



**A GUIDE TO BASIC BOAT TUNING AND SAIL  
SETTING ON AN INTERNATIONAL ONE METRE  
YACHT**

By

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## **Introduction:**

I began radio sailing about eight years ago as a complete novice to sailing of any kind - bar a couple of trips out in an old clinker built, lug sailed dinghy and playing around with various toy yachts as a school boy, together with a few books on sailing that I read around about the same time. One of the problems that I encountered was the lack of any simple but fairly complete, single source reference for beginners on how to set the sails and tune the boat in order to get it to sail in a reasonably competitive manner. It wasn't that fellow radio sailors were unwilling to help it was just that I lacked any written reference that I could go back to time and again when things didn't seem quite right. Of course I could never have compiled this list of what I hope is helpful information were it not for all the help, advice and encouragement I received, either through written publications or face to face contact, from many experienced and expert radio sailors. Among those who have been kind enough to encourage me with my radio sailing and share their knowledge are; Graham Bantock, Brad Gibson, Lester Gilbert, Peter Stollery, Martin Roberts and Geoff Byerley and what follows is a sort of montage of all the bits of information that I picked up from them together with a few things that I discovered for myself. By following my suggestions you should be able to rig your boat, tune it and set the sails so that it performs well enough for competitive racing at club level. Use the information as a starting point but experiment and try different things for yourself; read and research more and talk about boat set up, sail trimming and tuning with other sailors, especially those that always seem to beat you. It is of course important to practice racing as much as possible and experience serious competition in order to improve and progress because the best set up boat in the world won't win much if the man at the controls keeps making the wrong decisions during the race. Above all remember that racing is enjoyable and beats painting and decorating, gardening, shopping, watching TV or cleaning the car hands down. Have fun!

What follows is primarily about the IOM class but the general principles will apply to other classes of yachts.

## **First – you need to attach the rig to the boat:**

1. I suggest keeping the jib sail attached to the mast whilst the sails are stored off the boat, (preferably in a sail box) then provided you don't move the forestay bowsie the degree of mast rake will be preserved and the back stay will need only minor adjustment next time you sail.
2. Fit the fin, complete with ballast, to the boat and place the boat in a stand (be careful it doesn't blow over in the breeze) or lay it on the ground.
3. If you are right handed and rig your boat from its left hand side; take the rig from its box or bag, holding the bottom of the mast and main boom/kicker in your right hand, and the jib boom in your left so that you keep control of both sails and they don't flap in the breeze. Allowing the sails to flap uncontrollably could damage and crease them badly.
4. Place the mast heel in the mast tube making sure it is properly located.
5. Locate the mast in the mast gate and/or let it rest against the ram.
6. Check that the headsail leech line and forestay are not twisted and then attach the headsail boom to the appropriate deck eye.
7. Attach the backstay to the hook or eye at the stern of the boat and if necessary adjust the tension in it until the mast bend matches, approximately, the mainsail luff curve. If the top seam of the main sail begins to flatten or if creases run from the clew diagonally upwards the mast is over bent and the tension in the backstay should be reduced until the sail sets correctly. It may be necessary to revisit backstay tension later in the tuning cycle.
8. Attach the side stays to the appropriate deck eyes. I think it is best if the bottom part of the bottle screw is permanently attached to the deck eye. The threaded, upper part of the bottle screw should be fitted with a self-locking, nylon-lined nut and permanently attached to the side stay. As a rough guide, begin by putting just enough tension in the side stays, so that when the boat is laid on its side, the side stay nearer the ground doesn't become slack. Later you may need to change this slightly in order to obtain the desired rig tension, mast shape and boat performance. When you are satisfied that the side stay tension is about right, lay the boat on the ground, propped up by a sail box or tool box, or put it in the sort of stand that holds the boat at a shallow angle, and sight down the mast to ensure that it is vertical and not pulled off to the left or right. At the same time check that the head fitting and backstay crane are correctly aligned. If the mast is, for example, pulled off to the right, relax the tension on the right hand side stay and increase the tension on the left hand stay until the mast is vertical. Check that the side stays are still at the correct tension and if necessary go through

the procedure again until the mast is vertical and the tension in the side stays is correct. The side stays should be tight enough to avoid the slackening as described above but not so tight that they twang like guitar strings. If you want to temporarily reduce the tension in the side stays, for light airs or for some other reason, simply insert one or two washers between the bottle screw and lock nut before assembly. It is worth experimenting with side stay tension, especially when the deck mounting points are aft of the mast, because of the effect it has on rig tension, mast bend and the way the main sail sets. Tightening the side stays will pull the centre of the mast back and increase the tension in the forestay. Slackening the side stays will have the opposite effect. If doubtful about just how tight to have them, I suggest that it is probably better to have them a little bit loose rather than too tight. Once the correct setting is achieved the rig can be detached from the boat after sailing, leaving the nylon lined locking nuts undisturbed, so the same settings can be used again next time. It is essential that the side stays are evenly tensioned and the mast vertical (left and right) if the mainsail is to have the same amount of twist on both tacks. Side stays - especially new ones - will stretch and become loose and/or unevenly tensioned with use, so it is important to check them from time to time.

9. Attach the sheets to the main and jib booms.
10. If your mainsail has a luff wire don't over tension it because this may cause strange wrinkles to appear in the sail and it will interfere with the movement and set of the main sail when changing from tack to tack.
11. Tighten the downhauls on the jib sail and main sail just enough to remove any wrinkles or bubbles in the luff of each sail. For very light airs try leaving the downhauls and the luff wire in the main sail, slightly slack.
12. Start with the mast ram just supporting the mast. You may need to come back to the ram later when doing the fine tune.
13. When dismantling your boat at the end of the day simply reverse the above procedure and be sure to take all of the tension out of the rig by slackening off both down hauls, the luff wire tensioner in the main sail if your boat has one, and most importantly the kicker. Failure to do this will have the sails stored under tension with the strong likelihood that they will become permanently distorted and pulled out of shape. If after use the sails are wet, the sail box should be opened on your return home and the sails allowed to hang free so that they can dry out. If a bag is used the sails must be removed from it and allowed to dry.

**Now that you've got the rig safely on the boat you need to set the amount of camber in the foot of each sail, the distance each boom is out from the centre of the boat, in the close hauled position and the degree of twist in each sail.**

- I. The main boom should be about 15mm (+ or- 5mm) from the centre of the sheeting post in the close-hauled position.
- II. The end of the jib boom should be about 65mm away from the centre of the mast in the close-hauled position (+ or – 5mm).
- III. The gap measured between the mid point of the boom and the foot of the sail should be about 20mm for both the jib sail and main sail (+ or - 5mm).
- IV. To set the twist in the sails: Let the sails fully out and hold the boat in the wind so the sails fill as if the boat were on a run. Adjust the kicker so that the middle seam on the mainsail is at approximately 90 degrees to the mast. This is the correct setting for running before the wind and it is important to get this right. Keep in mind that the wind strength may not be the same on shore as it will be out on the water and that you are holding the boat stationery, this means that a little more twist may need to be set than seems correct. The final check must be done on the water with the boat sailing. Lay the boat down and check that the masthead fitting is straight fore and aft and not twisted off to one side. This will ensure an equal amount of twist in the mainsail on both tacks. With the boat still lying on its side, sheet in to the close hauled position and hold the main boom on the centre line of the boat without loading the kicker. Measure the distance between the middle seam of the mainsail and the backstay. I suggest that it should be somewhere between 40mm and 60mm. Twist can be increased by tightening the backstay slightly (be careful not to over bend the mast) and/or reducing the amount of ram pressure on the mast. Slackening the backstay slightly and/or increasing the ram pressure can reduce twist. It isn't good practice to alter twist in the close-hauled position by adjusting the kicker because this will probably result in the amount of twist being wrong for running before the wind. For this method of setting and controlling twist to work well it may be necessary to introduce some packing between the bottom end of the gooseneck body and the mast at the time the rig is built (a couple of layers of tape or deck patch material about 5mm wide will usually do the job). As a general rule, in flat water and steady winds less twist can be used. As the wind becomes more gusty and/or the water rougher, it is usually beneficial to increase the amount of twist. Similarly when sailing in very light or fluky air more twist is usually better. Try setting the gap between the centre seam and the backstay at 50mm for a start and see how the boat sails. If in any doubt or if the boat seems sluggish, set more rather than less twist.

- V. With the boat still lying on the ground, adjust the jib leach line until the gap between the mid point of the jib sail leech and the leech line is 20mm to 40mm. Less in flat water and steady breeze, more in choppy water or strong winds. When viewed from the front or back of the boat, both sails should show a similar degree of twist. Once again if there is any doubt or the boat seems sluggish, set more twist. There does seem to be a correlation between the distance the booms are from the centre line of the boat at close hauled and the amount of twist required; if the booms are tight in then it seems that more twist is needed to get the boat to perform well, on the other hand if the booms are set a little freer (further out from the centre line at close hauled) then less twist is needed. It seems to be a bit of a balancing act - experiment and make notes.
- VI. After a good days sailing when your boat has performed well, record in a little note book the weather and water conditions and the basic settings: - wind strength, choppy or smooth water, the gap at the foot of the main sail and jib sail, the distance between the centre of the sheeting post and the main boom, between the centre of the mast and the end of the jib boom and the amount of twist in each sail. After a time you will build up a picture of how to set your boat up for the various conditions you will encounter and this will help you to quickly achieve a good setting each time you are on the water.

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## OTHER IMPORTANT FACTORS WHICH AFFECT THE PERFORMANCE OF YOUR BOAT

- a) **Bulb Cant.** This is the amount the nose of the lead ballast is tilted upwards in order to minimise drag and it is generally agreed that about 2 degrees is right. Sometimes the boat builder fixes this and no adjustment is possible. However if the ballast is attached to the fin by a single central stud and nut, the amount of bulb cant can be adjusted by inserting shims, such as flattened crimps, between the bottom of the fin and the bulb. At the rear end to tip the nose upwards and at the front to tip the nose downwards.
- b) **Mast Rake.** The position of the mast is usually determined and fixed by the designer but the amount the mast is raked back is also very important because it is the primary factor governing the 'balance' of the boat and the amount of weather helm/ lee helm it displays. Raking the mast back moves the centre of effort of the sails back. The more the mast is raked back, the more the boat will tend to turn up into the wind, and this is called 'weather helm'. If the mast is not raked back far enough then the boat will fall off or bear away from the wind, this is called 'lee helm'. A certain amount of weather helm is often considered desirable because it means that when *small* amounts (no more than 5 degrees) of corrective rudder are used it produces lift in the same direction as the fin – to windward. Lee helm means that corrective rudder increases the load on the fin and consequently the leeway. However some sailors do prefer a neutral helm. Experiment and decide for yourself, which works best for you. Change mast rake by taking the entire ram off the mast and then adjusting the forestay and backstay to increase or decrease the amount the mast is raked back. Some boat designers/builders will supply measurements - usually taken between some point on the mast and the transom or bow - and this takes the guesswork out of the process. Alternatively and as a rough guide you can apply the following: Rig No.1, – 1degree to 2 degrees of rake; Rig No.2, – 2 degrees of rake; Rig No.3, - 4 degrees of rake. Finish rigging the boat, setting it up as above and then set it on a close hauled course to windward and see how it sails; if she bears off, falling away from the wind, then the mast needs to be raked further back. If she turns strongly up into the wind and the sails flap (luff) then the mast needs less rake, if she sails steadily to windward without showing any signs of weather or lee helm then the boat is 'balanced' and has neutral helm. You may decide that this works best for you, However if you prefer a small amount of weather helm, the mast will need to be raked back just a little more. You need to establish mast rake for each of the suits of sails allowed by the class rules and once these positions are determined measure the distance from the headsail stay limit mark to the rear most edge of the boat and record it for future reference. Don't disturb the forestay and backstay bowsies when de-rigging, and you can easily reproduce the settings each time you sail. Once a basic

mast rake setting is established for each rig I would suggest leaving it alone and not fiddling with it on a day-to-day basis. Minor adjustments to the balance of the boat can be made to account for stronger or lighter winds by changing the amount of twist in the sails and the relative sheeting angle of the main and jib. Sheeting the main sail in and the jib out will increase the amount of weather helm; sheeting the main out and the jib in will have the opposite effect. Similarly, less twist in the mainsail will increase weather helm and more twist will decrease it.

- c) **Mast pre-bend and mast bend.** Masts are usually given a certain amount of permanent forward bend or set (pre-bend) so that when the back stay is adjusted to set the main sail correctly, there is more tension between the backstay and forestay than would be possible with a straight mast. Tension in the forestay reduces sagging, and enables the boat to point higher than it otherwise would (pointing high means the boat will sail very close to the wind when on a beat to windward). The curve in the mast, rigged and under tension, should match the curve in the luff of the main sail. This allows the sail to set properly and fall easily into its designed shape. The shape of the mast is controlled by the tension in the forestay, backstay and side stays, the angle of the spreaders and the amount of pressure exerted by the mast ram. The side stays will have more effect on mast bend if the side stay anchor points on the boat, are set aft of the mast, transferring some of their tension to the forestay, which reduces or eliminates the need for pre-bend in the mast. The ram is used to control the bend in the lower part of the mast, the amount of twist in the mainsail and the fullness in its lower part. It is important to follow the directions of the sail maker concerning mast pre-bend; some sail makers cut their sails for straight masts, some require a small amount of pre-bend and others specify a quite significant amount of pre-bend. Usually the No.1 rig will require more pre-bend than the No.2 rig and the No.3 rig very little or possibly non at all. This is because the shorter masts of the 2 and 3 rigs are inherently much stiffer than the mast of the No.1 rig.
- d) **Luff ties.** It is important that the ties securing the luff of the mainsail to the mast are not too tight. A good way to achieve this is to ensure that a 2mm or 3mm drill bit - or a matchstick - can be inserted between the luff of the sail and the mast at the position of the tie. Be aware that dyneema and other tie materials will have to be replaced from time to time as they shrink and become too tight.
- e) **Masthead crane.** The mast head crane should always be as short as possible - only just long enough that the back stay clears the leach of the main sail with the main boom on the centre line of the boat. This ensures maximum rig tension fore and aft.



- f) **Spreaders.** The length of the spreaders should be around 55% - 60% of the beam of the boat. The designer of the boat should provide exact lengths. Spreaders are usually fitted to the number 1 and 2 rigs only. With the side stay mounting points aft of the mast, the degree to which the spreaders are angled back affects the amount of bend in the middle of the mast, so it is worth experimenting with this to get the sail to set nicely. Take care that the spreaders are angled the same each side.
  
- g) **The sheeting radius.** The sheeting radius is the distance from the boom pivot point to the sheet fairlead. The sheeting radius of the jib boom should be about 10% more than that of the main boom. The designer of the boat should provide exact dimensions. This is because at close hauled the jib is further out than the main, thus to maintain the balance between jib and main, the jib should travel in and out more slowly. Most IOM's have a main boom-sheeting radius of about 200mm and in this case the jib boom sheeting radius would need to be about 220mm.
  
- h) **The jib boom pivot point.** The jib boom pivot point is usually in the range of 20% - 25% back from the front of the jib boom. Again the designer of your boat will provide exact dimensions. This helps achieve high forestay tension as the tension from the backstay and side stays feeds into it. More tension in the forestay also puts more tension in the leech of the jib sail preventing the clew of the jib lifting too much in strong winds.
  
- i) **Flattening the sails.** When the wind strength is near the top of the range for the rig in use it can be helpful to de-power the rig by flattening the sails and increasing the amount of twist. Both the main and jib can be flattened to some degree by using the outhaul adjustment at the end of each boom. Increasing the tension in the backstay can further flatten the mainsail. Look at the top seam of the mainsail as you increase the tension in the backstay and you will see the point at which it begins to flatten off. Easing the pressure exerted by the ram will allow the lower part of the mast to move forward causing the bottom of the sail to flatten off slightly, but be careful not to relax the pressure on the ram so much that it is no longer controlling the mast at all. Increasing the tension in the backstay and relaxing the pressure exerted by the ram will also increase the amount of twist in the mainsail. Twist in the jib sail should be set to match that in the mainsail. This is just a quick fix and if the wind strength increases significantly the correct and sensible thing to do, in order to remain in proper control of your boat at all times, is change down to a smaller rig.
  
- j) **Corrector weights.** Most one metre boats need extra weight fitted into the hull to bring them up to the minimum weight allowed by the class rules. This weight is usually best placed low down in the bottom of the hull, either side of the fin box. Strips of lead flashing make suitable weights and these strips should be covered in deck patch material and then stuck in the boat using clear silicone sealant. Don't stick the

weights in with epoxy or similar glue because it may be necessary to remove them at some time in the future if a different rig, mast, winch or battery is used. Follow the recommendations of the designer/builder of your boat regarding the positioning of any corrector weight if it is different to the above. It is vital that your boat floats on it's designed water line if it is to perform to it's maximum potential and the best way to check this is by floating the fully rigged boat, complete with batteries and radio gear in a tank of water. Your measurer might be willing to do this for you if you don't have a suitable floatation tank.

More useful information on sail setting and tuning can be found here:

SAILSetc website; <http://www.sailsetc.com>

Lester Gilberts Radio Sailing website; <http://onemetre.net/index.htm>

And in the following books:

The Physics of Sailing Explained by Bryon D Anderson,

Sail Trim Theory and Practice by Peter Hahne Sail and

Rig Tuning by Ivar Dedekam.

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# Glossary of Model Yachting Terms

Definitions given in this glossary are simplified versions.

Words in **bold** and *italics* refer to standard definitions given in ISAF Equipment and Racing Rules of Sailing respectively.

APPENDIX E - part of ISAF RRS governing radio racing

BATTEN - **sail** stiffener

BEAM - the widest section of a hull

BEATING - sailing as close as possible to the wind

BOAT - **hull, hull appendages, ballast, rig, sails**, all parts used for *racing*

BOOM - **spar** attached to **foot** of **sail** used to alter sail shape and angle

BOTTLESCREW - adjustable **rigging** screw used to tension **shrouds**

BOWSIE - plastic or metal device for adjusting lines

CERTIFICATE - proof of measurement, rule compliance prior to *racing*

CONTROL AREA - specified area where competitors may walk to control **boats**

CRIMP - compressed brass ferule used to terminate **rigging** wires

CUNNINGHAM - device to adjust **luff** tension on **sail**

CLEW - rear bottom corner of **sail**

CLASS ASSOCIATION - body of owners that controls **class rules**, activities etc

CLUB - key local unit promoting model yachting

DRAUGHT - depth of **boat** below water surface

EVENT - number of races sailed within a set racing time

EYELET - metal reinforcement to form sail **attachment**

FLEET - all **boats** entered in an event

FOOT - bottom edge of **sail**

FREE SAILING - vane steered match racing, with spinnakers downwind

GOOSENECK - swivel mechanism to attach main **boom** to **mast**

GOOSEWINGING - sailing downwind with mainsail and headsail on opposite sides

HEAT - division of a fleet to get manageable numbers of **boats** on the water

HEAD - top corner of sail

HEADER - change in wind direction that causes a boat to sail below its heading

HEADSAIL - also known as jib, sail set in front of mast

HMS - MYA's Heat Management System for racing large fleets in heats

HOUNDS - point where shrouds attach to mast

HULL - the shell partly above & below water keeping water out, & all fittings, gear

IOM - International One Metre class

ISAF - International Sailing Federation, world authority for sailing

IRSA - International Radio Sailing Association

KEEL - a **fin** with **ballast** below **hull** to resist leeway and provide stability

KICKER - device for controlling the **leech** of a **sail**

LAUNCHING AREA - specified location for launching **boats**

LAYLINE - Course a close-hauled boat steers to just pass the windward mark.

LEEWARD - side of a **boat** away from the wind

LEECH - back edge of **sail**

LEECH LINE - adjustable line at leech to set shape of back of **sail**

LIFT - change in wind direction that allows a **boat** to sail above its heading

LINE BIAS - angle that start line differs from square to wind direction

LUFF - front edge of **sail**

MAINSAIL - **sail** set on and behind **mast**

NOR - Notice of Race, event organiser's descriptions, rules, conditions & facilities

OFFICIAL MEASURER - a person accredited by MYA

PERSONAL SAIL NUMBER - number issued by MYA/NCA to a member for use on all his/her **sails**

PIN END - outer mark of start line relative to the control area

RACE - a sailing competition in a single fleet or in heats

RHUMBLINE - straight line course between 2 marks.

RIG - combination of **spars** and **sails**, ERS definition is just **spars, rigging**, fittings etc

RO - Race Officer, person in charge of *racing*

RM - Colloquial term for International Radio Marblehead class Ditto for RA, R10R, R36", R6M classes

RRS - ISAF Racing Rules of Sailing governs behaviour, *rules* for all sailing **boats**

RUNNING - sailing a course directly downwind

SAIL NUMBER - last 2 digits of registration number or 2 digit personal number

SAIL TWIST - the difference in the chord angles between top and bottom of the **sail**

SEAM - bonded overlap of **sail** panels to create 3D shape

SEEDING RACE - first race of an event to divide the fleet into heats

SHEERLINE - the line of the junction between hull and deck

SHROUD - wire rigging attached to deck edge to support **mast**

SSI - Standard Sailing Instructions published by MYA to control events

SWING RIG - two sails of balanced areas set on a yard rotating on or about **mast**

TACK - forward bottom corner of **sail**

VANE GEAR - wind operated device for steering a selected free sailing course

WINDWARD/LEEWARD - marks set to form sausage shape course

WINDWARD - side of a **boat** towards the wind

# The Anatomy of the Radio Controlled Yacht

(Not any specific Class)

