BRITISH MODEL FLYING ASSOCIATION

THE R/C ACHIEVEMENT SCHEME

TEST STANDARDS for CHIEF EXAMINERS and CLUB EXAMINERS

GUIDANCE for TEST CANDIDATES

THE ‘A’ CERTIFICATE

(Multi-Rotor)

2014 ISSUE

General

The Achievement Scheme is run by the BMFA as a National Scheme and it is open to all model flyers. Where a non-member wishes to participate in the achievement scheme the examiner who will be conducting the test must inform the BMFA office via email or telephone no later than the day prior to the test being carried out of the non-member's full name, address and the date that the test will be conducted. This enables the BMFA to extend insurance at suitable levels for the day of the test. If this procedure is not followed the test will be invalid.

The examination for an 'A' Certificate may be taken on application to any Registered Club Examiner or Chief Examiner.

The 'A' certificate is a measure of flying ability and safety which 'may be equated to a safe solo standard of flying' and an increasing number of clubs use it as their 'safe solo' test. As an examiner, the level of competence you should expect of a candidate should be based on that criterion; that is, is this person, in your opinion, fit to be allowed to fly unsupervised?

A candidate wishing to take the 'B' must already have passed the 'A' in that discipline.

The candidate for the 'A' certificate should have studied the BMFA Members' Handbook and be familiar with the 'Safety Code for General Flying as well as the 'operational guides, 'all models', 'radio control' and 'helicopters'. Besides being an excellent guide to the safe flying of helicopters and other model aircraft, most of the questions asked at the end of the test will be from these sections of the Handbook. There is a section in the Handbook that gives the relevant page numbers of these sections but remember that addendum sheets to the Handbook are published in BMFA News and on the BMFA website and these may also be relevant as they contain up-to-date information.
Also be aware that you may ask questions on any local site rules that the candidate should be aware of and these may form an important part of the test questions you ask.

Outdoors

The test may not be flown indoors. It was designed to be flown outdoors and the text of the test manoeuvres highlights this. It is important to remind candidates that their ability to cope with various wind conditions is an integral part of the test.

The Model

The test can be performed with virtually any model multirotor, fixed pitch or collective. A multirotor for the benefit of this test is defined as a rotorcraft with two or more motors, but excluding tandem helicopters. Further details on suitable models can be found in the BMFA Multirotor Certification Appendix document.
Whatever model is brought by the candidate, it must be suitable to fly the manoeuvres required by the test they are taking. You do not have the authority to alter the required manoeuvres to suit a model and if, in your opinion, the model is unsuitable for the test then you should explain this to the candidate and tell them that they cannot use that model. The selection of the model to do the test is the responsibility of the pilot and it is their ability you are testing, not the model.
Electric Powered Models must be treated as LIVE as soon as the main flight battery is connected, irrespective of radio state and great care must be demonstrated by the candidate. The arming sequence should be clearly understood and discussed/demonstrated to you by the candidate.

Buddy Box Leads

Buddy leads and other dual control training aids must not be used during any achievement scheme test.

Gyros, Electronic Stabilisation and GPS.

It is acceptable to use an electro-mechanical or solid state gyro/s in a multirotor being used to take the test although electronic stabilisation is restricted to enabling flight, at no point should the stabilisation effect take over control from the pilot or achieve automated or self leveled flight. This allows a range of gyros to be fitted, from simple yaw dampers to solid state heading lock units.
The use of any autopilot and/or artificial stability features which are (or may be) designed into such units beyond definition above is not acceptable during the test and is not allowed.
Candidates should be prepared to explain the capabilities of the system they are using and show that it does not take over control from the pilot and that automated flight will not be achieved during the test.
GPS must not be used during the test.

Height and Speed

The ‘A’ certificate candidate should be a reasonably confident pilot, even though they may have been flying multirotor for only a few months. Flying too high or too low is not the mark of a confident pilot. The test should be flown at the heights specified in the individual elements with little deviation.
The two manoeuvres in the ‘A’ certificate test require slightly different speeds as will be explained on the manoeuvre descriptions.

Wind Direction

There is no requirement for the fixed positioning of manoeuvres relative to the wind direction in the Multirotor ‘A’ certificate and you will find no reference to the wind in the text of either the test or this Standards Document.
This makes it absolutely ESSENTIAL that you discuss this with the candidate at length so that you are both aware of exactly how you want the manoeuvres to be presented and what limitations will be accepted if the wind direction is not favourable.

Consistency

The candidate must ensure that the model stays at a reasonably constant height and heading and moves at a constant speed through the manoeuvres as required. All deviations from steady and well controlled flight should be noted as they will form part of your examiner’s judgement of the test flight. Good use of the controls to maintain a constant height throughout the test is something you must watch carefully for.
Slight variations of height and failure to fly spot-on lines are not necessarily reasons to fail the candidate on their own, but they do give an indication of the pilot’s general level of competence and should influence your final decision.
Very poor height control or significant failures to hover with the tail held in the correct direction are a sure sign that the pilot has not practiced the test and are legitimate reasons to fail the candidate.

Continuity

The manoeuvres are set out in such a way that they are flown one after the other as a short sequence. You should discuss with the candidate before the flight the way in which you would like the various elements flown and the candidate should have a good knowledge of the test before the event. If the candidate is very hesitant during the test and is not capable of following the set sequence then you might conclude that they have either not had enough practice or that their basic flying skills are not yet well enough developed.

Trim

It is expected that the candidate will start the test with a model that has been trimmed out previously. If you see obvious signs that the model is out of trim and the candidate makes no attempt to rectify the matter, you may well question their basic competence.
On the other hand, if they do need to re-trim and are making attempts to do so, you should make allowances for a short time of flight with a somewhat erratic path. This should not be penalised unless it puts the model in any dangerous situations or unless the model flies behind the pilot or into any other unsafe area. If the pilot does use the first part of the flight as a trimming exercise, they should be required to land as soon as they are satisfied with the trim and the test should then commence at manoeuvre (b). If a flight is abandoned prior to starting manoeuvre (b) because of trim problems it will not count as a test flight attempt.

Nerves

Quiet competence is what you are looking for during the flight, but most candidates may well be nervous, and you should make some allowance for this. If the flyer is very nervous you should seriously consider abandoning the test for the time being and arranging a coaching flight or two for the candidate to settle them down before re-taking the test. This can be done on the same day and can really help those candidates who have trouble with nerves when flying in a test situation.

Repeating Manoeuvres

At ‘A’ certificate level, the manoeuvres are simple and the candidate should be competent to fly them with very few errors. If you identify any major faults, the test should be taken again. It may be, however, that the candidate will make minor mistakes on a manoeuvre and if you are not fully satisfied with what you have seen you should not hesitate to ask for the manoeuvre to be repeated.
Some judgement is called for on your part here. The idea is not to let the candidate have multiple attempts at each manoeuvre until they get it right, but more to give you the best chance of assessing the competence of the pilot you are testing.
You should consider what you have seen the model do, and if you think to yourself, ‘that could be better’, then request that the manoeuvre be repeated. Beware of doing this too often, though, as you would be degrading the worth of the test and it must not degenerate into a series of practice manoeuvres.

Repeating the test

The rules allow two attempts at the test in one day and if the candidate fails the first of these you must consider their performance in deciding what to do next. Many failures will be reasonably good or borderline cases and in these circumstances it may be appropriate to arrange one or two coaching flights before repeating the test. Remember that many of the candidates will be unfamiliar with flying under pressure and might do very well on the second test.

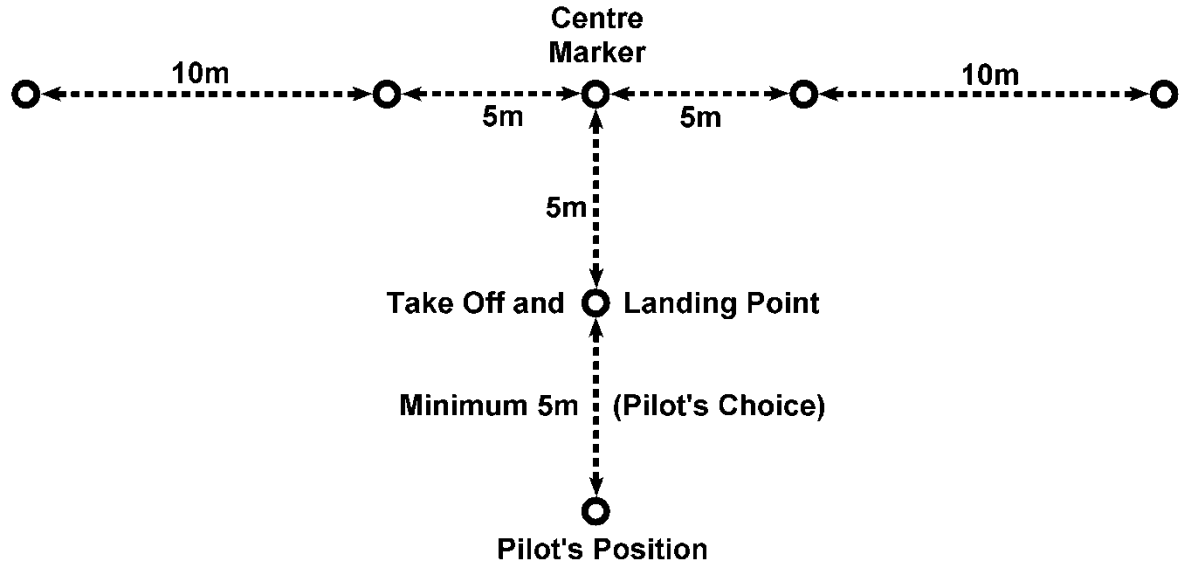
However, it will probably be obvious to you on many occasions that the pilot you are testing is simply not ready for the test they are taking. In this situation it is better that you tell them so quite clearly. It could then be extremely useful for you to arrange a demonstration test for them so that they can gain an understanding of the standard of flying that is required, especially if they are not clear about the manoeuvres and the positioning for them. This, possibly with a little coaching, is far more useful to everyone than simply telling the candidate that they have failed.
A flight which is abandoned for any reason prior to starting manoeuvre (b) will not count as a test flight attempt.

Interruptions to the Test

A possibility that may occur during a test is an engine failure part way through, which with multirotors could very well lead to a damaged model. If this is the case then the test obviously cannot continue and you should invoke the rule that the test should be performed in one flight and count the flight as one of the two attempts allowed during the day.
Genuine engine trouble or even engine-out situations during the test may be dealt with in one of three ways.
If the test was being generally flown in a satisfactory manner and the problem can be rectified quickly then the candidate may be allowed to continue the test from the start of the manoeuvre in which the problem occurred.
If the problem cannot be rectified quickly but you consider that it was a genuine unforeseen occurrence, you may annul the test and not count it as one of the two attempts.
If the test up to the point of failure was not satisfactory, you have the option to cancel the rest of the test and count the flight as one of the two attempts allowed during the day.
Obviously, you will have to use your judgement on this matter as there will rarely be black and white situations but how they handled the emergency should be of great interest to you when you come to review the candidate’s overall standard of flying.

Ground Positioning

When taking a multirotor test, it is your responsibility as the Examiner to lay out a series of ground markers to assist both the candidate and yourself to assess the manoeuvres being flown. Small cones or any other similar marker may be used as long as they don't interfere with the flying of the model. However, it is vital that the marker used for the take off/landing point (TOLP) does not affect the model at all and probably the best marker in this case would be something like the fluorescent discs that lay flat on the ground. Alternatively, you could use some of the biodegradable ground marker spray paint that is readily available.
The layout of markers required is shown below and it must be emphasised that absolute accuracy of distance is not required when setting them out. Pacing will be quite accurate enough. It is essential, though, that the centre marker, the TOLP and the pilot's position are in line



GROUND POSITIONING MARKERS

The general positioning of the markers will depend very much on the geography of the flying site and safe operation of the model and you should set them out with these factors in mind.
It is not a requirement that the markers in the cross bar are used by the pilot but they are there to help. However, the centre marker, the TOLP and the pilot's position must be used with some accuracy.
Landings should generally be no more than a metre from the takeoff/landing point and the pilot is expected to stay close to the selected pilot's position mark although it is not required that they 'plant' their feet. If you feel that the pilot is starting to wander, you should stop them and insist that they stand near the pre-selected mark. .
Remember that it is a requirement that 'all manoeuvres are carried out in front of the pilot' so the use of the pilot's position point will be important.

General Manoeuvres and Hovering

All take-offs and landings should be smooth, without undue ~~tail~~ oscillations, and lifts and descents should be straight and controlled with the model a comfortable and safe distance in front of the pilot. In any stationary hovering the model should remain steady and should not oscillate unduly.
Movement of the model from one point to another whilst in the hover should be done at a steady walking pace.
The standard 'brief' hover time should be about five seconds. You should discuss this with the candidate before the test so that they know that you will want to see a positive stop with the hover long enough to show that the model is well controlled and steady with little wandering or oscillation. Stopwatch accuracy is not required.
The candidate should also be aware that the decision to move on is theirs and that you will not be asking them to commence with the next manoeuvre. However, during your pre-flight briefing, they may ask that you indicate when you are satisfied that they have completed their 'brief' hover times to help them decide when to move on. This is quite permissible if requested by the candidate.

Intermediate Landing

Exceptionally, at a pre-determined point in the flight an intermediate landing may be permitted for the sole purpose of either re-fuelling or the fitting of a freshly charged flight battery. This landing may only be made with the prior consent of the Examiners. The pre-determined point may be either after a specific manoeuvre or at a specific time of flight, whichever is requested by the candidate and agreed by the Examiners.
Full pre and post flight checks are not normally required during an intermediate landing and take off unless the model suffered a hard landing. However, the candidate should give the model at least a quick visual examination whilst on the ground.

Administration

There are specific forms for Examiners to use during the Multirotor 'A' test, and if you do not have one then a call to the BMFA Leicester office will have some in the post to you by return. Completed forms should be sent to the Leicester office within seven days of the test and, whilst they must be filled in by the Examiner, they may be sent in to the office by either the Examiner or the Candidate. You should take great care that all the details are filled in correctly, especially the successful candidates **NAME** and their **BMFA number** (this can save a great deal of confusion). If the candidate is not a BMFA member then it is especially important that you get their name and address correct and in full.
This is very important as what is seen on the pass form is what will appear on the final certificate. It is embarrassing for you to have to send one back to be re-done and it gives the candidate a definite impression of sloppy work by someone.

Helpers for Disabled Candidates, Young Candidates and Others Who have Requested Help During the Test

When disabled or young candidates present themselves for the test it may be that they will not physically be able to perform all the actions that most candidates can. At times, other candidates may also request help with certain physical aspects during the test (they may, for instance, have an injured finger). There will be times when you, as an Examiner, will think 'how much can I relax the test requirements for this person'.

Some Examiners make the decision to make no allowances at all but this effectively bars many people from attempting the tests. If we think of the achievement scheme as a true national scheme then we must consider how we can accommodate candidates, not how we can stop them from participating.

The answer, of course, is that you, as an Examiner, must make on-the-spot decisions about what you will allow during the test and, in such cases, you are within your authority to take such decisions. The guidelines set out below may help but at all times the two items at the end of this section must take precedence. They are not negotiable and mean that, whoever the candidate is, they have to convince you that they know what they are doing or what is happening for the full duration of the test.

For instance, a disabled flyer may have difficulty handling the model and may not be able to carry it out to the strip or retrieve it after the flight. The sensible use of a helper is certainly allowable in such cases but it is essential that they only do what the candidate asks them to do. Pre-flight checks and engine starting may be another problem area that can be overcome by a helper but you should expect the candidate to do as much of the work as possible themselves and they should be able to talk you through anything that the helper does for them. Be sure to discuss all this with the candidate before starting the test.

All of these comments can apply to younger flyers too but there is an added complication with engine starting. Many parents are very unhappy about letting their children near a running engine and will not allow them to start their own engines. This is a perfectly valid view and, again, is a case where a helper can be used. If this situation does occur with the younger candidates, however, you should insist that they do all the pre-flight and preparation work themselves, up to applying the starter to the engine. If they cannot do this then they should not pass.

After engine start, the helper can adjust engine controls and carry the model but only on the instructions of the candidate.

In all cases:

(1) If, at any time, the helper takes over the decision making process from the candidate then the candidate must fail.

(2) You can make no allowances whatsoever for anyone during the flying of the test. The candidate can either perform the flight manoeuvres as specified or they can't. If they can't then they must not be passed.

Make sure in your briefing that both the candidate and the helper are fully aware of both of these points.

The Test

(A) Carry out pre-flight checks as required by the BMFA Safety Codes and BMFA Multirotor Certification Appendix document. See appendix 1.

The pre-flight checks are laid out clearly in the BMFA Multirotor Certification Appendix document. The candidate should also go through the pre-flying session checks, laid out in the BMFA handbook. Ask the candidate to go through their checks as if the test was their first flight of the day.

Points to look for are that the candidate has a steady and regular ground routine, especially when starting and tuning the engine. Nerves should not play a part in the pits, and you should satisfy yourself that the candidate is in full control of what they are doing whilst preparing the helicopter for flight.

A tidy flight box and a neat ground layout makes a good impression but bear in mind that that 'A' certificate candidates may not have been flying for too long and you should make allowances.

A poor performance in this area is not direct grounds for failing the candidate but can certainly be part of a cumulative fail if other aspects of the performance are below the standard you expect.

Pay particular attention to the way the candidate uses the local frequency control system and make sure that they fully understand it and use the correct sequence appropriate to their model. For 35 MHz, this is usually 'get the peg, Tx on, Rx on'. For 2.4 GHz, the candidate should be aware of any local transmitter usage limitations and if a flight peg is required, it must be obtained before the usual Tx on, Rx on sequence. Some radio equipment and, occasionally, a specific model requirement requires that the Rx be switched on first and, if this is the case, the candidate should explain this clearly to you.
With electric powered models, take note that the candidate is aware that the model is 'live' as soon as the flight battery is plugged in and that they take appropriate safety precautions. If a separate receiver battery is fitted, the candidate should have the opportunity to check the operation of the radio equipment before the flight battery is plugged in.
Watch carefully and take note that the transmitter controls, trims and switches are checked by the pilot.

All candidates are required to be aware of the local the frequency control system and anyone who is required to use it but switches their radio on before doing so should be failed on the spot.

Electric powered models must be carried out from the pits area to a safe point before the flight battery is connected and they MUST be considered live as soon as the flight battery is plugged in. Great care should be taken at this point and any help available to the candidate should be used in the interests of safety.

If there is no one else available then there is nothing to stop you aiding the candidate by, for instance, carrying the model to the test area etc. but any such actions must be performed by you directly on the instructions of the candidate. You must not prompt them or carry out any actions of your own accord.

It is important that you talk these points over with the candidate in you pre-flight briefing.

(b), (c), (d), (e), (f) and (g) together form a horizontal 'T'.

During the course of manoeuvres (b), (c), (d), (e), (f) and (g) the model should not have deviated significantly from a straight line drawn between the end points Slight drifting may be permissible in adverse wind conditions, but should be rapidly corrected and put back on the correct course. If the deviation is severe, or the model does not follow the line at all, the candidate should not pass. The hovering speed between the end points is at the discretion of the candidate but must be no faster than a slow walk.

Each stop should be a controlled hover, with any movement being quickly checked, without signs of large over-corrections. The pauses at each hovering point should be about five seconds, other than in (b).

The height of the multirotor should be consistent throughout these manoeuvres with no major deviations.

(b) Take off and hover over the take-off point, with the multirotor at eye level, for about twenty seconds and then land.

Take off should be smooth and the lift to eye level should be vertical, straight and controlled with the model a comfortable and safe distance in front of the pilot. Once at eye level the model should remain stationary and should not oscillate unduly. You should notify the candidate when the hover time of about twenty seconds has passed and ask him to commence with the next part of the manoeuvre. The descent and landing should be smooth and steady with little oscillation on touch down.

(c) Take off and hover for about five seconds, then hover the multirotor slowly forwards for approximately five metres, stop, and hover for about five seconds.

After the take off and five seconds hover time and, on your command, the pilot now hovers the model forward, at a slow hovering pace, for a distance of about five metres then stopping and hovering for about five seconds. All the previous comments about line, height at eye level, speed and steadiness apply and the orientation of the model should still be facing in the same direction as this initial forward hover, as for all the rest of the first set of manoeuvres.

(d) Hover the multirotor slowly sideways for approximately five metres, stop, and hover for about five seconds.

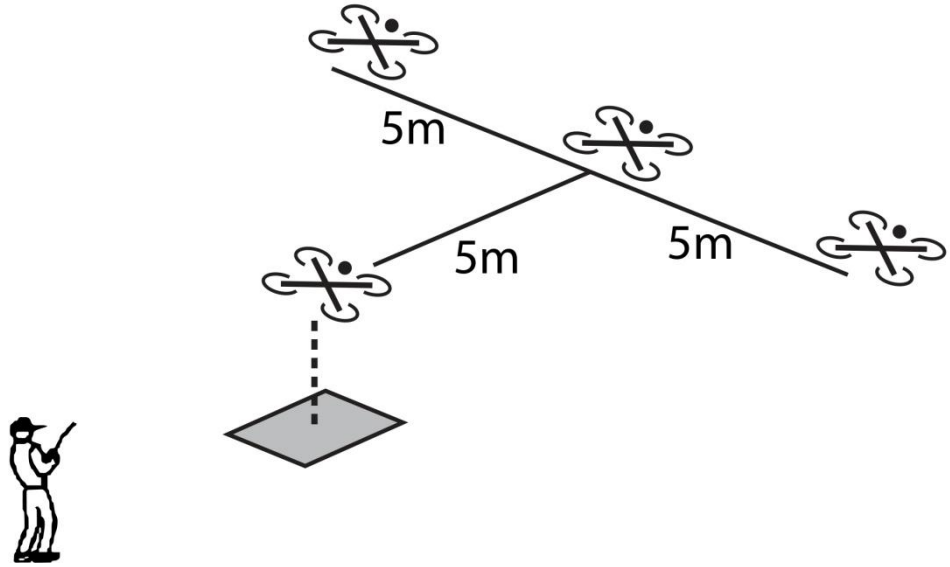
The pilot may choose to perform the initial sideways hover in either direction (to his left or right) and, once you have been told the direction, the candidate should, without turning the model, commence a sideways hover at eye level for a distance of approximately five metres. Having travelled about five metres the pilot will stop the model and hold it in a steady hover at eye level and, with the rear of the model pointing in the same direction as it was when it took off, for about five seconds

(e) Hover the multirotor slowly sideways in the opposite direction for approximately ten metres (five metres past its original position in front of the pilot), stop, and hover for about five seconds.

At the end of the hover time the pilot, without turning the model, will hover it sideways in the opposite direction, passing in front of them and stopping 5 metres past the centre line. At this point the pilot will once again stop and hover the model with it still facing in the same direction as it was at take-off.

(f) Hover the multirotor slowly sideways in the first direction to bring it back to its original position in front of the pilot, stop, and hover for about five seconds.

The candidate should, without turning the model, commence a sideways hover at eye level for a distance of approximately five metres back to the centre marker. Having travelled to the centre marker the pilot will stop the model and hold it in a steady hover for about five seconds at eye level and, with the rear of the model pointing in the same direction as it was when it took off.



(g) Fly slowly backwards, bringing the multirotor back to its original position over the take off point, stop, hover for about five seconds and land.

After hovering for about five seconds, the model is hovered backwards (without turning it) to the start position, stopped and hovered for about five seconds above the TOLP with skids at eye level. After the hover time has been completed the model should descend and land close to the original take off point. During this last section, you will be observing the same criteria as previously and the model should have performed as before in relation to the course and at a similar speed. The descent and landing should be smooth and steady with little bouncing on landing, caused by not being level or poor throttle control.

(h) Take off and fly slowly forward for approximately 5 metres, stop and hover for about five seconds. Turn 90 degrees either left or right and fly forward to perform two 'lazy eights', each at least 30 metres in length. Each time the multirotor passes in front of the pilot it must be sideways on to the pilot and throughout the manoeuvre the model must be flying forward, not sideways.

The pilot should make a quick visual check that the area he intends to overfly is clear and that no other models are flying in the near vicinity; you should be watching for definite head movements as they scan the area.

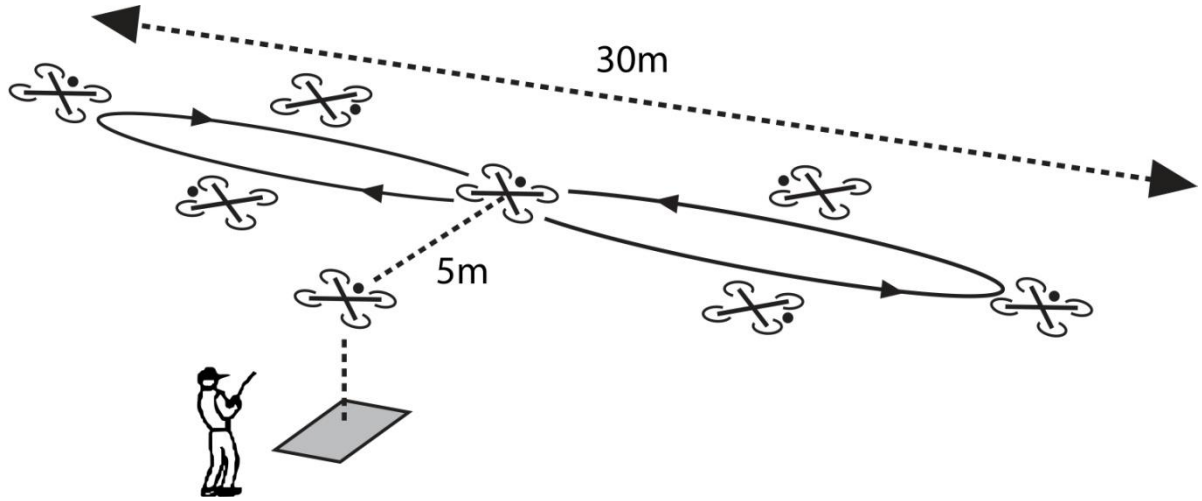
The pilot should fly this manoeuvre at a safe height above eye level, but should not fly at such a height that the model cannot be clearly seen by both the pilot and yourself. Between eye level and five metres is the correct height band for this part of the test and the model **must** hover through the lazy eights, not fly through them. The pilot must be clear about the height at which they wish to fly before they take-off and you should discuss this with them in the pre-flight briefing.

Having ensured that it is safe to start the manoeuvre, the pilot then takes the model off, rises smoothly to the flight level previously selected and hovers forwards for approximately 5 metres, stopping over the centre marker and hovering for about five seconds.

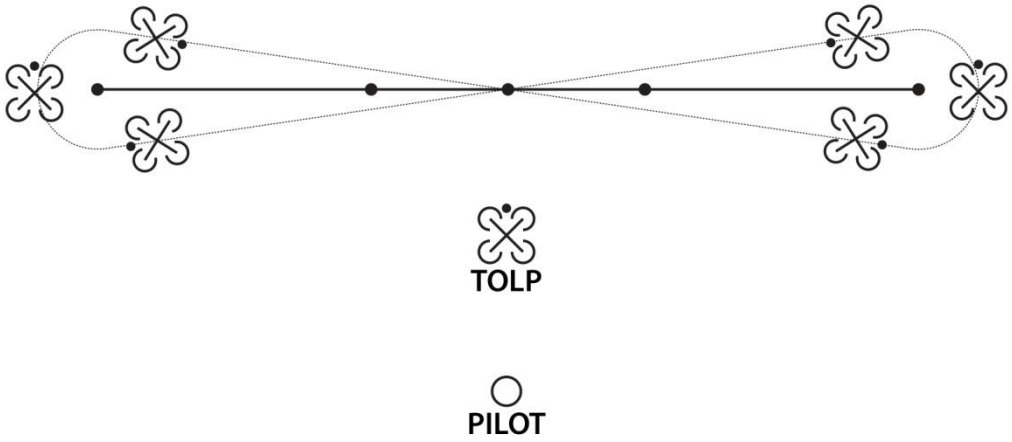
The pilot then turns the model 90_o, either left or right and, at the same time, slowly moves off forward at about a **walking pace** (but still in the hover). It is not required that the 90_o turn is completed before the model accelerates; the turn and acceleration may be one smooth manoeuvre although the pilot may treat them as separate manoeuvres if they wish.

The pilot moves away at his chosen height for a distance of about fifteen metres where they begin a turn the model smoothly through 180_o , flying forward in the hover all the time, and bringing the model back across in front of them. Without hesitation the model continues at the same speed in the new direction until it has flown past the pilot for a further fifteen metres to his opposite side. At this point he smoothly executes another 180° turn, causing the model to be now moving in the same direction as the first leg, again hovering across in front of the pilot.

The model does not stop at this point but it then repeats the events of the first lazy eight until two full eights have almost been completed and the model is near or over the centre ground marker.



During the lazy eights, you will be looking for a safe controlled flight throughout. The candidate should not lose or gain height significantly on the turns and should hover in a straight line between the turns with only sufficient drift on the model to prevent the it from moving either further away or, more dangerously, closer to himself during each leg of the manoeuvre. The **overall** length of each eight should be at least thirty metres and the model must be sideways on to the pilot each time it passes across their front. Some allowance can be made for a strong or gusty wind but the basic points of the manoeuvre must still be demonstrated.



At no time during the manoeuvre should the model be flying sideways. Throughout all the turns and straight flight, it must be flying forward in the hover and not 'crabbing' sideways.

The turns should be made by use of cyclic and rudder co-ordinated correctly, and must **not** be half pirouettes at the end of each leg. The flight pattern should be as the diagram in the BMFA Multirotor Certification Appendix document and not deviate significantly from it. The pilot should be equally competent to the left and to the right when flying this manoeuvre. If any significant difference in their flying skills shows up here then you should seriously consider whether they show the degree of competence necessary. It should be borne in mind that the manoeuvres in the test have been made reasonably simple, so that a fairly high degree of control can be demanded.

(i) At the conclusion of the two 'lazy eights', bring the multirotor to a halt sideways-on over the centre marker. Turn the model until the rear of the model is facing the pilot and hover for about five seconds. From this point fly the model to a landing on the original take off point.

At this point the model should be approaching the area of the centre marker, still at the chosen manoeuvre height, and the pilot should aim to smoothly decelerate the model to a stop in front of and sideways on to himself. The model is then turned to the heading it had before the lazy eights were started and hovered for about five seconds. At this point it should be over the centre marker, about five metres in front of the TOLP and hovering at the standard height.
The model is now flown to a landing at the original take-off point. The path taken is entirely at the discretion of the pilot and you should take the opportunity to watch carefully for a smooth well-thought-out and safe manoeuvre.
After landing, the candidate should shut down the engine/s and allow the rotor blades to stop turning before collecting the model to return to the pits.
Remember that electric models must be assumed to be 'live' until the flight battery has been disconnected and the handling of the aircraft by the candidate must reflect this during retrieval and in the pits area.

(j) Complete post flight checks as required by the BMFA Safety Codes.

These are clearly set out in the BMFA Members' Handbook and BMFA Multirotor Certification Appendix document, but you should pay particular attention to the correct Rx off, Tx off sequence and ensure that the frequency control system in use is cleared correctly.

The Questions

The candidate then ‘must answer correctly a minimum of five questions on safety matters, based on the BMFA Safety Codes for General flying, the BMFA Multirotor Certification Appendix document and local flying rules’

How many questions you ask will depend on the circumstances at the time. For instance, if the candidate has done a good flying test and answers the first five questions with confidence then you need go no further. An acceptable test but with some rough edges can be offset to an extent by the candidate performing well in the first five questions.

A candidate who has done a test which you found only just acceptable and who hesitates on the questions should be asked a few more than five questions and if you are still not satisfied that they have actually read the safety codes, you should no hesitate to fail them.

The achievement scheme is a test of both flying ability and knowledge. It does not matter how well the candidate can fly, if they are unable to answer the safety questions they should not pass.

There is some debate as to whether a list of ‘approved’ questions should be published for examiners to use. Current opinion is that if such a list is published then candidates will also be able to study the list, and will not need to study the BMFA handbook. This is probably not a good idea.

As an examiner, however, you should prepare yourself thoroughly for any testing that you do, and you may wish to sort out your own personal and private list of suitable questions. Do not forget that you can call upon any local rules which you are aware of and that the candidate should know. If you do compile a personal list of questions, do not let the candidate see them.

Remember that the majority of the questions you ask are to be BASED on the BMFA safety codes; you are not expected to ask them ‘parrot fashion’ and the candidate is not expected to answer in that manner either.

This opens up the possibility of asking the candidate if they can think of reasons behind specific rules, for instance, why is the club frequency control system operated as it is and what could go wrong? ; why should models not be hovered out of or into the pit area?

Examiners and Candidates Check List

The following is a short checklist of matters to discuss with the candidate taken from this document. This checklist can be used to ensure that all points raised above have been discussed with the pilot prior to any flights:

1 Has the candidate read: -

The BMFA handbook
Local site rules (if applicable)
'Safety Code for General Flying' and
'Operational Guide, All Models and Radio Control'.

2 Discuss whether the model is suitable in “these conditions”

3 Any “no fly zones” need to be identified

4 Remind candidate to talk you through anything that a helper may do for them as the test progresses

5 Agree any manoeuvre requirements that need to be pre-determined by the Examiner and Candidate prior to the commencement of the test flights

6 Clearly identify the take off / landing point and agree with the candidate the required hovering times that he will be flying and you will being looking for.

‘A’ CERTIFICATE (MULTIROTOR)

Examiners Test Flight Check List

Candidates Name	BMFA Number	Date	Examiner

	FLIGHT TASK	COMMENTS
(a)		Carry out pre-flight checks as required by the BMFA Safety Codes.
(b)		Take off and hover tail in over the take off point, with the multirotor at eye level, for about twenty seconds and then land.
(c)		Take off and hover for about five seconds then hover the multirotor slowly forwards for approximately five metres, stop, and hover for about five seconds.
(d)		Hover the multirotor slowly sideways for approximately five metres, stop, and hover for about five seconds
(e)		Hover the multirotor slowly sideways in the opposite direction for approximately ten metres (five metres past its original position in front of the pilot), stop, and hover for about five seconds.
(f)		Hover the multirotor slowly sideways in the first direction to bring it back to its original position in front of the pilot, stop, and hover for about five seconds.
(g)		Fly slowly backwards, bringing the multirotor back to its original position over the take off point, stop, hover for about five seconds and land.
(h)		Take off and hover forward for about five metres, stopping over the centre ground marker and hover for about five seconds. Turn 90 degrees either left or right and fly forward to perform two ‘lazy eights’, each at least 30 metres in length. Each time the multirotor passes in front of the pilot it must be sideways on to the pilot and throughout the manoeuvre the model must be flying forward, not sideways.
(i)		At the conclusion of the ‘lazy eights’, bring the multirotor to a halt above the centre ground marker, turn the model tail in to the pilot and hover for about five seconds. Then fly to the original take off point, and land.
(j)		Complete post-flight checks as required by the BMFA Safety Codes.
Answer a minimum of five questions on safety matters from the BMFA Safety Codes and local flying rules.		

Appendix 1

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Multi-Rotor types
Multirotors come in numerous variations, sizes and formats, not all of which will be suitable for the multirotor tests. Some use servos to tilt motors, but these should not be confused with tilt shift aircraft.

Bi-rotor
These have two motors only and two servos. Each motor is mounted on a servo controlled pivot. **These are the least stable of the multirotors and are therefore not recommended to use for either test.**

Tri-rotor / Tricopter
As the name suggests these have 3 motors, typically spaced in a Y-shape, with the rear single motor being mounted on a servo controlled pivot.

Quad-rotor / Quadcopter
These are likely to be the most common model used, using four motors and no servos. (This excludes variable pitch models mentioned further down this list) They can be safely flown in either a plus or cross format, this will boil down to what the individual pilot feels is easier to orientate and no preference should be given to either. There will be two motors spinning clockwise and two counter clockwise to overcome the torque effect. By slowing a pair of motors down and speeding up the other pair, the torque effect is used for yaw.

Hex-rotor / Hexacopter
With six motors, these can either have the motors spaced out evenly in a circle or doubled up in a Y-format. Again no servos are used for this format. Hex-rotors offer no more stability than a quad, but do offer an ability to keep flying in the event of a certain motor failures. These will have three motors spinning clockwise and three counter clockwise, when set up as a Y-shape, there will be one motor of each direction on each arm.

Octo-rotor / Octacopter
As per the hex-rotor, these can be set up with all motors in a circle, or set up with double motors as per the plus or cross quad-rotors. As with hex-rotors these offer more resistance to motor failures. These will have four motors spinning clockwise and four counter clockwise. When set up as a quad-rotor format there will be one motor of each direction on each arm.

Variable Pitch Multirotors
These can be any format from above, but are most typically done as quad-rotors as this tends to be the best balance between size and aerobatic performance. In the quad-rotor format a single motor drives four variable pitch rotors, which are intern controlled by servos. This variable pitch approach allows for a motor idle up to be set and sustained inverted flight to be achieved.

Reverse Direction Multirotors
Another recent development has seen multirotors with reversible speed controllers / motors, this allows for sustained inverted flight as the motors reverse when inverted.

Multirotor Flight Modes

All multirotors will require a flight controller for operation, a device which contains a three axis gyro, much like a flybarless helicopter, but with the additional task of taking the radio control signals (Throttle, Aileron, Elevator and Rudder) and converting them in to motor or servo outputs. In order for a multirotor to fly, the flight controller will be making constant adjustments to al parts of the flight train, however it can also offer additional flight modes.

It should be noted that multirotors of all formats and sizes can be fitted with none or all of the following flight modes as part of the main flight controller or in separate units.

Manual

This is the only flight mode acceptable for use in the tests, as in this mode the multirotor is not self stabilised. A continued aileron input for example will see the model continue to rotate around the aileron axis. An easy demonstration to request from the pilot to confirm this is the flight mode in use is to ask the pilot to apply a small aileron input and then release the stick to centre. The model should continue along the new aileron trajectory and not self level, requiring opposite aileron input to stop the slide and return the model to level.

Attitude Mode

Often referred to as ATTI mode or STAB, this is the first of the auto pilot modes. In this mode the model will self level when the sticks are centred and the model will simply drift with the wind if no input is given. In addition full aileron or elevator will only result in the model reaching a maximum tilt of 30-40 degrees and never tipping over.

GPS Mode

Occasionally referred to as Loiter Mode, the model uses GPS to lock its position via satellite. The model will often still accept flight control inputs and behave much like in ATTI Mode, however centering the sticks will see the model stop still in it's position. In this mode the model will also resist external forces such as wind and make corrections to stay still. It is also possible with some GPS equipped models to set waypoints and send the model on its way completely autonomously or have the model 'Return to Home'.

Compass Mode

Often also referred to as CAREFREE mode. This mode works by setting an artificial North. With the model facing in a set direction, entering compass mode will see the model travel along it's new North from forward elevator input irrelevant of which way the model is now facing. Essentially this allows the model to be pirouetted while always travelling in the same direction from forward elevator input. It should be noted that the compass will typically take the front of the model as it's new North when activated, so it is possible for forwards on the stick to become left, right or backwards, depending on which way the model was facing when activated.

Altitude Mode

Some models are also capable or maintaining there altitude.

Multirotor Pre & Post Flight Checks

(A) Checks before daily flying session.

1. Check that all rotor blades are in good condition with no damage and securely attached to the motors or blade grips.
2. Check for loose or missing nuts and bolts.
3. Check all ball links for slop and change as necessary.
4. Check there is no backlash in the drive system apart from gear backlash which should not be excessive.
5. Check that servos are secure.
6. Check that the receiver aerial is secure and in good condition with no chafing or damage.
7. Check that the flight controller is secure and that all aerials including GPS are secure and orientated in the correct direction.

(B) Checks before and after each flight.

1. If the multirotor suffers damage or a heavy landing, recheck all of (A) above.
2. Check all controls before starting especially for binding links or slowing servos.
3. Check for vibration and eliminate before flight.
4. Check that all wiring is secure and cannot become entangled with any moving or rotating part, especially the receiver aerial.
5. Before starting insure all switches are in the correct position for take off and the correct flight mode selected before **EVERY** flight.
6. If planning to use GPS at any point during the flight, confirm that you have a suitable lock before taking off. (Method for this will vary from unit to unit, but is typically by way of a flashing indication LED)
7. Are the multirotors arms secure, especially in the case of collapsible or folding air frames.

Multirotor Additional Safety Considerations

The following is a list of additional scenarios that multirotors can create, but is in addition to standard procedures for electric or i/c models and general safe flying practices. Due to the fast changing nature of multirotors this list should not be considered definitive.

Different multirotors will use a vast selection of propellers from soft plastic, through wood and up to carbon. In all cases the propeller should be suitable for the type and power output of each motor and metal propellers must never be used.

Many multirotors use the frame as a power distribution board, it is important to insure that all wires are secure and that there is no risk of short circuiting.

Multirotors can create more RF interference than the average model aircraft and although the use of ferrite rings might not be necessary with 2.4Ghz radios it is advised to carefully consider the positioning of any and all aerials and wiring.

Multirotors are predominantly electric, so all standard controls of electric models should be applied, especially the consideration that the model is live the moment it is connected. As a result models should not be connected in pits areas or car parks.

Models with GPS can typically be programmed to follow waypoints, at no point may the craft become fully autonomous, in other words the pilot should be in control as all times and capable of taking control and over riding any preprogrammed flight commands with the transmitter. The same applies to the use of the ‘Return to Home’ feature.

Models using Waypoints or Return to Home must consider the flight path of the model and insure no obstacles will interfere with the model, as this type of flight is often ‘As the crow flies’.

Careful consideration must be taken with models with GPS and ‘Return to Home’ features as to where they are connected and or started, as this is often the ‘Return to Home location’ and must be set as a safe area, e.g. a safe distance in to the runway and not the pits or car park.

Currently ‘Return to Home’ may only be used as a flight mode while under control and not set as a failsafe option.

It is not easy to safely restrain a multirotor so when testing the failsafe it is necessary to remove the propellers.

GPS is typically very good at holding a model to within inches of its position, but is only truly accurate to within 5m of latitude, longitude and altitude.

GPS can take time to ‘find itself’, especially on the first initialization of the day, so time should be given to achieve a safe and stable lock before **EVERY** flight.

A descending multirotor is flying through it’s own prop wash and will often ‘wobble’ as it descends. Trying to descend too fast can cause a model to suffer too much wobble creating a tip stall. A great method to avoid excessive wobble is to descend while travelling, e.g. a 45deg descent.

A multirotor with too much gyro gain will oscillate in the air, where as too little will create a model that rocks or drifts excessively.

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