipping** - a mode of flight sometimes applied to quickly lose unwanted height on the landing approach. It is not an easy manoeuvre to master, and can be dangerous to try at low altitude. It is achieved by *momentarily* "crossing the sticks" so that opposite forces of bank and yaw occur. The aircraft appears to "crab" partially sideways through the air, slightly dropping the wing in the opposite direction to the yaw. This cannot and must not be sustained or the aircraft will enter a spin. Sometimes an experienced pilot will slideslip from one side to the other alternatively until the necessary height is lost, however sideslipping also introduces extra drag which will slow the aircraft, so it is not for the inexperienced or faint-hearted!

**Silicone Wire** - a very flexible electrical cable which is sheathed in silicone rather than plastic. It is much more impervious to higher temperatures than plastic coated-cable and is therefore used as standard on virtually all LiPo batteries and ESCs. Aeromodellers should always ensure they only use silicone wire when making up extension leads which will carry the high currents drawn in electric-powered models.

**SIM** - slang for flight simulator - see above.

**Slop or Play** - the amount of unwanted movement in a control linkage due to loose connection between the control surface horn and the servo arm. In a closed loop system this may be due to the wires not being sufficiently taut, and in push rod systems it may be that the hole on the horn and/or servo arm may be too large. See Linkage, Horn, Servo arm, Closed loop.

**Slope Soaring** - a model flying discipline involving flying gliders or PSS models from a hill or higher ground so as to use the updraught of the wind blowing towards the slope as a means to get lift and stay airborne. True slope-flying models are unpowered but some may have a motor installed for use if the wind should drop unexpectedly.

**Slow Flyer** - A slow-flying lightweight model designed as a park flyer or indoor model. These often use a special lightweight "Slow-Fly" propeller turning at relatively low RPM.

**SMAE** - Society of Model Aeronautical Engineers Ltd. In the early days of BMFA there was some concern regarding the potentially onerous legal liabilities carried by its officers. For this reason it was decided to form a limited-liability company (SMAE) which would then be the holding company for its wholly-owned subsidiary which is the BMFA. That is the situation today.

**Snake** - a specific type of long control rod system connecting servos mounted near the front of the airframe to the control surfaces at the rear - e.g. rudder and elevator. Because the control rod is long and therefore likely to flex and bend in use, it is housed throughout its length in a plastic or nylon sleeve, and in some cases two plastic sleeves - one inside the other.

**Solarfilm®** - a trademarked brand of polyester film used for covering model aircraft airframes.

**Spar** - a strengthening wooden or carbon fibre beam that run through the wing and/or tailplane, roughly parallel to the leading edge. Spars add both strength and rigidity.

**Spat** - a streamlined fairing for a wheel, fitted on an aircraft to reduce drag. Called a 'wheel-pant' when the fairing incorporates the undercarriage leg as well as the wheel.

**Spin** - the state of an aircraft that is stalled and losing altitude, and also rotating in a downwards spiral. The aircraft attitude itself may be nose-down, flat or inverted. From the ground the model appears to be falling rather like a sycamore leaf, turning as it does so. The rate of descent in a spin can vary and pilots should endeavour to recover facing into wind at a reasonable height.

**Spinner** - the cone-shaped fairing that covers the propeller boss. Its purpose is both cosmetic and for streamlining.

**Splines** - raised corrugated elements of a gear wheel or cog, such as on the head of a servo.

**Spoiler** - a movable part of the upper wing surface which deflects or pops upwards to reduce lift and increase drag. Used to make a glider lose height in a controlled way for landing.

**Spoilerons** - a control surface that performs the dual function of ailerons and spoilers. Like flapperons, spoilerons are on the trailing edge of the wing, but move upwards to 'spoil' the lift to assist with landing - especially of gliders. They are activated by a switch on the transmitter and require an elevator mix to keep the model stable in pitch.

**Spool Up/Wind Up/Rev Up** - all slang terms for opening the throttle to increase RPM

**Sport Flyer** - a general term for model aircraft that can be used for general flying and capable of basic aerobatic manoeuvres but rarely 3D or precision aerobatics. The term can also be used to denote a non-competitive model flyer who flies just for fun and personal enjoyment.

**Spread spectrum** - the latest technology for radio control systems. Based on the 2.4GHz frequency band, spread spectrum radio systems are virtually interference-proof and require no frequency control for multiple users. Usually integrated with "Frequency Hopping" technology which is the basis of all current WiFi, Bluetooth and GPS systems as well as radio control. Interestingly the concept of frequency hopping was originally conceived by the famous film actress Hedy Lamarr during the second world war.

**Stabiliser (Gyro stabiliser)** - small electronic devices which detect movement in the attitude (and sometimes also velocity) of a model and can apply signals to the control surfaces via the receiver to correct the movement. Receivers can be purchased which have the stabilising electronics built into their design or the stabiliser can be a stand-alone device which is plugged into the receiver. A stabiliser

can very very useful for smoothing the flight pattern of models in gusty wind conditions, and some can be turned on and off (or switched between their various functions) via a switch on the transmitter. Some stabilisers are designed to help novice pilots in the early stages of learning to fly, by instantly returning the model to level flight at the flick of a switch on the transmitter in the event of the novice losing control or orientation, but is important for novices not to rely on this facility for too long or they will develop bad flying habits which may be difficult to correct later.

**Stall** - when the angle of attack of a wing is increased to the point where the smooth airflow over the wing is severely disrupted. At this point the wing suddenly loses its lift and its ability to support the weight of the aircraft and the nose therefore drops abruptly and unless quickly corrected the aircraft will lose altitude rapidly. In some cases the wing-tip may stall before the rest of the wing in which case that wing will suddenly drop and the aircraft may go into a spin. Needless-to-say, it is highly undesirable for either of these situations to be allowed to develop at low altitude - especially during the landing approach. It is good practice to test how a new model behaves at the stall on the maiden flight, but obviously this should be done at an appropriate altitude to enable recovery from the stall or spin without any danger of crashing the model.

**Stall turn** - an aerobatic manoeuvre whereby the aircraft is put into a vertical climb, power is reduced and full rudder is applied just before the model reaches its climax. The model should stop in mid-air and turn through 180 degrees, thus facing the ground in the direction that the rudder was applied. It is quite a difficult manoeuvre to perform well as it requires good judgment to apply full rudder at precisely the right moment just before the wing stalls and while there is still enough forward momentum for the rudder to have sufficient authority to induce the rapid 180° turn.

**Stand-off/Semi-scale/Cartoon Scale** - any model that is loosely based on a real full-size aircraft, so that it is recognisable as such but lacking in detail and the correct proportions of the original.

**Starlock** - a special type of retaining washer which is easily pushed on to a shaft but designed to be hard to pull off. The centre of the washer comprises numerous angled spikes which grip the shaft one way. Sometimes used to retain a wheel on its axle.

**Stick-Time** - this is the amount of time spent actually flying model aircraft.

**Straight and level** - when the model is flying in a straight line, with no fluctuation in altitude. All models should be trimmed to fly straight and level at normal cruising speed "hands-off" with the control surface transmitter sticks in their central positions. Inexperienced pilots should ask experienced colleagues to trim their new models for them until they are capable of doing this themselves. Aerobatic models are often also carefully balanced and trimmed to fly straight and level "hands-off" when flying inverted. Trimming usually requires very light wind to be done accurately.

**STOL** - abbreviation for "Short Take Off and Landing" or an aircraft which has this characteristic ability.

**Swapmeet** - an informal gathering for the barter or sale of new/used models or equipment.

**Tachometer** - small inexpensive gadget for measuring motor rpm. Pointed at the rotating propeller outside in daylight it measures RPM by the ambient light reflected as it rotates. Doesn't work well indoors as indoor lighting is AC (Alternating Current) which itself produces flashing which confuses the gadget. RPM can also be measured electronically using telemetry devices. Rarely is measuring the RPM of great value.

**Take-off** - the action of accelerating your aircraft along the ground until flying speed is reached, and it lifts off the ground to become fully airborne. Only suitable for models with an undercarriage unless a dolly is used, otherwise a hand-launch is required.

**Tail-dragger** - an aircraft that has two main wheels near the front of the aircraft and a small tail-wheel at the back, which on models is often (though not always) linked mechanically to the rudder and therefore steerable via the rudder control for taxiing. On full-sized tail-wheeled aircraft directional control for taxiing is usually done by alternatively braking one or other of the two main wheels using the rudder pedals and the tail wheel is often castored. On some larger full-sized aircraft the castored tail-wheel must be locked in a central position during take-off.

**Tail Fin** - common term in UK for the vertical stabiliser

**Tailplane** - the more common term in the UK for the horizontal stabiliser at the rear of the aircraft

**Tail Skid** - An alternative to a tail-wheel on aircraft of tail-dragger configuration. It is simply an angled peg protruding from the tail of the aircraft to raise the tail from the ground when static or during take-off and landing. Its purpose is to avoid ground damage to the tail of the aircraft, especially the rudder, but models with a tail skid cannot be steered on the ground and therefore cannot be taxied.

**Tail Wind** - when the wind is blowing from behind the model, in the same direction as it is flying, or taking off or landing.

**Taxiing** - The process of driving and steering an aircraft along the ground under its own power, usually to a take-off point on the runway or to clear the aircraft from the runway after landing. Clearly this can only be done with a model if its tail-wheel or tricycle nose-wheel are steerable from the transmitter. Great care must be taken, especially with lightweight models which might take off unexpectedly if too much power is applied. Under no circumstances should any model ever be taxied towards the flightline or the pits, or towards people.

**Telemetry** - a feature of some 2.4GHz radio systems that allows real-time data from sensors in the model to be sent back to transmitter and reflected on the transmitter screen or a separate add-on screen/box. In some cases the telemetry data is not available during the flight but needs to be downloaded from the receiver or sensor equipment post flight.

**Thermal Cut-Out** - Most ESCs incorporate a thermal cut-out to prevent fire in the event of over-heating. When specifying an electric power-train it is important to keep this in mind and ensure that the ESC amp rating has plenty of "headroom" so that it cannot overheat and suddenly cut out. A wattmeter is an important tool for bench-testing electric power systems to help ensure that all components are operating well within their maximum current parameters. This is also another good reason to use a separate receiver batter in models using greater than a 3-cell LiPO battery for power.

**Threadlock** - a substance smeared on a bolt to prevent it or its nut from accidentally unscrewing due to vibration or other influence. There are two primary types - permanent and non-permanent (removable).

**Three-pointer** - a landing by a tail-wheel aircraft whereby all three wheels touch down at exactly the same moment. This effectively requires stalling the aircraft on to the runway at the precise moment it touches down and is a particular skill which many full-size pilots aspire to, as well as model pilots.

**Threshold** - the very nearest point of the runway as it is approached when landing.

**Throw** - this term signifies the amount of movement or deflection of a control surface. Some transmitters use the term "Travel" or "Weight" for setting the degree of servo arm movement which determine the throws of the airframe control surfaces.

**Thrust** - the force which provides the aircraft with forward motion. It is generated by the aircraft's power-train, (ie. spinning propeller or fan/turbine of the aircraft), and pushes or pulls the aircraft through the air. Gliders (and other models when gliding) must trade height for airspeed to maintain airflow over the aerofoil (wing).

**Timer** - a timing device with an audible alarm is almost essential for an RC pilot because it gives an indication of elapsed flying duration, and an audible warning to bring the model in for landing well before he runs out of fuel or battery capacity. A count-down timer is especially useful as it can be set to the safe flight duration for each specific model and provide the necessary warning to terminate the flight in good time. Many transmitters incorporate timers within the transmitter itself, with many of them able to store a dedicated preset countdown time within each individual model memory. Many also feature both a count-down and count-up facility. In the absence of a timer feature within the transmitter, a simple kitchen timer can make a useful substitute.

**Tip-Stall** - a situation that can occur close to the model's stalling speed where the wing area around the tip of the wing stalls before the area nearer the wing root. It is also almost always the case that one wing stalls before the other, causing that wing to drop suddenly inducing a spin. It most often occurs when turning the aircraft when it is close to its stalling speed, and model pilots must always be careful not to turn too slowly at low altitude as this is one of the most common causes of model crashes. The final turn from base leg on to finals for landing is time for particular care. Certain wing forms are more prone to tip-stalling than others, and washout is often used in model wing designs to help minimise the danger of tip stalls.

**Toggle** - can refer to a simple pull handle on a short cord, or more commonly in electronics and computing, a switch which uses a single physical action to produce two opposite effects, such as push-on, push-off.

**Torque effect** - affects models with a single front-mounted propeller-driven tractor power train and is the equal and opposite reaction to the turning of the propeller (basic physics). The result of the torque effect is a tendency of the aircraft to want to turn upwards and bank left in the opposite direction to the propeller spin. The larger and faster RPM of the propeller, the greater this effect will be. This is designed out and trimmed out for normal straight and level flight at cruising speed (largely by motor side-thrust and down-thrust), but can become an issue when taking off at full throttle, so a model often requires some right rudder being applied during the take-off run and initial climb out. Turbine-powered jets and EDF simulated jets are not affected by torque effect or prop-wash.

**Touch and Go** - This is a landing which is deliberately aborted as soon as the main undercarriage wheels touch the ground. The pilot goes through all the motions of a normal landing but then guns the motor and climbs away again before the model stops on the runway. It is often done repetitively in both full size aviation and model flying as a means of practising landing technique.

**T/E or Trailing edge** - the rear edge of the wing, tailplane or rudder.

**Tractor** - A model where the propeller or other motive force is fitted at the front and pulls the model through the air.

**Trainer** - any radio controlled model aircraft that has been designed for novices to learn to fly with. Usually trainer models are high wing designs with considerable dihedral, features both of which make the model more stable. The term may also refer to a person who is instructing another person who is learning to fly RC.

**Transmitter** - the radio control "box of tricks" that is held and operated by the RC pilot to control all the functions of the model in the air. Many these days are computerised with a large range of programmable features which themselves are sometimes quite a daunting prospect for novices. All transmitters have control sticks and various switches and knobs, and in many cases their functions can be user-defined through the transmitter menus. Transmitters are said to be configured as either Mode 1, Mode 2, Mode 3 or Mode 4 each of which specifies how the main control sticks operate. (See Mode above).

**Travel** - a term used for programming the degree of servo arm movement in computerised transmitters, to manage the throws of the control surfaces. Some transmitters use the term "Weight" to mean the same thing.

**Trimming** - the process of using the transmitter trim buttons to make small adjustments to the control surface alignments so as to eliminate unwanted tendencies when the model is flown "hands-off". All new models need to be trimmed as an integral part of the maiden flight, although some require less correction than others. It is critical that the model should be correctly balanced at its recommended centre of gravity (CG) before attempting trimming. It takes some experience to do this well so it is advisable for novices to ask an experienced pilot to do this for them. Trimming usually requires no more than a very light wind to be done accurately.

**Tricycle undercarriage/ Trike** - a fixed undercarriage that consists of two main wheels and a nose wheel, which is sometimes steerable via a servo for taxiing and easier ground handling.

**Twinnie** - slang term for a twin-engined aircraft design

**TX** - common abbreviation for transmitter. See also RX = Receiver

**UAV/UAS** - Unmanned Aerial Vehicle/Unmanned Aerial System - terms applied to all forms of model aircraft, which are also sometimes generically termed "drones" by the authorities.

**UBEC** - a standalone voltage regulator which functions as a BEC (see above).

**UHU POR®** - this is not the standard solvent-based everyday UHU glue which will melt foam, but a special variant which is very useful for modelling and repairing EPO/Elapor/Z-Foam foam models as an alternative to CA superglue.

**UMX** - This is a term applied to models which are very small, especially but not exclusively to those designed to be flown indoors in a sports hall or similar facility. Increasingly the use of electronic gyro stabilisers has made it possible to fly very small models out-of-doors on reasonably calm days.

**Up-Wind** - this can mean flying the model against the wind, or used to indicate the general direction of anything in relation to the direction the prevailing wind is coming from.

**Undercarriage or Undercart** - the system of wheels mounted on legs protruding from the underside of an aircraft to support it on the ground. Undercarriage can be fixed or retractable into the underside of the wing or fuselage during flight. See Landing Gear.

**Undershoot** - Opposite of overshoot. This is when an aircraft accidentally lands short of the runway threshold.

**Vertical stabiliser** - see Fin and Tail Fin

**Vital Actions** - a term used in full-size aviation to relate to important cockpit checks made immediately prior to take-off (and a different set of vital actions checks are made immediately prior to landing). Because of the complexity of modern aircraft these checks are normally done with reference to a printed check-list. A similar system of pre-flight checks should also be carried out prior to every model aircraft flight, and for novices particularly, a check-list can be quite useful. (See Control Checks).

**Velcro®** - a trademarked brand of what is generically called "Hook and Loop" tape. It comes in self-adhesive strips and also non-adhesive bands or "ties". Very useful for anchoring flight batteries within the fuselage.

**Volts** - See Ohms Law above

**V-Tail** - an airframe design configuration often used on gliders but also on some full-sized powered civilian aircraft (notably the famous Beechcraft Bonanza) and even some military fighter-jets. In this configuration the two halves of the tailplane (stabiliser) are angled upwards in a V-shape and the moveable control surfaces attached to the trailing edges then act as both elevators and rudder via transmitter channel mixing. Many transmitters offer V-Tail as a predefined mix option in their programming menus. When acting as rudder, the control surfaces must move in the opposite direction to the ailerons whereas the elevator function works in the conventional way. As both functions can be activated simultaneously by the pilot the correct channel-mixing is essential.

**Warbird** - scale or semi-scale model of a full-size military aircraft.

**Washout** - the slight twisting of the wing, especially near the wing-tip, with the leading edge twisted downwards and trailing edge upwards, so the wing tip is in a negative angle (incidence) compared with the root of the wing. This design feature is often used to reduce the risk of tip-stalls.

**Wattmeter** - an almost indispensable device for electric flyers. The device is used for bench-testing models (not in flight) and inserted between battery and ESC to provide an indication of the actual current load (Amps) being drawn from the motor and propeller combination to give an indication of the safe flight duration of the model, and the suitability of the Amp rating of the motor and ESC and the C Rating of the battery. They also display in indication the actual power generated by the system in watts, and this is important in relation to the weight of the model as an indicator of its expected

performance. Most also provide other useful information such as voltage-drop under power which will also affect performance and flight duration. See Ohms Law and Power-to-Weight Ratio above.

**Watts** - See Ohms Law above

**Wheel Collet** - A retention device, normally a thick metal ring with lateral threaded hole for a grub screw. Used to clamp the ring on to the axle outboard of the wheel to secure the wheel on the axle. Sometimes useful in other applications too.

**Weight** - this most commonly refers to the All-Up-Weight of a model in its ready-to-fly state, but some computerised transmitters use this term to denote the setting of servo arm travel which determines each of the control surface throws.

**Windsock** - a large cone-shaped tube of light fabric material mounted on a tall pole at the flying field in view of the flightline. Its purpose is to indicate wind direction and speed at runway level, primarily to enable model pilots to take-off and land into wind whenever possible. It must be remembered that the windsock only gives an indication of windspeed and direction at ground level and is not necessarily a reliable indicator of wind conditions at normal flying altitude.

**Wing Loading** - a ratio of aircraft weight to wing area, either in ounces or pounds per square foot, or kilograms per square metre. It's a calculation that is useful when determining the flight performance characteristics of an aircraft and the airspeed that it is likely to need to keep it airborne. Obviously a model with large wings relative to its weight will have a lower wing loading and vice versa. High wing-loading designs require a high airspeed to keep them in the air and the wings are relatively smaller making them less draggy and capable of higher speeds than those with low wing loading. However their relatively high stalling speed can make them tricky to handle, both on take-off and landing.

**Wingspan** - the overall length of the wing, from tip to tip. Wingspan is a primary measurement when referring to an aircraft's size.

**Wing Section** - see Aerofoil

**WOT** - abbreviation for Wide Open Throttle (Full Power). The term "throttle" is still widely used in relation to electric powered models even though a throttle as such is not part of an electric power train.

**Xtal** - an abbreviation of crystal (see Crystal) an important component in radio control systems prior to the advent of 2.4GHz. In RC this applies particularly to 35Mhz and 27Mhz radio systems

**Y-lead** - a wire harness designed to allow two servos to be connected to a single channel on the receiver - for example to connect two aileron servos to the aileron channel.

**Yaw** - the rotational movement of an aircraft about its vertical axis, controlled by the rudder.

**Z-bend** - double right angle bend made on the end of a control rod (wire) to attach to hole in servo arm or control horn. Z-bend pliers are a tool used to achieve just such a shape. Often used at one end of a push rod, with an adjustable clevis, "Quick-link" or "Nipple Grip" at the other end.

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