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British Model Flying Association

Members' Handbook

Annex B -

Model Flying Technical Handbook

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CONTENTS

1. HAZARDOUS MATERIALS

We come into contact with hazardous materials every day but there are some that we use in and around our models that you should be particularly careful about.

1.1 Carbon (and sometimes boron) fibre

This is regularly used as strengthening and structural material in models. These fibres, when stressed or fractured give off clouds of ultrafine microscopic fibres which are immune to your lungs' natural cleansing mechanism. Long term exposure may have very serious consequences. 'Stressed or fractured' carbon fibre could be found when you are repairing a model but it is also found when cutting and sanding new material. Whenever working with such material, always wear an appropriate mask. Cut over clean white paper. When finished, fold the paper and dispose of carefully. Vacuum the work surface and your hands regularly. When finished, always wash your hands initially in COLD water.

1.2 Kevlar fibres

May also give long term problems so equal care should be taken if using this material. If any model aircraft is built or repaired using composite materials or parts then it is essential to be particularly diligent in picking up any debris after a crash or mid-air collision. Composite shards do not degrade quickly and can be a dangerous hazard in and on the ground for many years.

1.3 Cyanoacrylate glues (superglues)

These are well known for causing severe allergic reactions in some people and such reactions can build up over time. Work in a well ventilated area, avoid breathing superglue fumes and, if necessary, wear a fume proof mask and eye protection. Superglue fumes may be absorbed through the tear ducts. Superglue 'kicker' is also known to cause adverse reactions on occasions so care should be taken when using that too.

1.4 Epoxy and polyester resins

These are also known to build up allergic reaction in some people over time. It is likely that the main culprit is the fumes given off by the products as they cure so it is important that you heed the advice to work in a well ventilated area.

1.5 Methanol

This is fairly safe to store in a cool place and out of sunlight. However, it is a poison and the ingestion of even small quantities can be dangerous. Don't let it stay on your skin if you spill any.

1.6 Petrol

An increasingly used fuel and the ease with which its vapour ignites make it one to be very careful with. A small spark can lead to a big explosion. Don't store it or try to transfer it between containers indoors. This is one where working outdoors is essential advice.

1.7 Smoke Systems.

Some of the oils used in model aircraft smoke systems are known to be carcinogenic when burnt and all of them are irritants to varying degrees, even the purer types. Smoke should only be used when the wind is blowing away or at least along the pits / flightline area and there is no possibility of the smoke cloud being blown over pilots or spectators.

2. R/C FLYING SITE LOCATION

2.1 Inter-club interference

(a) Inter club interference is possible when 35 MHz is in use as a model control frequency. However, if a club is set up to use 2.4 GHz equipment only then the following section is not relevant and lesser safety distances will apply. If your club is using 2.4 GHz only, the organisation must be very careful to police the rule rigorously and, in the case that there are nearby clubs, it would be good practice to inform them of the club's location and the fact that only 2.4 GHz will be used.

(b) As a general rule, when 35 MHz is in use as a club frequency in both clubs, they should not operate closer together than 2 miles unless an agreement has been negotiated between them giving an equitable and workable frequency sharing plan. The 'block' frequency sharing arrangement is the safest and most common method. The use of odds/evens split by power and glider clubs flying close together is another, lesser used example (see the section 'Frequency Allocation at Club Sites').

(c) Both parties are bound by the implications of radio transmission law and the Air Navigation Order to take action. Therefore, **please take note that negotiation in such circumstances (i.e. where interference is possible) is mandatory.**

(d) The use of the 35 MHz frequency bands and channels is legally granted to all of us but no one group or individual has the 'right' to reserve the use of any of the frequencies, no matter how long they have been using them on a particular site, and whoever turns on a transmitter first in any given situation is the legal user of that frequency until they turn the transmitter off.

(e) It is recommended that each negotiating club or group appoints a named person as a point of contact, possibly from its existing Committee members. Good communication is important in these circumstances to avoid misunderstandings occurring and rumour spreading and to make sure that your flying is as safe as possible.

(f) It must always be borne in mind that continuing to operate in these circumstances, (i.e. using 35 MHz as a model control frequency) without reaching a practical frequency sharing agreement may have serious legal consequences under the terms of the Air Navigation Order and may also have insurance implications for both the pilots and clubs concerned.

3. RADIO CONTROL AND YOU

3.1 Introduction

This section gives advice and guidance on the operation of your radio equipment which may not be covered in the manufacturer's literature.

3.2 Aerials

(a) The aerial on your transmitter is an integral part of the set that is certified/tested by the manufacturer in order to qualify for the CE mark. If you are replacing a telescopic aerial on a 35 MHz set you should try to obtain the manufacturer's spare part. If you can't do this then the aerial you fit should be of the same specification (length, screw fixing etc) as the original.

If you wish to fit a base loaded or 'rubber duck' aerial, you should be aware that you may only use one of these aerials if the manufacturer has cleared your particular transmitter for such an aerial. If this is the case, then you should be able to buy the manufacturer's authorised spare.

If your particular 35 MHz transmitter is cleared to use such an aerial by the manufacturer but you can't get the original manufacturer's spare then any replacement aerial you buy must meet the same specification as the manufacturer's item. Note that, with this type of aerial, the specifications are more complex than simply matching the length.

You should be aware that fitting an aerial that does not meet the transmitter manufacturer's specifications will result in you being considered to have introduced into use a new variant of the transmitter which will not be covered by the manufacturer's testing/certification and CE mark.

If you wish to fit an aftermarket aerial you should first contact the manufacturer/importer of your transmitter for further information. You might also find information on the Ofcom website at www.ofcom.org.uk

(b) A dirty or oily telescopic transmitter aerial will degrade the range of your transmitter, sometimes quite severely, and may even affect the output frequency. Clean it every two or three months with methylated spirit or similar and never lubricate it.

(c) Take care to route your receiver aerial well away from any carbon fibre in your aircraft. Carbon fibre is electrically conductive and is a good aerial itself. Large quantities of it can blanket your receiver aerial completely and even a few strands used for strength can cause glitching in flight if they are close to the aerial and can affect the signal reaching it.

It has also been reported that some metallic covering films and certainly some metal clad airframes have also been seen to suffer from degraded range and glitching and the siting of receiver aerials in these types of model can be quite critical.

(d) A point that is often overlooked, even by experienced flyers, is that the placement of 2.4 GHz receiver aerials is much more critical than for 35 MHz equipment. You must read the manufacturer's installation instructions very carefully and take note of the information they give you. If you don't do this you may find yourself flying with equipment that is low on airborne range simply because the aerial configuration you have set up is inefficient.

If you do not have the original instructions, visit the manufacturer's website and download the information from there.

3.3 Batteries

(a) Dry cell batteries do have their uses in some transmitters but care should be taken to monitor pack voltage at all times.

(b) The use of dry cell batteries in airborne battery packs is strongly discouraged and they must never be used in the airborne pack if you have four or more servos operating.

(c) Subject to the advice given below, It is recommended that you only use rechargeable batteries in your radio control equipment. However, when fitting Nickel Cadmium (Ni-Cd) or Nickel Metal Hydride (Ni-Mh) rechargeable batteries to equipment designed and sold to take dry batteries, always ensure that the cells are soldered or welded into packs and that the packs are either hard wired or wired through a plug and socket into your transmitter and receiver systems. Do not rely on the spring type battery contacts in battery boxes.

(d) There are, however, exceptions to this advice. Some modern transmitters have very low current drain and are supplied as dry battery sets with battery boxes that are not removable. In these cases dry cells give an acceptably long operational life and may be used safely.

If you do use individual re-chargeable cells in these transmitters, make sure that the cells are removed at least monthly. While the cells are out of the transmitter, carefully clean the spring battery contacts and the ends of the cells before replacing them. You should also carry out this procedure if the transmitter has been standing idle for any length of time.

If you don't take these precautions, your transmitter might suffer from the same symptom as many TV remotes when they stop working until you have disturbed the batteries.

(e) Lithium Polymer batteries (Li-Po) are being used increasingly in radio control transmitters and many flyers are retro-fitting Li-Pos in place of Ni-Cd or Ni-Mh battery packs. If you are considering this, it is essential that you contact your Tx manufacturer / importer for information on whether this is allowable in your transmitter. This is because there are significant issues with voltage differences between the different types of battery pack and the ability of any specific transmitter to cope with them. It is safer to consider using Lithium-Fe cells as their voltage is lower than Li-Po cells and equate more closely to standard transmitter battery packs.

If you are not given clearance to make this change but you still go ahead then you will run the risk of damaging your Tx and, in addition, any warranty you have will be invalid, you may not be able to have the equipment serviced and the CE mark on the transmitter will also be invalid. The legal responsibility that you then take on yourself is considerable and must not be underrated.

(f) The regular use of a battery checker for receiver batteries is essential and there are many cheap reliable units available, either hand held or on-board, to cover most battery types so no matter what type of cells you are using you can buy a checker to suit. Ensuring that the receiver battery has sufficient capacity to support the flight is essential if the pilot is to comply with the ANO and having the peace of mind in knowing that the last flight of the day will not be the last flight of the model is well worth having.

(g) The Electroflight section later in this handbook. Gives more information on the use of batteries and associated equipment.

3.4 Nickel Cadmium (Ni-Cd) Batteries

(a) Ni-Cd cells will self discharge at a rate of around 20% of their capacity each month and if a stored pack discharges below approximately 1 volt per cell, there is a danger that one of the cells in the pack may be irreversibly damaged. The lower the voltage reached the more risk there is that this will happen. It is therefore recommended that all Ni-Cd packs be charged regularly, at least every few months, and that any pack not in regular use be initially stored fully charged.

(b) Ni-Cd cells are very resilient when trickle charged at around 1/10C (i.e. 50mA for a 500mA h battery). Most chargers supplied with radio equipment are designed to work in this range and there is little risk involved if packs are inadvertently left on charge when using them. Even if you regularly fast charge your cells, it is good practice to trickle charge them occasionally.

(c) Overcharging Ni-Cds at high currents (fast charging) can ruin your cells and has been known to cause battery packs to explode violently. Most fast chargers have a ‘delta peak’ voltage controlled cut-off and are generally very reliable. If you don’t have such a charger and wish to fast charge your cells then, as a minimum, you should use a charger with a timer or temperature controlled cut-off.

(d) If you have a charger capable of both discharging and charging your battery packs then you should fairly regularly cycle the packs as this will help to keep them in optimum condition. However, it is also good practice to occasionally trickle charge any packs that are regularly fast charged whether they have been cycled or not. Just make sure that the pack has been well used or discharged before you start (no lower than 1 volt per cell though).

3.5 Nickel Metal Hydride (Ni-Mh) Batteries

(a) Ni-Mh cells can self discharge at a rate of up to 40% of their capacity each month and the danger of a stored pack discharging below 1 volt per cell and possibly causing irreversible cell damage is therefore considerably greater than with Ni-Cd cells simply because it will occur sooner. It is therefore recommended that all Ni-Mh packs be charged more regularly than Ni-Cds, at least every two or three months, and that any pack not in regular use be initially stored fully charged.

(b) Ni-Mh cells may be trickle charged at around 1/10C (i.e. 50mA for a 500mA h battery) and most chargers supplied with radio equipment are designed to work in this range.

However, Ni-Mh cells are more fragile than Ni-Cds and are susceptible to damage by overcharging even at normal trickle charge rates and should never be left connected to the charger longer than is necessary. The ‘safe’ constant trickle charge rate is very much less that that provided by the standard type of charger supplied with most radio equipment so the possibility of overcharge damage when using these trickle chargers must always be borne in mind.

(c) Ni-Mh packs can be charged at high currents (fast charging) but overcharging can quickly ruin the cells. Most fast chargers have a ‘delta peak’ voltage controlled cut-off and are generally very reliable but you must ensure that the one you are using is specifically designed for Ni-Mh batteries.

(d) Ni-Mh packs may be cycled, as with Ni-Cds, and you should consider doing this fairly regularly. However, it is also good practice to occasionally trickle charge any packs that are regularly fast charged whether they have been cycled or nor. Just make sure that the pack has been well used or discharged before you start (no lower than 1 volt per cell though) and note the advice in (b) above.

(e) A noticeable feature of Ni-Mh technology has been the increasing capacity of the cells for any given cell size. For instance, the early AA pencells were rated at around 700 mA h but you now see capacities of around 2000 mA h for the same cell size.

The only way this extra capacity can be achieved is by increasing the surface area of the active components within the cell and, for a given size of casing, this can only be done by making these components thinner. The problems that this will give you are increased internal resistance (the cell won't give it's energy up as easily and may get hot) and increased fragility of the cell. Thinner materials can be damaged more easily, both electrically when charging or discharging and mechanically, for instance, due to overheating when soldering or being over-stressed in a crash.

These problems may not be apparent in your transmitter pack but you should think carefully about using very high capacity Ni-Mh cells in airborne packs where the demand on the batteries will fluctuate and can be much higher than in a transmitter. You can easily get into a situation where a high capacity pack is unable to supply the voltage required by some hard working servos simply because the internal resistance of the cells will not let the energy stored in them be released quickly enough.

3.6 Low Self Discharge (LSD) Ni-Mh Batteries

Originally developed by Sanyo under the trade name 'Eneloop'. This type of cell is now produced by several other manufacturers.

These cells have such a low self discharge rate that you can treat them very much as you would a Li-Po and charge them when you come in from flying rather than the day before you go out.

They are robust and can be charged with a standard Ni-Mh battery charger. They are a little more expensive than standard Ni-Mh cells but their very slightly higher operating voltage gives good energy storage levels and the claimed number of possible charge cycles is greater than the standard cells. The technology is certainly worth considering as an alternative and very useable battery, especially in Transmitter applications or in airborne packs that cannot be readily removed from the airframe for charging..

3.7 Lithium-Polymer (Li-Po) Batteries

Li-Po batteries are now used by a very significant number of model flyers and they must be treated differently to the more conventional rechargeable batteries.

For full details on safety and use of Li-Po Batteries, please see the Battery Safety Booklet which is available from the Leicester office or for download from the BMFA website.

3.8 Battery Isolator Switches

One of the most dangerous points in the flight preparation of electric models is when the flight battery is plugged into the model. A freshly charged battery has a lot of power locked up in it and many models are very awkward when it comes to connecting the battery pack, especially as you usually need both hands to do the job.

Consequently, if the pilot fails to set the throttle to the correct setting or the onboard electronics in the ESC fail, it's very easy to have a propeller or rotor come to life when you least expect it to, with possible serious consequences.

Under no circumstances should an isolating switch be placed between the ESC and the Battery unless it has been designed specifically for that usage. Current flow from even a 3S LiPo pack can reach 60 amps. With some models, it is difficult to connect the battery to the ESC while keeping your arms outside the propeller arc. In such cases, an external arming plug is recommended typically of the type and rating that is used to connect the battery to the ESC. At least one manufacturer is offering a battery isolator switches covering 100 A and 200 A but these are in excess of £100 currently. The use of a spark arrestor to eliminate the crack when you first connect a battery to the ESC is good practice. Spark arrestors can be made by the modeller or else bought commercially.

3.9 BECs / UBECs / Receiver Batteries

A large majority of Electronic Speed Controllers (ESC) have a built in battery eliminator circuit (BEC) and the use of the BEC to run the airborne radio package of electric models is very popular.

However, there are factors that you should bear in mind when using or considering the use of the BEC.

All BECs are limited in the amount of current they can supply. The cheaper BECs can usually supply current that is adequate for most sport models with three or four servos but if you are using more servos than this or are using digital, large or special servos, you should check the specifications of the BEC you are using to see if the current it can supply is adequate.

Remember that digital servos may require more current supply than you might expect and, no matter what type of servo you use, any binding or stalled servos or high aerodynamic loads will also pull significant current. Helicopters can be particularly demanding.

If you have any concerns, there are two ways to improve the situation and give your airborne system the ability to supply the current that the receiver and servos require.

(a) Fit a Universal BEC (UBEC). This is a stand-alone BEC unit that is not reliant on the ESC circuitry. These units are usually quite cheap and you can check the current capabilities of the units before you buy.

(b) Fit a separate receiver battery of an appropriate capacity.

Both of these solutions are valid but you should think carefully about the model and flight requirements before making your choice.

For instance, if you have a model that requires nose weight, it would make sense to fit a separate receiver battery and use this as part of the weight required. An electric powered glider might also be a good candidate for a separate battery as you may reach a situation where you have exhausted the propulsion battery but may still have significant flight time to come, especially if you are thermalling.

There is one other point that you must bear in mind and that is the ESC will have limits to the voltage (number of cells) and to the out-put current in amps. The BEC output will be specified in amps at the standard voltage (4.8 to 5.2 volts) but the BEC has to handle the total voltage of the supply pack (e.g. 12 volts for a 3S Li-Po). The higher this voltage the greater is the power dissipated in heat which might require a reduction in the output current demanded of the BEC to avoid overheating and possible damage and failure. It may be that, in these circumstances, the BEC will not be able to safely supply the current needed by the airborne RC pack. If this is the case then a separate receiver battery will be essential. The ESC manufacturer's documentation should indicate the BEC current limits at given main pack voltages.

3.10 Black Wire Corrosion

(a) Systems fitted with rechargeable batteries, particularly the older Ni-Cd batteries, can suffer from **black wire corrosion**. When this happens the surface of the copper strands in the core of the negative (black) wire in a circuit receive a coating of black material which works inwards until all of the copper in the wire has corroded. This corrosion has a high electrical resistance so as it gets deeper into the wire it lets less current through until eventually your radio stops working.

(b) The wires which are most affected by this corrosion are the negative wires from the battery to the switch in both transmitter and receiver wiring but in severe cases the corrosion can go much further than this and in extreme cases has even been seen in servo leads.

(c) The causes of the corrosion are very complex but it seems worse on batteries in storage, particularly in a damp atmosphere, or which have been allowed to go flat. Well used and maintained batteries certainly suffer much less but they are not immune to the problem.

(d) Unfortunately, there is only one practical way to find out if your wiring is suffering from black wire corrosion and that is a visual inspection of the core of the wire. If you are competent to do this, inspect the wire leading from the negative terminal of the battery. Stripping back a very short length of outer will show if you have the problem.

(e) There is no cure for black wire corrosion other than removing the affected wire and replacing it with new.

(f) If you are unsure of any of this advice, it will be well worth sending your rechargeable batteries and switch harness back with your radio equipment when you have it serviced with a specific request for black wire corrosion checking. Several companies specialise in supplying batteries and they might also be able to help. Another source of advice could be your local model shop but failing all this you should ask an experienced modeller for assistance.

3.11 Crystals

(a) It is essential that you use the correct specification crystals in any non-2.4 GHz transmitter or receiver you are using. Not all crystals are the same and you should **NEVER** use one manufacturer’s crystal in another’s Tx or Rx. The only exceptions are many of the aftermarket receivers and their manufacturers actually specify which crystals are compatible.

(b) When buying crystals, always take care to specify in which individual piece of equipment they are to be used. Original manufacturer’s crystals are always the best choice.

(c) Receiver crystals are a fragile point in any airborne R/C system and they are susceptible to crash damage. If you have any concerns about your Rx crystal after an incident, then you should replace it with a new one. This could be a very good investment if you consider the implications of crystal failing in the air a few flights later.

3.12 Failsafes

(a) <u>For All Model Aircraft</u>

Any powered model aircraft fitted with a receiver capable of operating in failsafe mode (i.e. PCM receivers, Digital Signal Processing (DSP) receivers or 2.4 GHz equipment) <u>must</u> have the failsafe set, as a minimum, to reduce the engine(s) speed to idle on loss or corruption of signal.

This means that you will have to carefully consider what type of receiver you are using in ANY i/c or electric powered model, even the smallest.

<u>For Models Weighing 7 to 25 kg</u>

A serviceable ‘fail-safe’ mechanism should be incorporated to operate on loss of signal or detection of an interfering signal. For example, on a power driven model this should operate, as a minimum, to reduce the engine(s) speed to idle.

<u>For All Gas Turbines</u>

All gas turbine models should be fitted with a failsafe. This must bring the engine to idle in the event of radio interference or failure. The fuel system must be capable of manual shut off via a fuel valve or fuel pump switch.

(b) All PCM sets, most DSP 35 MHz receivers and all 2.4 GHz equipment have settable failsafe modes and if you are using any one of these then you must take care to set the failsafe to at least engine idle.

For over 7.5 kg, you must ONLY use failsafe settable equipment and, again, set to engine idle as a minimum.

(c) As a reminder, nearly all PCM and DSP receivers and **all 2.4 GHz equipment defaults to 'hold last position' out of the box** so if you don't set the failsafe, then that's what it will do. This means that, for even the smallest model, interference or loss of signal will mean throttle and control lock-on and a potential flyaway or high throttle, high energy impact. If ever you re-bind a model, please remember to recheck the failsafe as some sets may revert to default settings under these circumstances.

(d) Users of any failsafe capable radio equipment (PCM, DSP or 2.4 GHz) should check fail-safe operation before each flying session. With the model restrained, switch off the transmitter and ensure that all relevant controls on the model move to their pre-set fail-safe positions. Switch the transmitter on again and make sure that normal control operation returns within a few seconds. If the fail-safe does not re-set quickly there may be a fault, so **DO NOT FLY.** Also remember that if the failsafe is set to retract the undercarriage the model will need supporting off the ground.

To be safe, you must take the positive step of specifying what your failsafe should do instead of leaving it set at default. Read your radio manual carefully for details of settings.

If you don't initially understand the instructions for setting the failsafe on your equipment, then you MUST take steps to find out how to do it. This is one thing you cannot ignore and ignorance of the procedure is not an excuse that can be accepted.

Note: If you have PPM equipment and don't have a DSP receiver but are using an add-on failsafe, it too should be set as a minimum to low throttle.

Glider Failsafes for Models Weighing 7.5 to 25 kg

The requirement to use and set failsafes applies to silent flight models too, although obviously the 'setting of throttle' does not apply. The purpose of failsafes is to prevent flyaways, not to deliberately crash the model, and you should set the controls of your model with this in mind. Application of spoilers, 'crow' brakes or even rudder and elevator to spin the model might be appropriate.

Electric Model Failsafes

The setting of the failsafe to, as a minimum, reduce the engine(s) speed to idle, obviously applies to all electric models too. However, given the ability to re-start the motor(s) at will, it makes sense to have the failsafe cut the motor(s) completely. This will give you the desired 'minimum power' situation and will avoid you having to decide on what idle speed you might need to set.

Multi-rotor Failsafes

The development of modern electronics means that it is now possible to fit model aircraft with what are known as 'Intelligent Failsafes'. These are particularly applicable to multi-rotor aircraft and full details are given in the Multi-rotor section of General Model Safety later in this Handbook.

3.13 Frequency Identification

Users of 2.4 GHz will not have or need any method of frequency identification but for users of 35 MHz there will be many occasions when others might need to quickly identify the frequency you are operating on and your transmitter should carry an easily visible channel identification pennant; For 35 MHz, an orange flag with one inch black or white numerals should be used.

3.14 Mix-and-Match Tx and Rx

Using different makes of transmitter and receiver is common practice when using 35 MHz equipment (and 2.4 GHz – much of which is now multi-protocol), especially with the large range of aftermarket receivers available. There is a point you must be aware of, however, concerning manufacturers guarantees. A matched Tx and Rx will be warranted by their manufacturer both as individual items and to work together as a pair. If you 'mix and match', the individual warranties still apply but you have no guarantee that the pair will work together. In this case you take upon yourself the legal responsibility of making sure that your equipment operates correctly.

3.15 Mobile Phones

Although mobile telephones operate on frequencies far removed from our model control frequency bands they are a major addition to the increasing background radio 'noise' that our equipment has to filter out. In addition, there is some evidence that there may sometimes be an interaction between mobile 'phones and microprocessor controlled transmitters.

Many mobile 'phones transmit powerful signals regularly even when on standby and BMFA recommends that they are not taken into the pits area and especially not on to the flying area. Many 'phones also emit a powerful signal pulse when switching off, which is also something you may have to consider. Your radio equipment has a hard job to do filtering out background RF radiation and you could make it much worse with your mobile 'phone.

3.16 Module Equipped Transmitters

Plug-in transmitter modules sometimes suffer from corrosion of the connecting pins, especially if the transmitter has been operated in a damp or humid atmosphere. Unplug it regularly and check for dirty connections. Carefully clean the pins with methylated spirit or similar (check that the solvent doesn't affect the plastic before you use it).

Broken fixing lugs on the plug-in module is another problem that may affect a module equipped transmitter. Never rely only on the connector pins to hold the module in. Modules in this state have been known to fall out of the transmitter without warning, sometimes with a model in flight.

3.17 Neckstraps

There have been several cases of transmitter neckstrap users accidentally knocking the throttle stick open when getting ready to fly. This can have very serious consequences so take great care with your pre-flight preparations if you use a neckstrap.

When starting an IC engine while wearing a neckstrap, always make sure the free end of the strap is restrained so that it cannot be drawn into the rotating propeller.

3.18 Pacemakers

The use of radio control equipment by heart pacemaker users has been investigated but no direct interaction problem has been identified. If you are a pacemaker user, however, and you require more information you are strongly recommended to speak to the Consultant who fitted your pacemaker. He should have all the technical specifications of the particular unit you use and should be able to identify any problems you may have.

It should be noted that modern pacemakers, fitted since around 2006, are very much more resistant to interference that the older models and should give very little cause for concern.

3.19 Servos

Do not use standard inexpensive servos in any situation where flight loads are likely to be very high, i.e. virtually any flight control on a large or fast model. Standard servos have many uses and are usually very reliable and good value but they simply do not have the torque, precision and power of a servo designed to cope with very high loads. There is an enormous range of servos available so think about what you expect of the servo and choose carefully. If your model is large or likely to be fast then don't automatically fit the cheapest you can get or those that simply come to hand in your workshop.

Many modern models feature long servo and battery leads and the trend towards separate aileron servos in each wing means that even quite small models might have extended servo leads fitted. If you are using 35 MHz equipment, these long leads can make excellent aerials, feeding signals back into the receiver and possibly causing interference. Any extended lead should be de-coupled either by a using a commercial opto-electronic de-coupler or by looping the lead several times through a small ferrite ring which may be obtained from your local model shop.

It should be noted that this should not be a problem with 2.4 GHz radios.

High power, high torque and digital servos may have a high power drain and you should carefully consider the capabilities of the batteries you use with them. Multiple battery systems may be required in some cases. This is especially so if you expect your servos to work hard in your model. The more work you expect them to do, the more current they will take to do it.

3.20 Switches and Wiring

The standard airborne wiring harness and switch sets supplied with most new radio equipment, and also many of those available as aftermarket spares, are usually rated at approximately 3 amps. You can recognise this quite easily as the three core flat cable and plugs used are similar or identical to normal servo connector leads.

When multiple, digital or high torque, servo installations are used, the 3 amp limit can very easily be exceeded, sometimes by a large margin. So if you are using a demanding servo setup (and, for instance, most 3D capable fixed wing and Heli models or larger or faster models will be) then you should think very carefully about using a higher rated switch and wiring harness.

3.21 Telemetry

Many modern radios have the ability to downlink telemetry data from your model to suitable ground receivers such as laptops, tablets or smart-phones as well as your transmitter. If you are using this facility it is essential that you have a helper to monitor the data and not to do it yourself unless it is auditory only. You are obliged by the ANO to remain in visual contact with your model at all times.

If you use a smart-phone as the receiver you should ensure that it is switched to 'flight mode' as this will enable you to take it on the flightline with no risk that it will operate as a mobile phone whilst you are flying.

3.22 Transmitter and Receiver Issues

With new or repaired radio control equipment, a ground range check is essential, preferably in a model and with the model's engine running if possible. Check the manufacturer's literature or website for guidance on your transmitter or, if this is not possible, look for a minimum range of between 30 and 50 metres with the transmitter aerial down and no servo jittering.

2.4 GHz equipment usually has a ‘range check’ button that enables a ground range check to be done, even though the aerial cannot be altered. It is recommended that you make use of this facility regularly so that you can monitor the performance of your radio.

It is good practice to carry out a routine range check on your equipment at regular intervals, at least every month or so, and a check is advisable if you have not flown for a few weeks. You should also be prepared to do a range check if you feel that you have a problem with your radio equipment or if you have removed and replaced crystals or a transmitter module. If the model has a spark ignition or electric motor then the range check should always be carried out with the engine running.

If you use aftermarket 35 MHz receivers be aware that many are designed for indoor use, especially the very lightweight models. The range and ability to filter out interference of such receivers may not be suitable for outdoor use and you should take care that you are aware of the limitations of the equipment you are using.

When selecting which receiver to buy and use you should consider carefully where you will be flying and remember that to a great extent you get what you pay for. Single conversion receivers are usually the cheapest and work well in most circumstances but the more expensive high specification or dual conversion receivers are generally more capable, especially with outside interference rejection. Small 2.4 GHz receivers often have a limited range and this is stated in the documentation.

If you are operating in a busy radio environment (such as at a busy club site or on a site known to be subject to outside interference) then you should seriously consider only using 2.4 GHz equipment.

The radio spectrum gets busier by the day and your transmitter signal has to be filtered out by your receiver from every other signal out there. This situation will only get worse and there are already some sites where only high specification, dual conversion or 2.4 GHz equipment is safe to use.

With certain types of transmitter, when setting up mixers and servo interconnections on a model it has been shown that, in some circumstances, the trim button will work in the opposite direction to that expected. Take a few seconds in the workshop to ensure that every control and trim works exactly as it should.

Problems have been reported with the binding of 2.4 transmitters and receivers when the Tx is surrounded by metal, such as in an open car boot or an open transmitter case. Make sure that the Tx is in ‘clear air’, close to and in line of sight to the Rx when binding. But note that some 2.4 systems require a minimum separation (usually a metre or so) for binding to properly take place.

Whilst periodic range / installations checks are appropriate to establish long term stability, on 2.4Ghz equipment they are unnecessary and undesirable as checks for every flying session.

For 2.4GHz equipment, it is far more important to check and test the effectiveness of the installation before the first flight of a model, **or after any changes to the model, equipment or installation.** This is primarily because the short antennas of 2.4GHz equipment are easily shielded by materials in the aircraft, particularly materials such as carbon fibre and metal.

The ‘installation check’ should be conducted under the range test conditions specified by the individual manufacturer. The ‘installation check’ should involve a full 360 degree rotation of the model to check for any shielding, and should ideally be performed with the model a metre or so off the ground to avoid any shielding by long and or wet grass. The individuals involved in the test should also take care not to position themselves between the model and the Tx, as this will also have a shielding effect, as the water in the human body is very efficient at absorbing (and hence attenuating) 2.4GHz radiation – also see advice on flying in damp / wet conditions.

Subsequent to the initial ‘installation / range check’ and first flight of the model, the use of some form of onboard device or telemetry, to check antenna ‘fades’ or ‘frame losses’, which may then be used to refine the best location of antennas or satellite receivers, is highly recommended.

4. RADIO CONTROL AND YOUR CLUB

4.1 Introduction

(a) Before starting to use a flying site every effort should be made to determine if there is any radio interference present on the bands it is intended to use. Particular attention should be paid to other major users of the radio spectrum in the area, such as other model clubs or hospitals, factories etc. (who might be using paging systems or other high power radio frequency transmissions).

(b) All radio control clubs (unless they are 2.4 GHz only) should have access to some means of frequency checking or monitoring. There are several 35 MHz monitors on the market which retail from around £50 to £400. These are all good value and offer a range of facilities ranging from a basic scanner up to a combined scanner/pegboard.

(c) BMFA has several frequency monitors which are available to clubs on loan. Contact the Leicester office for details. An alternative is a ham radio type scanning monitor which will cover all the bands we use. These are about £400 to buy new but a second-hand unit in good condition could be a good investment.

(d) Hand held **frequency checkers** are also available at reasonable cost and are a purchase that is highly recommended to any R/C club that has significant numbers of 35 MHz transmitters in use. They will enable a Club to keep a regular comparative check on its members' individual transmitters and are invaluable for spotting such things as faulty crystals, wrong frequency flags etc. One model even allows the checking of receiver crystals.

(e) If your club feels that some monitoring information on 2.4 GHz is required, please note that a USB dongle is now available that will allow a laptop to act as quite a reasonable spectrum analyser which gives good results on the 2.4 GHz band. Contact the BMFA Leicester office for details of the supplier.

4.2 Cellphone Masts and Microwaves

(a) It has been shown that Cellphone transmitter masts may cause short range interactions with the radio equipment we use. To be safe, do not allow models to fly within 100 metres of such masts. If there is a mast near your field, you should arrange your flying area so that the pilots have their backs to the mast and it is in ‘dead airspace’ if possible.

(b) The UK is crossed by many low level microwave communication beams and the number of these has increased dramatically since most cellphone masts have been converted from landline feeds to microwave interconnection.

If one crosses your field it may cause problems with interference and glitching, particularly with 35 MHz radios. If your club member’s suffer from such interference regularly (usually in the same place on the field) then it may be a microwave problem.

(c) You can guard against it completely by simply wrapping 35 MHz receivers in a layer of aluminium cooking foil, making sure to tightly crimp the foil for about 5cm out along both the receiver aerial and the bundle of servo leads. The interference affects the components of the receiver directly and doesn’t work through the aerial. Note that some receivers already have a conductive coating of carbon sprayed on the inside of their plastic case which has the same effect as the external foil wrap.

4.3 35 MHz Transmitter Interaction Problems

Any model using 35 MHz can suffer severe interference if it flies closer to an operating 35 MHz transmitter other than the one that is controlling it. To avoid the chance of this happening Clubs should:

(a) Ensure that all pilots stand reasonably close together when flying. The concept of a 'pilot's box' is useful, even though it will not usually be marked out.

(b) Ensure that operating transmitters are not overflown. Care should be taken by the club to ensure that flying field procedures make this very clear.

(c) Take action to prevent operating transmitters being taken out on to an active flying area when, for example, models are being retrieved. Transmitters should be handed to a helper on the flightline and should remain switched on until the model has been retrieved and switched off.

(d) Ensure that all inactive transmitters in the pits area have their aerials retracted if possible. The extension of the aerial should be one of the last actions taken when moving out to the pilot's box to fly and retracting the aerial should be one of the first actions when moving back into the pits area with your model and transmitter switched off.

4.4 Frequency Control at Club Sites

(a) All clubs should operate some form of frequency control system on the flying site, such as a peg-board

(b) At larger flying sessions the use of a transmitter pound should be considered in addition to the frequency control system.

(c) All transmitters, except 2.4 GHz sets, should carry an easily visible channel identification pennant;

For 27 MHz, a correctly coloured ribbon and/or a white flag, approximately three inches by two inches with one inch minimum height black numerals.

For 35 MHz, an orange flag, approximately three inches by two inches with one inch minimum height black or white numerals.

For 2.4 GHz, there is no need for an identifier.

(d) All clubs operating a mix of 35 MHz and 2.4 GHz transmitters should institute very robust pre-flight checks, especially if individual members fly a mix of frequencies.

Several incidents have occurred where a flyer has not appreciated that the 35 MHz set they have in their hand is not the 2.4 GHz set they are used to using and have neglected to extend the aerial. Constant vigilance is required.

(e) If you are setting out a pegboard after a flying session starts, take care to identify all the models present and the frequencies they are using. Check thoroughly as a mistake can lead to a shoot down and don't assume that a model in the air is on 2.4 GHz

4.5 Pegboard Recommendations

For 35 MHz frequency control (and for 27 MHz where still used) there are three basic pegboard systems: Peg Off; Peg on; and the Double Peg. There is also the Individual marker system which is used by some clubs. Each of these systems is described below and it is essential you determine which system is used at your club before you ever switch on your transmitter.

It is highly recommended that all club pegboards are clearly marked with the GPS co-ordinates or map reference of the flying field. This will enable emergency services to find your location easily in the event of a serious incident, even in isolated areas.

(a) 2.4 GHz – 2.4 GHz radios do not need a pegboard system to be set up to control radio frequency safety. However, there is one circumstance where a 2.4 GHz pegboard might be extremely useful to a club and that is when there is a limit to the number of models allowed to be flown at any one time.

Many clubs in these circumstances use the number of pegs 'on the board' to help control the number of active models and the ability to monitor the number of 2.4 GHz sets actually in use at any one time could be important.

(b) The 35 MHz Peg-Off System – The pegboard displays all useable channel number/colours each with an appropriately numbered peg or marker clipped to it. To reserve a channel the flyer must take the correct peg off the board and, usually, clip it to his transmitter aerial.

Pegs must be returned to the board at the end of each flight or there can be confusion as to who has the right to fly. This system is useful for fixed base operations when the board and its pegs can be left on site without being subject to vandalism.

(c) The 35 MHz Peg-on or Reversed Peg System – The pegboard is marked out with the channel numbers/colours as before but with no pegs. Each flyer carries his own named peg and to reserve a channel the peg is clipped on to the board before a transmitter is switched on. It is essential that pegs are removed from the board when a flight is finished and pegs must always carry the pilot's name.

This system is useful for sites where vandalism might be a problem as the pegboards can be made small enough to carry easily and each member of a club can have his own, only one being used at any flying session of course.

(d) The 35 MHz Double Peg System – The pegboard used is exactly the same as for the peg-off system, complete with a full set of numbered pegs. The pilot, however, also has a named peg that he carries with him as in the peg-on system. In use, to reserve a frequency, the pilot takes the numbered peg off the pegboard and replaces it with his own named peg.

This system still has to be used carefully but it is recognised as probably the most reliable system as it avoids several of the potential problems with the two other peg systems.

(e) The Individual Marker System – A further popular system is where each club member has his own small individual frequency marker board with his name and channel number marked on it. These are stuck side by side in the ground by the flyers as they arrive on the site making, in effect, one large pegboard. Flyers on the same frequency place their markers one behind the other and use a peg or similar to reserve the channel between them.

This system has been known to be effective on beach and hill sites as the marker boards can carry 'permit to fly this year' details as well as name and frequency information. It may also have uses with 2.4 GHz equipment, not as a frequency control system but to enable the flyers to see who is actually on the field or slope and this may have significant safety implications if anyone is injured or taken ill.

(f) There are other variations and clubs should select the system which they feel is most appropriate to their flying field situation and, whichever system is chosen, should ensure that the operation of frequency control is well understood by all their members and visiting flyers.

(g) Pegboard Problems

(i) Switching on without 'getting the peg' is the cardinal sin and can have very serious consequences so Clubs should make very sure that their flyers do not slip into such bad habits. This is especially important as many flyers are now using both 35 MHz and 2.4 GHz sets and not using the 35 MHz pegboard because they have become used to using a 2.4 GHz set is becoming a common problem. It cannot be emphasised enough that all Clubs should insist on high standards of training in the use of their frequency control system. The move to the pegboard before even thinking about switching on a 35 MHz set should be second nature to all R/C flyers.

(ii) Changing 35 MHz crystals, either on the field or at home, can also have very serious consequences if the flyer forgets that he has done it. It is very easy to then take his 'usual' peg and reserve a completely different frequency to that which he is actually using. The dangers are obvious. If 35 MHz channels are changed, it is essential that channel flags are used and changed with the crystals. Pilots must discipline themselves to act correctly in these circumstances as it is very easy to make a mistake with the pegboard after a change has been made.

(iii) With the Peg Off system, flyers sometimes take the peg home with them and the 'missing peg' can lead to a new peg being made. The problems then occur when both pegs then turn up at the same time. Even worse is the situation where it is assumed that a missing peg has been taken off-site and a new temporary peg is made for the rest of the day. You can very easily have two people both thinking that they have use of a frequency

(iv) With the Peg On system, under no circumstances should anyone simply remove a peg that is reserving a frequency. If, however, you suspect that a peg has been left on the board in error (the flyer may have gone home) then you should check with senior flyers on the field and the peg may then only be removed after stringent checks that it is no longer in use. The name on the peg helps again here and is yet another reason to make sure that all pegs are named.

4.6 35 MHz Synthesised Frequency Transmitter Control

Synthesised frequency transmitters are legal to use in the UK, as long as they have been tested and carry the familiar CE mark.

Synthesised transmitters do not have a higher risk factor than crystal controlled sets but the possible problems that may arise are slightly different because of the ease with which channels may be changed.

To help control this situation, all UK available synthesised frequency sets either have a two stage switch-on sequence where the frequency to be transmitted is clearly shown on initial switch-on or a permanent display of the set frequency that is shown even when the transmitter is switched off.

This is virtually the same procedure that the user of a crystal controlled transmitter goes through and it gives the users of both type of set the opportunity to go to the frequency control system and reserve their frequency ('get the peg').

Whatever type of 35 MHz transmitter control is used, the biggest risk will always be the flyer who switches on without thinking and without 'getting the peg' and it makes no difference if their transmitter is a synthesised one or not.

4.7 35 MHz Frequency Allocations at Club Sites

The 35 MHz frequency band is by far the most used by club flyers but, because almost every club operates in unique circumstances, it is not possible to recommend a fixed band plan for the regulation of those frequencies on every site.

There are, however, several different types of frequency allocation already in operation at club level, as laid out below, and all clubs should consider very carefully which method of frequency allocation they should use.

(a) Use of all frequencies at 10 kHz spacing – This is the most used system and it is operated successfully by most clubs. Modern equipment gives very few problems at 10 kHz spacing, especially when common sense precautions against self generated radio interactions are taken. As one safeguard, it is important that flyers regularly operating together on adjacent channels should perform an adjacent channel check every two or three months. Use of all the frequencies at 10 kHz spacing, combined with the Club's general safety precautions and the Adjacent Channel Check is probably the safest way to operate. Modern equipment is quite capable of operating to this standard and when faults do develop (usually faulty crystals) they can usually be spotted before they cause any trouble.

(b) The 35 MHz Adjacent Channel Check – The check is quick and easy to do. Flyer A switches on transmitter (with aerial down), then switches on his receiver and stands about 4 metres from his model. Flyer B, on an adjacent channel, switches on transmitter (aerial up) and stands alongside flyer A. No interference should be noted on A's model and it should be under the full control of A's transmitter. The test is then repeated using B's model and with his transmitter aerial down and A's extended.

Note that 'interference' will range from 'glitching' with older sets to failsafe operation with DSP receivers or PCM sets. Any interference noted indicates possible tuning or crystal problems and must be investigated further. The test may save your model as it will give early warning of problems beginning in your radio equipment, usually well before they become bad enough to cause control problems in the air.

(c) Use of the Contest Band Plan / 20 kHz spacing – The original contest band plan, dating from the first allocation of 35 MHz frequencies, is as follows:

R/C power..... all odd frequencies
R/C silent flight all even frequencies

The original allocation of competition channels was the responsibility of the BMFA Technical Committees but it was also used by most clubs as their standard 35 MHz frequency band plan. It gives an automatic 20 kHz split between frequencies in use on a site and this was important in the early days of 35 MHz, when the equipment available was not as reliable as it is today.

However, increased demand for frequencies and better standards of radio equipment has led to this system becoming used much less, both at club level and in competitions. This system may still be useful for some 'silent flight' clubs and for some power clubs with sites near to known slope or thermal soaring sites. Its use has, however, been overtaken by frequency requirements and availability and the 'block frequency allocation' is now more appropriate in many cases.

(d) Use of Block Frequency Allocation – Where a club has a large site and is able to set up two or more flight lines, or where two clubs operate closely together then each is allocated an agreed block of frequencies. Each flightline then has its own pegboard, allowing only the agreed allocated frequencies to be used.

Many combinations can be worked out to suit individual needs and the increased number of channels made available in recent years has made this type of frequency sharing much easier. The ability to have targeted pegboards on each flightline or site is very important in avoiding frequency clashes.

4.8 Lone Flyers

Lone flyers, or people who fly in small groups of two or three, must take the greatest care that they are not operating in situations where they can cause interference to a local club or flying group. As a general rule, you should not fly within two miles of a recognised club flying site unless you have some arrangement with the club who fly there.

This is for the benefit of both parties as interference works both ways and could result in the loss of aircraft on either site.

Lone Flyers, in fact, are far safer when operating on 2.4 GHz as there are no interference implications and the radios can be used anywhere that the flyer wishes.

If you wish to fly alone and are still using 35 MHz radio but are not sure if there are clubs sites local to you, contact your local model shop or the BMFA’s Leicester office for information. You will usually be able to get into contact with clubs quite easily through these sources and it is essential that you do so to ensure safe flying for all concerned. You should also consider the purchase of a hand held scanner, although remember that at ground level it might not pick up a signal that is apparent at your model’s altitude.

5. INTERFERENCE

5.1 Individual Cases

It is a great temptation to claim interference whenever a model crashes but the plain fact is that outside radio interference is rare and causes very little trouble. If you have crashed a model and think you have been affected then run through this checklist first. These are the main causes of model crashes.

(a) Pilot error – this includes stall/spin incidents on final turns, tip stall incidents everywhere, not 'keeping up' with the model so that it doesn't seem to be doing what you tell it, disorientation, lack of awareness of where the model is in relation to ground features, flying over operating transmitters, the inappropriate use of low specification radio equipment and very many more.

(b) Airborne power failure – including receiver battery failure or lack of capacity, wiring, plug and switch failures, black wire corrosion etc.

(c) Airborne hardware failure – including individual servos and receivers, crystal failures, aerials breaking or being masked, linkage failures, airframe failures etc.

(d) Ground failures – transmitter battery failure or low capacity, transmitter crystal failure, module pins corroding, dirty, faulty or loose transmitter aerial, dirt and oil in transmitter electronics etc.

(e) 35 MHz Club interference – other members switching on without frequency clearance, other transmitters faulty, people wandering over the field with operating transmitters etc.

The list is by no means exhaustive and you can add to it if you give it some thought but these are the things that you should think about very carefully. If you can honestly say that you can eliminate all of these then you MAY have suffered from interference. If so, then you should report the matter to your club committee, setting down all the relevant facts, and your club will then be in a position to file a report with BMFA if necessary.

5.2 Club Cases

(a) If your members are reporting regular cases of what seems to be interference then it is almost certain to be on 35 MHz and your first step is to conduct what on-field investigations you can.

(b) Look very carefully at the individual incidents to see if you can eliminate any. Try to collate the incidents you have to see if there is any pattern. Use your club scanner to see if you can pick up any specific interference.

(c) Investigate the equipment used by anyone suspected of suffering from interference. It may be that your site requires the use of high specification receivers and you can spot this quite easily if those affected are all using single conversion but no high specification receivers are affected. Read the section 'Radio Control and You' for more information. A new club site rule may be all that is required to solve the problem.

(d) When you are reasonably sure that you are suffering from 35 MHz interference then contact BMFA Leicester office and ask for an interference reporting form. When you have completed and returned this form, it will be cross-referenced with the BMFA interference database and appropriate action will be taken, usually in conjunction with the UK Radio Control Council (UKRCC) of which BMFA is an active member.

(e) The action taken may range from setting up an independent on-field investigation with specialised tracking equipment to gain more information to directly reporting your problems to Ofcom for immediate action.

6. AN INTRODUCTION TO THE DEPARTMENT OF THE ENVIRONMENT NOISE CODE

6.1 Introduction

In addition to the occasional scrutiny of model flying by Magistrates referred to in the section 'Legal Controls over Model Flying', Planning Authorities are constantly making decisions on whether to allow change of use for model flying sites or whether to issue clubs with a licence to fly on Local Authority land.

When they are taking these decisions they have a statutory duty to ensure that the activities on the site are not a potential nuisance to the surrounding area. When considering possible noise nuisance, the document to which they will most likely refer is the DoE Code of Practice.

If a noise complaint is made against your flying site, the Local Authority will probably send an Environmental Health Officer (EHO) to investigate. He will arrive armed with his noise meter and a copy of the DoE Code of Practice.

If the noise your models make is going to be judged by anyone, then the Code of Practice is most likely to be the standard that it will be judged against. For this reason alone, you should take careful note of the conditions laid out in this document; you never know when it may be applied to you.

Finally, the model flying knowledge of the EHO who may turn up will vary from nil to extremely good and, strange as this may seem, the same may apply to his knowledge of the Noise Code. Read and absorb the Code and it's likely that you will know as much (or more) about it as he does, which would certainly be to your advantage.

The Code can be downloaded from:

https://www.gov.uk/government/publications/code-of-practice-on-noise-from-model-aircraft

6.2 BMFA Advice on the Noise Test

The noise testing procedure noted in the DoE noise code above should be followed carefully but to get the best results it is strongly recommended that you should take special note of the following.

Make sure that no noise reflecting surfaces are near the test site. This means not just buildings but cars, concrete, models, model boxes and even hard packed earth. Do the test over grass.

Do not take measurements when there is any appreciable background noise. Traffic on a nearby road, other models flying or being readied for flight and even people talking near the meter can affect the readings.

Wind blowing across the microphone has a big effect on readings. Do not test on breezy days and when you do test, use a microphone wind shield.

Make sure that the actual microphone is over the end of the seven metre tape, not your hand or the centre of the meter.

Think carefully about the four test positions of the model at the other end of the tape. As a suggestion, for the sideways-on readings put the fuselage on the seven metre mark, for the nose-on reading put the propeller over the mark and for the tail-on reading line the trailing edge of the wing up with it.

Please remember that large engines at full power can be very dangerous and before conducting any noise tests you are strongly advised to contact the Club Support Officer at BMFA Head Office for recommended procedures.

6.3 Helicopter Noise Testing

Because of the specific problems associated with performing noise tests on helicopters, it is recommended that a revised procedure be adopted.

Three markers should be laid out in a line on the flying area, one central, one seven metres to one side (crosswind) and one seven metres to the other side (crosswind). The helicopter which is being checked is held in a steady hover above the centre marker with the pilot standing downwind of it, as normal.

Noise readings are then taken with the meter positioned over each of the end markers in turn. For safety, when the meter is being carried from one end marker to the other, the checker must walk around behind the pilot flying the model.

The two readings obtained take the place of the four obtained in the fixed wing test and all other criteria are as noted in that test procedure.

Note – This method of testing is offered by the BMFA as a safe way of obtaining meaningful figures for helicopter noise levels on club sites by club flyers. It is not officially part of the DoE Noise Code.

6.4 Gas Turbines and Electric Models

The advent of model gas turbines and some higher powered electric models has presented an interesting problem in terms of noise levels and how they fit into the DoE Noise Code.

Although the gas turbine is, in scientific terms, an internal combustion engine, it is the BMFA's contention that the DoE Noise Code should not apply to it. The reason for this is that the noise code was written to cover the types of model i/c engines that were known at the time, i.e. piston engines, and the concept of model gas turbines was not even considered.

The fact is that model gas turbines are very quiet indeed in the air when heard from any reasonable distance, far quieter than most piston engines, and on that evidence you would expect them to be able to pass 82 (d)BA at 7 metres.

However, most of the noise they emit is very high frequency and the higher the frequency of any noise, the better it dissipates with distance. Consequently the problem is that a very quiet gas turbine in the air will not pass the DoE i/c engine noise code on the ground because the test is done at 7 metres and the high frequency noise it emits has not yet had a chance to dissipate.

The Noise Code clearly does not apply to electric models as it is specifically for i/c powered models. Again most electric models are very quiet in the air and will cause no complaint

However there are certain turbine powered models and types of electric model that can sound very loud when in close proximity. EDF models and high speed pusher electrics can produce noise levels that can seem very loud at close quarters. Although there is no meaningful test that can be applied directly to such models, a subjective assessment can be made with a little common sense.

Given that the high frequency noise produced by such models does dissipate quickly with distance, the question has to be whether a model will cause a noise complaint and you cannot judge this from the flying field close to the flight path of the model. The only way to check is to go to a reasonable distance from the flying field and listen to model as a possible complainant would.

If a model is still considered to be too noisy for the field then it would not be unreasonable to ask the pilot to either modify the flight pattern or not to fly that particular model.

It should be noted that the BMFA have no record of any electric models causing direct noise complaints on flying fields, in clear contrast to i/c models.

7. RADIO CONTROL TECHNICAL INFORMATION

7.1 Official Frequency Allocations

The specific frequency bands available for the use of radio controlled models are shown below, with the maximum effective radiated power output of the transmitter measured in milliwatts

Frequency (MHz)	Bandwidth (kHz)	e.r.p. (mW)	Use
26.96 to 27.28	10 or 20	100	General model control
34.945 to35.305	10	100	Air model control
40.66 to 41.00	10	100	Surface model control
49.82 to 49.98		10	General model control (SRD)
433.05 to 434.79	25	1	Data telemetry (SRD)
434.04 to 434.79	25	10	Data telemetry (SRD)
458.50 to 459.50	25	100	General model control
868.0 to 873.0	100 preferred	25	General model control (SRD)
2.4 GHz	Wideband	100/10*	General model control
5.8 GHz	Wideband	25	Airborne video

* NOTE: 100mW e.i.r.p and 100mW/100kHz e.i.r.p. density when frequency hopping modulation is used. 10mW/MHz e.i.r.p. density when other types of modulation are used.

This and other information concerning modelling use of radio frequencies can be found in the Ofcom document OfW 311. You can view the latest copy on www.ofcom.org.uk (use the search box).

7.2 The 27 MHz Band

(a) Identification is by coloured ribbon attached to transmitter aerial in the colours as listed when using 20 kHz spacing and a white flag with channel number in black when using 10 kHz spacing..

(b) The channel spacing on this band is 10 kHz and all modern sets, with the CE mark, should meet this specification. However, many older specification sets are still in use and these have a minimum channel spacing of 20 kHz. This situation will remain for a number of years so if you are operating narrow band 27 MHz then be aware of the danger.

(c) You must not use an old 20 kHz split crystal in a new set. Even if you wish to transmit on the same frequency, a new narrow band crystal will be required in a narrow band set.

(d) The **27 MHz** band is legally shared by other users, in particular, model cars, model boats, citizens band operators and an increasing number of radio controlled toys. It therefore cannot be recommended for use by airborne models. In fact many clubs have already found it necessary to ban it completely.

(e) If you really must use it take great care particularly near urban areas and remember when you fly a model aircraft you are personally responsible for the safety of the flight. So think very carefully before proceeding because of the many sources of potential interference..

Chan.	Frequency.	Old Colour	Chan.	Frequency.	Old Colour
1	26.965		17	27.125	Orange-Yellow
2	26.975	Black	18	27.135	
3	26.985		19	27.145	Yellow
4	26.995	Brown	20	27.155	
5	27.005		21	27.165	
6	27.015		22	27.175	Yellow-Green
7	27.025	Brown-Red	23	27.185	
8	27.035		24	27.195	Green
9	27.045	Red	25	27.205	
10	27.055		26	27.215	
11	27.065		27	27.225	Green-Blue
12	27.075	Red-Orange	28	27.235	
13	27.085		29	27.245	Blue
14	27.095	Orange	30	27.255	Blue
15	27.105		31	27.265	
16	27.115		32	27.275	White or Purple

7.3 The 35 MHz Band

(a) The **35 MHz** band is SOLELY for model aircraft and under no circumstances must it be used for any other purpose, such as the control of surface vehicles. Transmitters must not be airborne.

(b) Identification is by orange flag with black or white channel numerals.

34.950	channel 55	35.070	channel 67	35.190	channel 79
34.960	channel 56	35.080	channel 68	35.200	channel 80
34.970	channel 57	35.090	channel 69	35.210	channel 81
34.980	channel 58	35.100	channel 70	35.220	channel 82
34.990	channel 59	35.110	channel 71	35.230	channel 83
35.000	channel 60	35.120	channel 72	35.240	channel 84
35.010	channel 61	35.130	channel 73	35.250	channel 85
35.020	channel 62	35.140	channel 74	35.260	channel 86
35.030	channel 63	35.150	channel 75	35.270	channel 87
35.040	channel 64	35.160	channel 76	35.280	channel 88
35.050	channel 65	35.170	channel 77	35.290	channel 89
35.060	channel 66	35.180	channel 78	35.300	channel 90

(c) To Identify the Channel Number of an Untagged Crystal,

(1) If the crystal is marked 34.xxx you subtract 40 from the first two numbers after the decimal point of the frequency marking, (i.e. 34.960, subtract 40 from 96 giving channel 56)

(2) If the crystal is marked 35.xxx you add 60 to the first two numbers after the decimal point of the frequency marking, (i.e. 35.260, add 60 to 26 giving channel 86).

7.4 The 40 MHz Band.

(a) This is for surface vehicles only and band identification is usually by green flag with white channel numeral. The band will use the last three numerals of the actual transmitted frequency as the channel identification, for instance,

40.665 MHz will be channel 665
40.825 MHz will be channel 825

(b) This band is SOLELY for surface vehicle use and under no circumstances must it be used for the control of model aircraft

7.5 The 49 MHz Band

The very low radiated power of this band would limit it to indoor use only. As far as is known no commercial equipment for model use is available, although it is widely used by the toy industry, including for indoor model aircraft. Transmitters may not be airborne.

7.6 The 433 MHz and 434 MHz UHF Bands

These are data telemetry bands for short range devices (SRD) and may be used to transmit data back to the transmitter. However they are not exclusive to model controllers and are shared with other users who are permitted to radiate relatively higher powers, so you must take care when selecting a channel for use in a particular locality. All equipment used must be type approved (ETSI 300 200-1) and therefore show the CE mark.

7.7 The 459 MHz UHF Band

Identification will be by channel numeral.

458.525	channel 1	458.850	channel 14	459.175	channel 27
458.550	channel 2	458.875	channel 15	459.200	channel 28
458.575	channel 3	458.900	channel 16	459.225	channel 29
458.600	channel 4	458.925	channel 17	459.250	channel 30
458.625	channel 5	458.950	channel 18	459.275	channel 31
458.650	channel 6	458.975	channel 19	459.300	channel 32
458.675	channel 7	459.000	channel 20	459.325	channel 33
458.700	channel 8	459.025	channel 21	459.350	channel 34
458.725	channel 9	459.050	channel 22	459.375	channel 35
458.750	channel 10	459.075	channel 23	459.400	channel 36
458.775	channel 11	459.100	channel 24	459.425	channel 37
458.800	channel 12	459.125	channel 25	459.450	channel 38
458.825	channel 13	459.150	channel 26	459.475	channel 39

The **459 MHz** is shared with various industrial telemetry and telecommand devices between 458.5 and 458.95 and to specialised telemetry beween 458.95 and 459.1, so users of these channels should be aware of the possibility of interference being present. The use of frequencies above 459.100 MHz (channel 24) is recommended. Transmitters may not be airborne.

7.8 The 900 MHz Band

This is a Short Range Device (SRD) band and is license free provided the e.r.p. does not exceed 25 mW and the transmission uses Adaptive Frequency Agility (AFA – frequency hopping) and in the EU is Listen Before Talk (LBT). The frequency spread is 868.0 MHz to 873.0 MHz but there are some specific users in the upper part of the band, particularly above 870.0 MHz. 500 mW e.r.p. is permitted from 869.4 to 869.65 MHz, but must be AFA and LBT.

7.9 The 2.4 GHz Band.

This is a worldwide Industrial/Scientific/Medical (ISM) band, similar in scope to the 27 MHz band.

There are two currently available types of equipment. One uses spread spectrum technology and does not operate on a fixed frequency. There are 80 channels available and each set uses two channels during operation. They automatically set themselves to a pair of unused frequencies when switched on. Operation is constantly self monitored and the set will move to an unused frequency if any interference is detected.

The other technology in use is frequency hopping which operates in a similar manner to mobile ‘phones.

All should be self regulating when it comes to selecting frequencies to use and the two different operating systems can co-exist with each other. Consequently, no direct frequency control is required for the band.

This band is useable for most regular R/C applications. It is also used by many computer applications such as wireless networking and Bluetooth devices but the method of operation of the equipment in this band means that the possibility of interference from such devices is extremely low.

The band may also be used by video equipment but only at a maximum radiated power of 10 mW.

7.10 The 5.8 GHz Band

The band covers 5.725 GHz to 5.875 GHz.

This band is used by most FPV video equipment. It has been divided into four bands A, B, E, and F, each band having 8 channels as the table below.

	1	2	3	4	5	6	7	8
A	5865	5845	5825	5805	5785	5765	5745	5725
B	5733	5752	5771	5790	5809	5828	5847	5866
E	5705	5685	5665	5645	55885	5905	5925	5945
F	5740	5760	5780	5800	5820	5840	5860	5880

As you can see the grey channels are illegal for use in the UK. Some commercial manufacturers may use a different range of channels some of which may also be illegal. Check very carefully the frequencies used by any video equipment you intend to purchase.

7.11 72 MHz Equipment

Contrary to some people's belief, **72 MHz IS NOT A LEGAL FREQUENCY FOR MODEL CONTROL IN THE UK.** A manufacturer's development license is available (under very strict conditions) to bona-fide designers/manufacturers from the DTI. Anyone using 72 MHz without such a current special licence is operating illegally and may face a fine and confiscation of the equipment. This licence is for genuine development work only and does NOT give the operator the right to use the frequency for normal R/C flying.

72 MHz is very widely used in the UK for communications purposes.

7.12 R/C Equipment Type Approval

In October 1998, harmonised standards for low power radio control equipment were introduced into European Union Countries. From that date all new equipment either manufactured or imported into the UK has to comply with the requirements for the issue of a CE marking

The European standards which apply to all newly introduced R/C equipment are ETSI 300 – 220 For Equipment pre 2.4 GHz and ETSI 300 440 covering Wideband (2.4 and 5.8 GHz) equipment. For full details see ofw 311 and IR 2030 available at www.ofcom.org.uk These also reference the above ETSIs.

It is therefore essential that any radio control equipment you buy and use carries an official CE marking.The CE marking is your only assurance that the equipment you own, or are intending to purchase, complies with the standards laid down by the Government. When purchasing your next R/C equipment, make a special point of looking for the CE marking; this is the only way you can be sure the equipment you are using is legal.

Notes:

(a) From October 1998 all newly introduced 27 MHz equipment must also carry a CE marking and be capable of operating at 10 kHz spacing. 27 MHz equipment manufactured before that date is exempt from this legislation.

(b) The 1998 legislation noted above was not retrospective so all 35 MHz equipment which was previously tested against the old SAME/MHTF Type Approval standards remains legal to use.

(b) Current legislation allows the CE mark to appear on the equipment itself, the instruction leaflet or on the box.

7.13 Synthesised Frequency Equipment

(a) 35 MHz synthesised frequency transmitting equipment is legal in the UK as long as it has been tested and carries the CE mark. There is, however, a limitation to its use in the UK that has been agreed with Ofcom and also at international level by the FAI.

(b) This is that any synthesised transmitter must have a two stage switch-on process. The first switch-on stage must NOT transmit but must give a clear indication of the frequency that will eventually be transmitted. This is to enable you to select frequencies safely and, more importantly, to obtain clearance from the site frequency control system.

(c) Only after you have done this should you activate the second switch-on stage which enables transmission.

(d) Synthesised frequency equipment will give you much greater flexibility in your frequency selection but it also has many pitfalls and you should take great care if you use such equipment. Remember that most people you are flying with will not have the same facilities and your operations must fit in with what is accepted as normal operating procedures.

(e) For instance, you should be showing a frequency flag and be prepared to change it if you change frequencies. You must take extra care when using the frequency control system as your opportunities to reserve the wrong frequency will be much greater. You may find that the ability of your transmitter to select any frequency will be viewed with suspicion by some and, in the event of interference being suspected, you could find that you are the first person checked. The only way to avoid problems is to be scrupulously careful in your operations.

(f) Finally, although synthesised sets have the potential to be more reliable and cheaper to produce than plug-in crystal sets, remember that they still use a fixed crystal in the transmitter module and the receiver and that any crystal can drift over time. You will still need to have your radio equipment checked occasionally as a master crystal drifting will affect all the other frequencies synthesised from it. Curing the problem will be a job for the importer/manufacturer and will not be as simple as just plugging in a new crystal.

7.14 Grey Imports

There is a small but increasing trend, driven in many cases by the ease of internet shopping, for flyers to directly import equipment from sources outside the EU for their own use. All frequency bands are affected by this and sets on 35 MHz. 900 MHz and 2.4 GHz are especially involved.

Now most of us are not familiar with EU and UK law on this subject but you should consider the following very carefully.

It is a fact that the onus for making sure that the equipment meets EU standards rests not on the manufacturer but on the original importer into the EU. This applies whether the equipment carries a real or bogus CE mark or no CE mark at all.

This means, of course, that equipment bought through the normal model shop chain is warranted to be legal by the major importers who do the original importing into the EU. However, if you have imported equipment directly from outside the EU for your own use then you are personally responsible for it's legal operation within the UK.

This is extremely important to you as a user because you may inadvertently find yourself in serious trouble if you are involved in an incident.

Just to take two instances;

(1) The application of bogus CE marks to equipment manufactured and supplied from certain parts of the far east is not unknown. If you have one of these sets you have no idea whether it is legal to operate or not.

(2) The USA and Canada have higher power limits for 2.4 GHz equipment than we do and it is known that most Spektrum sets sold there have been built to take advantage of these higher powers. If you have personally imported a set from the USA then it will almost certainly be illegal to operate in the UK unless it has been re-calibrated by the official importers.

7.15 Radio Control Licence

From 1.8.1981, model control equipment is **exempt** from the requirement of a Licence under Section 1 (1) of the Wireless Telegraphy Act 1949 subject to the terms, provisions and limitations set out in parts 1 and 2 respectively of the Statutory Instrument 1980 No. 1848.