Royal Ocean Racing Club
Rating Office

IRC

MEASUREMENT MANUAL

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IRC MEASUREMENT

1. General

This version, IRCMEAS08-1, has been revised and re-issued in January 2008. Little has changed from the previous version. Significant changes are marked by a left marginal sidebar.

The guide is intended to ensure good and consistent measurement practice by IRC measurers both within UK and abroad. In addition to describing each measurement, some of the common mistakes and errors are noted.

While the term 'measurer' will be used throughout, this should be taken to include 'official' (both RORC and other) measurers and also owners self measuring their own boats.

Official measurers should note the following:

> Bear in mind that you are measuring a boat for the owner, BUT on behalf of the rest of the fleet. The aim is thus to achieve a fair and accurate result, rather than the optimum result for the particular owner. These are not necessarily one and the same.
>
> A professional approach and attitude is also very important. The owner is paying for your services, and wants to have confidence in the measurements you take, both on his own boat and also on his competitors' boats. This cannot be emphasised sufficiently; whilst the owner you are dealing with may be scrupulously fair, he is certain that his opposition are anything but. He needs the confidence that you will not let them get away with it! In this context, if you are not sure REFER TO THE RULE BOOK OR CONTACT THE RORC RATING OFFICE (via your National Authority if appropriate) FOR CLARIFICATION.
>
> Always explain what you are doing and show the owner the outcome, particularly if it is not in his favour! He is going to get an unpleasant surprise anyway when his certificate arrives; better that he should know there and then and understand why.

In the particular case of measurement for Endorsement, owners should contact the Rating Office first. We will advise what measurement is required and direct the owner to an official measurer.

The Rating Office has now published a guide to the measurement standards and methods required for issue of an endorsed certificate. This together with other relevant information is available from our website www.rorcrating.com.

A lot of what follows is (or should be!) self evident. It is nevertheless worth inclusion.

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2. Equipment

With the exception of weighing, nothing complicated is needed! If full measurement is the target, the following will be required. Other bits and pieces may also be desirable.

Essential:	Steel tape measures:	5m and 30m
	Wooden (floating!) rulers:	1m and single hinge 2m
	Spirit level with 45^0 bevel:	0.5m (minimum)
	2 plumb bobs	
	Sundry string	
Desirable:	3, 8 and/or 10m steel tape measure	
	2m multiple hinge wooden ruler	
	2 more plumb bobs	
	0.15m - 0.20m spirit level	
	Callipers	
	Basic tools: pliers, screwdriver, PVC tape	

3. Accuracy

IRC rule 19.8 now includes MHW, MTW, HSA, SPA, y, x, and h. It requires that for a successful rating protest, the following levels of inaccuracy must be found:

P, E, STL, LOA, LWP, Beam, Draft, FL, LLmax, J, LP, MHW, MTW:	1%.
HSA, SPA:	2%
y, x, h:	5%
Weight:	The lesser of 5% or 200kg.

The rider is added that for the protest to succeed, the error must also favour the boat. This then gives basic accuracy targets.

However, the measurer's aim must always be to achieve the best possible result. In this context, and for an ENDORSED certificate, a target accuracy of +/-10mm for linear dimensions and 50kg for weight should be the measurer's MINIMUM standards.

In a few instances in the past, attempts have been made to take the above protest limits as measurement ‘tolerances’. In other words, measured linear dimensions are adjusted by the protest limits above. This is NOT the purpose of the above. They are what they say: protest limits. Nothing more nor less. Measurers should report the actual measurements found

It should also be noted that in the case of a 'composite' measurement, (LWP for example), the final accuracy is dependent on the accuracy of the component parts. To demonstrate: if LOA, BO and SO all have errors of 50mm, then LWP could be in error by as much as 150mm. Unlikely perhaps, but to be borne in mind by the measurer.

This issue is relevant also to the equipment used. When weighing for example, ensure that the accuracy of the equipment is sufficient. The Rating Office has six load cells, one rated up to 1 tonne, one to 7.5 tonnes, one to 10 tonnes, one to 12 tonnes, and the other two to 20. Each has a quoted accuracy of +/-0.2% of full scale, ie +/-2, 15, 20, 24 and 40kg respectively. As a

rule of thumb, a load cell should not be used to weigh a boat with a weight of less than a MINIMUM of 15% of the cell's capacity. Inevitably, this ‘rule’ has to be breached on occasion.

4. Techniques

Please note the following pointers to good measuring practice:

Ensure horizontal measurements are actually horizontal. For instance, when measuring from a reference point to a plumb line, hold the end of the tape on the reference point and arc the tape at the string looking for the minimum figure.

Ensure vertical measurements are actually vertical. For instance, when measuring draft ashore, allow the tape to hang freely. If it does not hang above your lower reference point, move so that it does.

When measuring to a plumb line, hold the tape behind the string. The required measurement is then clearly marked by the tape.

NEVER measure between two plumb lines, always between each plumb line and an intermediate FIXED reference point.

Be very aware of the environment, particularly the effect of wind and/or current on plumb lines and free hanging tapes. On a windy day, use a weight to steady the tape.

Never attempt to identify the waterline (eg for draft or overhangs) by reference to for example discoloured anti-fouling. this is firstly inaccurate in itself, and secondly may be misleading if the boat is not in the correct trim.

Whenever possible repeat a measurement, including any setting up. This practice is a good example of not only doing a good job, but being seen to do so by the owner. His confidence will be affected not by your measurement but by the presentation of your measurement.

5. Previous Measurements

Many boats will have had either IMS, IRM or other certificates in the past. WITH CARE, some of the figures on the latest of these will be directly useable. Others will require checking. In general, hull and spar measurements will not have changed, unless the boat has been modified. Others, such as sail measurements will often need physically checking. The following may be used as a guide:

	IRC	IRM/IMS	Comment
Values likely to be unchanged:	LOA	LOA	
	Beam	BMax	Unlikely to change, but has been known.
	Engine weight	EW	
	Foretriangle base	J	
Values which may have changed:	Spinnaker tack length	STL (SPL)	
	Mainsail hoist	P	
	Mainsail foot	E	
	Draft	D	May have changed, either as result of keel modifications or re-ballasting.

6. Weighing

The weight of boats causes possibly the most dispute of any measurement; while an apparently simple procedure, it occasionally results in wildly anomalous figures. In most cases, this can be ascribed to inadequate weighing equipment. When weighing for ENDORSEMENT purposes, measurers should refuse to use a load cell that has not been cleared by the Rating Office or the local MNA. Obviously, one of our own load cells is to be preferred whenever possible. Experience over the years has shown that weighings using Rating Office or locally officially sanctioned equipment are close to 100% reliable. When other load cells are used, of the order of 50% of weighings are subsequently proved to be inaccurate!

The RORC Rating Office's preferred method of weighing is hanging the boat from a single point beneath a load cell. An alternative acceptable method is the use of 3 or 4 compression load cells to weigh the gross weight of the boat in a travel lift or cradle. By then deducting the weight of the travel lift/cradle, boat weight can be found. This method can produce good results, but is more susceptible to error by way of missing straps, and other equipment. It is also a composite measurement, with all the inherent possibilities for error. Good measurement practice is essential. Please see Appendix 1 and discuss the method intended with the Rating Authority before going ahead.

What is **NOT** acceptable is recording the load in each sling of a travel lift by either load cell or the travel lift's in-built equipment. The latter particularly has been shown to be capable of errors of up to 50%! The former is erroneous to the extent that the slings are not vertical, either athwartships or fore and aft. Simple geometry shows that very small errors in sling angles rapidly combine to produce gross errors.

There are also a number of traps the measurer can fall into.

It is absolutely essential that the boat is EMPTY (see IRC rule 22). The measurer must be pedantic, inspecting every locker, lifting every board, and insisting on the removal of EVERYTHING, down to the toilet rolls.

Among things to watch for are:

- Bilges full of water.
- Mainsail on the boom.
- Anchors 'forgotten' under bunks.
- Water and fuel. Watch for second (and third and fourth....!) water tanks.
- Chart tables full of charts and other rubbish.
- Safety gear: horseshoe rings and Dan buoys on the transom.
- Gas bottles (and spares!).
- Fire extinguishers.
- Additional internal ballast.
- Fenders and mooring lines as the boat is lifted.

Do not treat the above as exhaustive. Vigilance is the only answer.

Water tanks should be pumped dry. Fuel is more difficult and it is acceptable to deduct a known weight of fuel from the gross weight. If doing the latter, 2 means of estimating quantity should be sought. For instance a fuel gauge, and a measurement of tank volume together with either dipping the tank or a sight glass. Diesel has a specific gravity of 0.8, ie 1 litre weighs 0.8kg.

The only loose items aboard should now be fitted (but not necessarily fixed) bunk cushions, loose bunk boards, floor boards and washboards, and spinnaker pole(s). Make a note of the number of loose cushions for our records. Note also the number, identification if possible, and size of

batteries. In the case of production boats any deviations from standard, eg addition/removal of furniture such as doors and tables should also be noted.

Having emptied the boat, the weight of lifting gear below the load cell (ie spreader bars, straps, shackles, etc.) must be found for deduction from the gross weight. Unless using an internal centre lift point, the slings should first be immersed. On some load cells (not the RORC cells), this weight can be tared out. If not, note the reading for later deduction.

The boat should now be weighed twice, with all weight removed from the load cell between weighings. If any significant (+/-10kg) difference is seen, STOP AND FIND THE PROBLEM.

Re-weigh the strops etc. to check finally that nothing has shifted. Again if any significant difference is seen STOP AND FIND THE PROBLEM.

Be rigorous in recording everything, and input all weights, notes and comments to us. Please do NOT 'adjust' the figures.

So what goes wrong? Obviously, equipment still aboard will not help! There are however also many more subtle things.

Wind and rain can have noticeable effects. Directly, wet decks and topsides can hold significant quantities of water. Wind will also always increase the figure read.

The shackles for the RORC load cells are carefully sized, not only for strength, but for match to the holes in the load cell. If sufficient freedom of movement is not allowed, any torsion or twist when lifting will be directly transmitted into the load cell, giving a potentially erroneous answer.

Load cell battery level is also important. If in doubt, change or charge the batteries.

When noting the weight of strops etc, read the sign (+ or -) on the display. NEGATIVE VALUES ARE QUITE POSSIBLE IF THE DISPLAY HAS NOT BEEN ZEROED BEFORE USE.

7. Hull

7.1 LOA

This is best done ashore with the boat set up level to the waterline fore and aft. Hang plumb bobs on the centreline over the bow and stern. Measure from a convenient point on the keel or underbody to each plumb line and total for LOA.

DO NOT: Include pulpits, pushpits, stemhead fittings, runner/backstay tangs, bowsprits, etc.

DO NOT: Measure LOA with the boat out of level fore and aft. You will get the wrong answer! On occasion, measurers may find that a boat has been deliberately levelled bow up to minimise measured LOA. Measurers are quite within their rights to require that the boat be re-levelled.

If necessary, LOA can be measured afloat by dividing the boat into convenient sections, measuring each and totalling. Eg: (Stem to mast) + (mast) + (mast to forward face of cockpit), etc. If doing this, BE CAREFUL and check that reference vertical surfaces are actually vertical.

7.2 Beam

Inspect for maximum beam station by sighting from off the boat. It is very desirable to do this from both ahead and astern of the boat if possible. It is easy to be fooled by the shape of the boat! Maximum beam is nearly always further aft than you think! If in doubt, check several stations to find a maximum value.

Having found the right station:

If afloat: Using a level held vertically at the point of maximum beam (ignoring rubbing strakes) measure inboard to a convenient point on the deck of the boat. Repeat from the other side.

If ashore: Hang plumb bobs at the required station and measure in from each to a reference point on the hull or keel. Again, NEVER measure directly between two plumb lines.

7.3 Draft

The boat will need to be seen by the measurer both ashore and afloat. It doesn't matter which is first. As with overhangs, draft is measured in empty (ie weighing) trim.

Ashore: Ensuring first that the boat is in level trim, establish a convenient reference point on each side of the boat above the waterline in way of the section at maximum keel depth. Using a spirit level, project horizontally from the underside of the keel outboard to vertically below the reference point each side. Measure vertically down from each reference point. Alternatively, if available, a surveyor's level may be used.

If measuring a drop keel boat, measurements will be needed with the keel fully up and fully down.

Afloat: Ensure first that the boat is in the "Empty Weight" condition (IRC rule 22), that everybody is off the boat(!), and that she is in level trim both fore and aft and athwartships.

Using a wooden ruler, measure vertically downwards from the reference point each side to the water surface. By subtraction from the ashore figures, and then averaging the results, draft is found.

7.4 Overhangs

Please refer to the attached diagrams before taking any measurements. Before an IRC certificate can be issued we require BO, SO, y, x, and h for EVERY BOAT.

The boat should first be inspected to ensure she is, as required by IRC rule 23, in the Empty Weight condition (rule 22).

Bow overhang is usually straightforward. Stern overhang can be difficult! These measurements can only sensibly be taken in still water. Any current will offset the plumb line positions; even small waves can make an accurate stern overhang measurement very difficult.

Note that on boats with skegs, stern overhang is measured to the intersection of the actual hull (the canoe body) with the water, ignoring the skeg.

Hang a plumb line over the bow and stern, ensuring that they are on the centreline and do not include any hull fittings.

Bow (BO): Using a floating ruler, position one end of the ruler against the bow at the waterline. Pivot the rule about this point towards the plumb line. REPEAT AS MANY TIMES AS IS NECESSARY TO ACHIEVE A CONSISTENT RESULT.

Stern (SO): Measurement can be difficult, particularly with modern designs with transoms low to the water. A dinghy or float is essential with an assistant to hold this in position. As with the bow, position the end of a floating ruler against the required measurement point and pivot the ruler about this point towards the plumb line, REPEATING AS MANY TIMES AS NECESSARY TO ACHIEVE A CONSISTENT RESULT.

y: In all cases, the dimension 'y' should also be supplied. Measurement is straightforward.

x and h: If the boat has a flying bow, measure also x and h. The diagrams define the exact measurement points. x can be awkward to measure. h is straightforward once the measurement point has been established. If there is no flying bow, please say so and input 0 figures for x and h.

8. Spars

Spar and rig measurements are straightforward. P and E are exactly as other rules, with the exception that if there are no black bands, P is measured from the top surface of the boom or boom track to the halyard shackle pin when the halyard is fully hoisted, and E is measured from the aft face of the mast to the extremity of the boom.

For 2007, the definition of P has been amended to read:

P *The hoist of the mainsail measured on the mast, from the top of the boom when set at right angles to the mast, or the mainsail tack whichever is the lowest, and the bottom of a 25 mm band of contrasting colour at the top of the mast above which the mainsail shall not be hoisted. If there is no band the measurement shall be taken to the top bearing surface of the halyard shackle. In the case of a gaff rig, the upper measurement point is the head of the mainsail at the peak or the head of the topsail if carried.*

In other words, all reference to a band at the boom has been removed. P is measured to level with the top of the boom

For ENDORSED certificates, hoisting a tape on the main halyard and 'eyeballing' its position from deck level is NOT acceptable. If the rig is up, sending a man aloft with the tape is the only method.

FL can be a little more complex depending on the detail of the forestay attachment. What we are after is the point where the centreline of the forestay intersects the front wall of the mast, or would if extended. The only exception to this is a masthead rig where the upper limit is the top surface of the mast. The attached diagrams show the various possibilities. Again someone will need to get into the bosun's chair for Endorsed certificates.

At the bottom of the forestay, the measurement point is local deck level. The diagrams attached demonstrate the point.

J is exactly as IRM/IMS, ie the HORIZONTAL distance from the front face of the mast at deck level to the intersection of the forestay with the deck. Note HORIZONTAL. A spirit level to project upwards from the bottom of the forestay to the height of the mast at deck level is nearly always necessary.

STL is slightly different from IMS but is the same as IRM. The definition says: "*The length of the longest spinnaker pole, whisker pole or bowsprit measured on or near the centre line of the boat from the forward face of the mast tube to the extremity of the spinnaker pole, whisker pole or bowsprit, or the horizontal length from the forward face of the mast tube at deck level to the spinnaker tack point on deck projected vertically as necessary, whichever is the greatest.*" This definition ensures that the measurement of bowsprits is consistent with spinnaker poles. Note that when the spinnaker pole is a bowsprit, STL is measured to the extremity of the bowsprit, NOT any notional tack attachment point. We have also seen a recent trend towards spinnakers tacked to the deck ahead of the forestay; hence the final paragraph.

9. Sails

IRC rule 8.5 states: "*Sails shall be measured in accordance with ERS Part III, Measurement Rules, Section H4, Sail Measurement*.". ERS are defined by rule 8.2 *as "the current version of the ISAF Equipment Rules Of Sailing*.". These rules are obtainable from ISAF, either as hard copy or from the ISAF website, www.sailing.org. Salient points from the rules are included below and on the attached diagrams showing the relevant measurement points. Note that IRC Rule 8.4 (see Appendix 2) invokes the ERS Sail Definitions with various exceptions related to spinnakers.

IRC Rules no longer differentiate between spinnaker types. All spinnakers are measured in the same way, irrespective of shape.

IRC sail measurement is very straightforward. Mainsails require measurement of widths, 4 measurements for headsails, and 4 for spinnakers as follows:

Mainsails:	Half Width	MHW	
	Three Quarter Width	MTW	
	Upper (seven eighth) Width	MUW	
Headsails:	Luff length	LL	
	Luff Perpendicular	LP	
	Half Width	HHW	
	Three-Quarter Width	HTW	New for 2008
	Top Width	HHB	
Spinnakers:	Luff length	SLU	
	Leech Length	SLE	
	Foot Length	SF	
	Mid Width	SHW	

For all measurements, light tension should be applied to the cloth, sufficient to remove wrinkles.

With effect from 1st January 2008, the definition of headsails and spinnakers was amended to:

26.3.4 RRS 50.4 shall not apply.
A spinnaker is defined as a sail set forward of the foremost mast with half width (measured as a spinnaker) greater than 75% of foot and without battens. Any other sail tacked down forward of the foremost mast is a headsail.

Thus, if a sail satisfies the definition of a spinnaker (ie half width is greater than 75% of foot), the that is what it is: a spinnaker. Any other sail is a headsail. 'Code zeros' are nearly always intended by the sailmaker to be spinnakers. Measurers should however beware. If a sail has battens, defined in IRC as *"Any material added to the sail, as either a removable element, permanent stiffening, or other contrivance, the purpose of which is to support and/or stiffen the sail."* then it is a headsail rather than a spinnaker, irrespective of what the dimensions are.

Measurers should be aware of the potential shortfall in luff length caused by not stretching the boltrope when measuring LL, and if uncertain should err on the side of excessive tension.

Measurers should also be aware that sailmakers on occasion (and particularly for smaller boats with hanks as opposed to luff grooves) sometimes fit pre-stretched bolt ropes which when relaxed are significantly shorter than the luff length of the sail itself. In this context, light tension may be taken to mean firmly pulled by hand.

With effect from 1st January 2008, for headsails the required dimensions are LL, LP, HHW and HTW of the largest area headsail. In addition, the longest luff length (LLm) of any headsail carried is also required, as is the largest headsail top width (HHB). Headsail area, HSA, is calculated from:

$$HSA = 0.125 * LL * (2*LP + 3*HHW + 2*HTW)$$

With HHW and HTW taken as not less than 50% & 25% of LP respectively for the purpose of the calculation.

Unlike spinnakers, we need the actual dimensions of the largest area sail, *not* just HSA.

We have also seen a recent trend towards careful placement of headsail battens to minimise 'hollows' as defined by ERS. If in doubt, please refer to ERS and/or consult the Rating Office or your local IRC Rule Authority.

For spinnakers, what is required are the dimensions of the largest area sail calculated from:

$$SPA = ((SLU + SLE)/2) * ((SF + (4 * SHW))/5) * 0.83$$

While SPA is all that is required for rating the boat, measurers are asked to submit actual sail dimensions to minimise the likelihood of error.

IRC does not include any rules regarding sail reinforcement.

The historic rules relating to sailcloth have now effectively disappeared. While IRC Rule, 26.4 refers to 'exotic materials' in sailcloth, the current exotic list is none.

IRC Rule 26.7 gives a rating credit to boats rated for a single roller furling headsail. To be eligible, rated LP must be greater than 1.3*J. The Rating Office will pick up qualification in this regard. More importantly from a measurer's point of view is that, while other sails may be carried aboard, only storm jibs and, when declared, heavy weather jibs may be used while racing. The definitions of storm and heavy weather jibs are as defined by ORC Special Regulations:

Storm Jib: A headsail which complies with Special Regulations Paragraph 4.24: ***A storm jib*** *of area not greater than 5% height of the foretriangle squared, and luff maximum length 65% height of the foretriangle.*

Heavy Weather Jib: A headsail which complies with Special Regulations Paragraph 4.24: ***A heavy-weather jib*** *of area not greater than 13.5% height of the foretriangle squared and without reef points.*

These are repeated in IRC Definitions in the Yearbook. Note that a No.3 headsail is NOT a Heavy Weather Jib. With effect from 1st January 2005, IRC certificates will in relevant cases show the maximum permitted heavy weather jib area.

10.0 Other Issues

Measurers should be aware of other IRC rules issues, and are asked to keep their eyes open when aboard a boat. For instance:

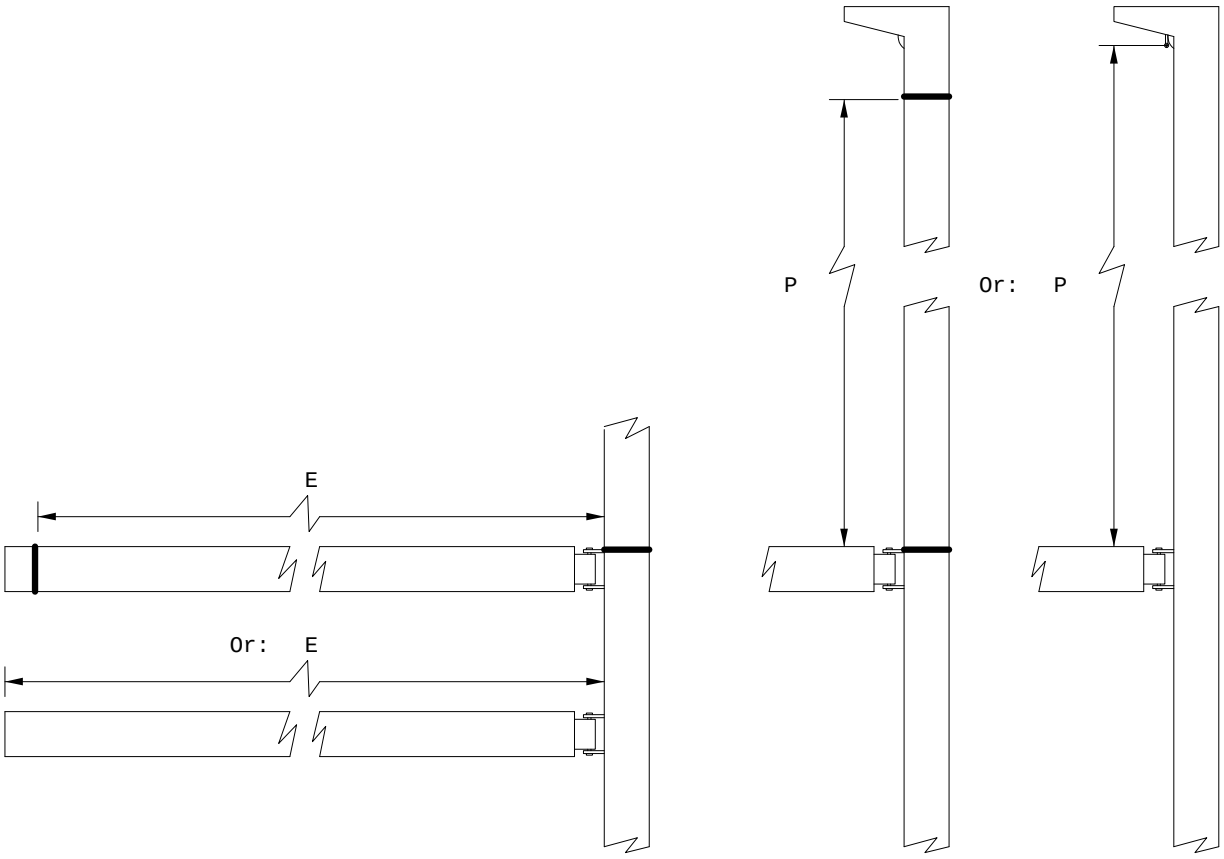
- Has furniture been removed from below and not reported in contravention of IRC rule 27.1?
- Are the correct number of spreaders/jumpers/runners/checkstays declared?

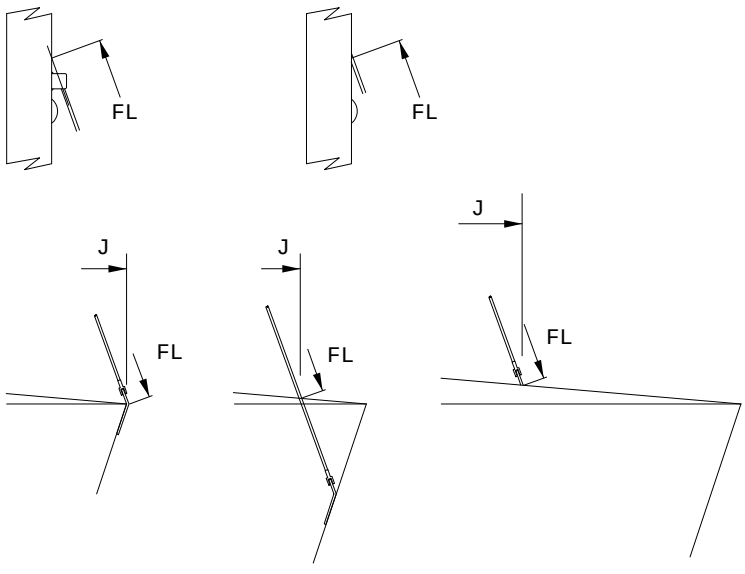
- Quantity (if any) of internal ballast. Has ballast been added or removed?
- If originally an IOR rated boat, have the bumps and creases been faired out?
- No. of spinnakers carried.
- Does the boat use stored power? See IRC rule 14.

It is impossible to detail every point. Measurers are simply asked to check whatever detail is possible whenever possible.

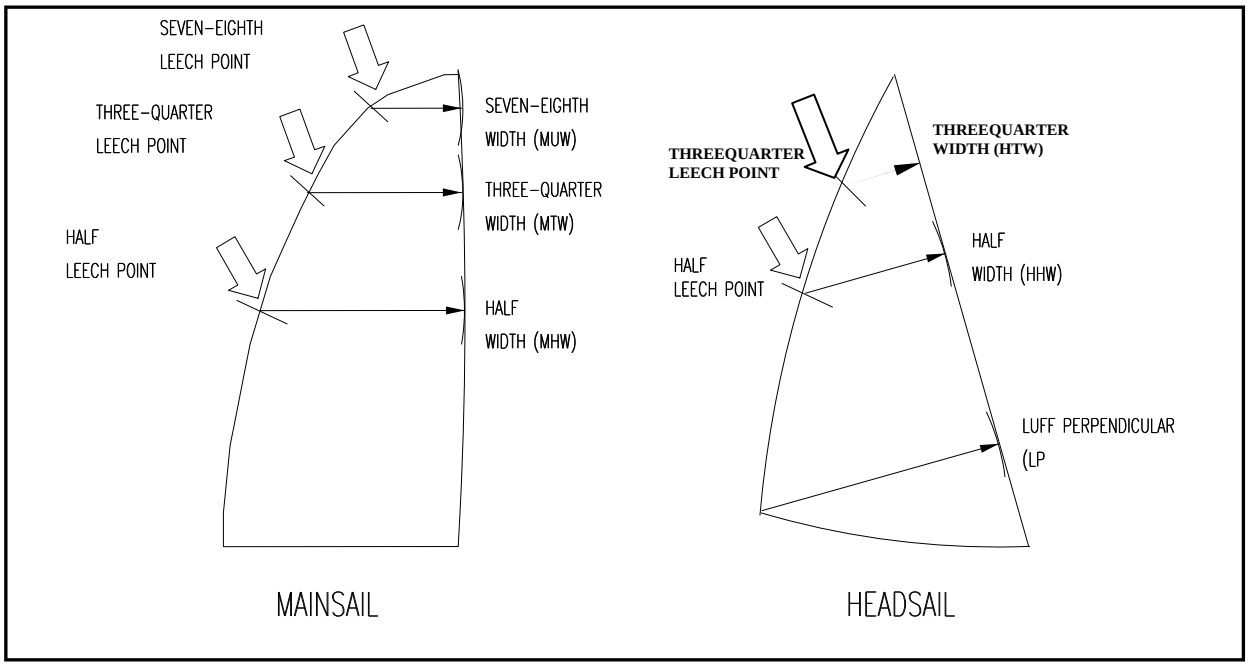
Mike Urwin. RORC Rating Office Technical Director.

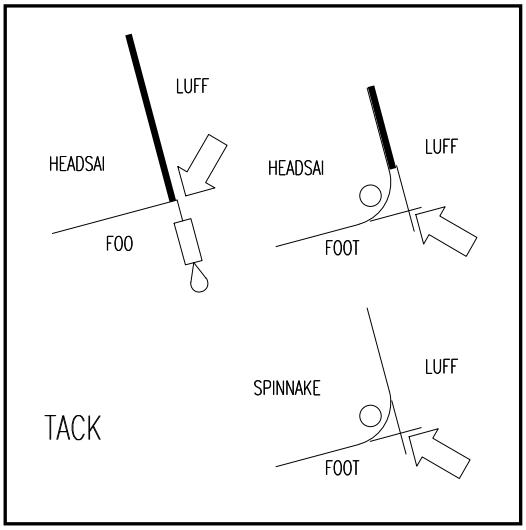
RIG MEASUREMENT POINTS

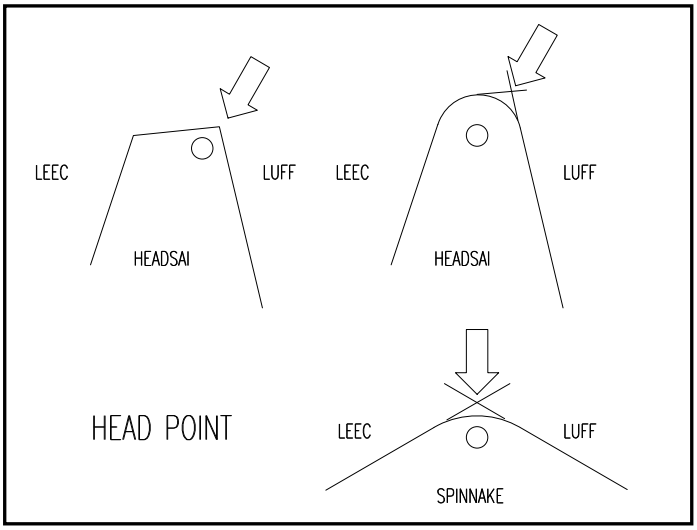


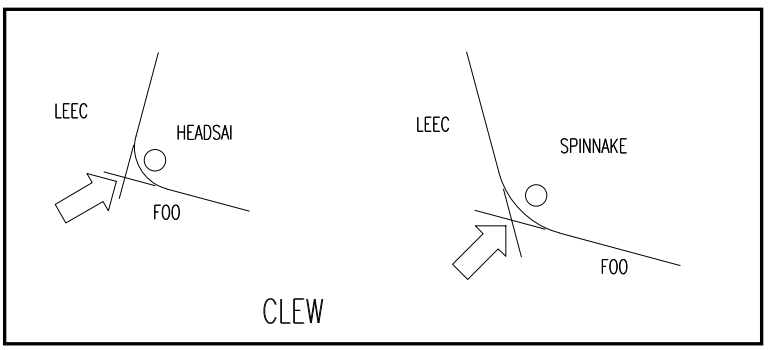


SAIL MEASUREMENT







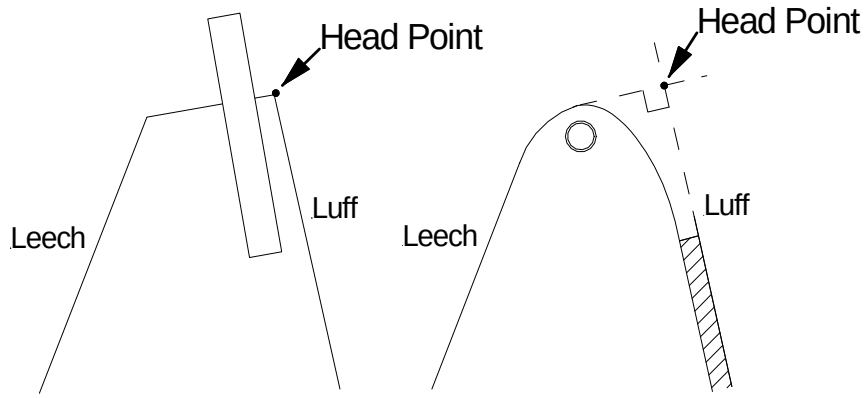


Measurement of Headsail Top Width (HHB)

IRC Headsail Top Width (HHB) is defined as *the widest headsail top width of any headsail carried measured as the distance between the head point and the aft head point.*

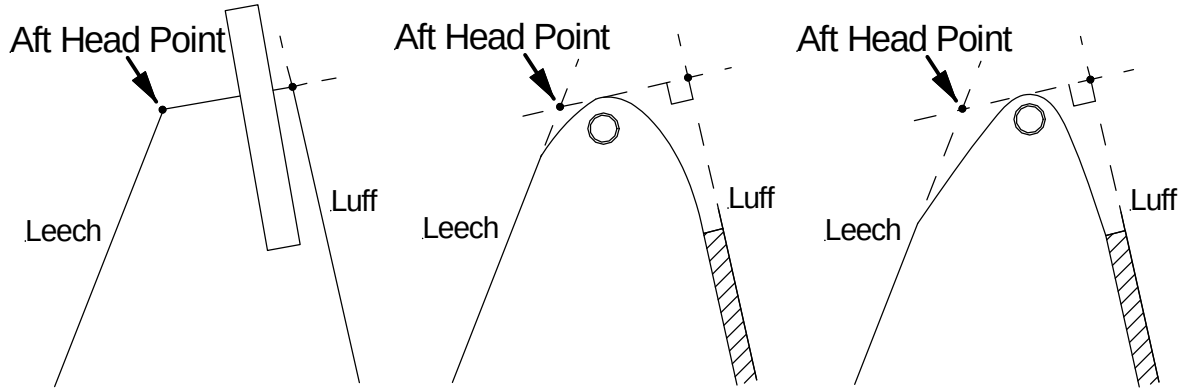
The head point is defined in ISAF Equipment Rules of Sailing (ERS) G.4.2(b):
*HEADSAIL: The intersection of the **luff**, extended as necessary, and the line through the highest point of the **sail**, excluding **attachments**, at 90^0 to the **luff**.*

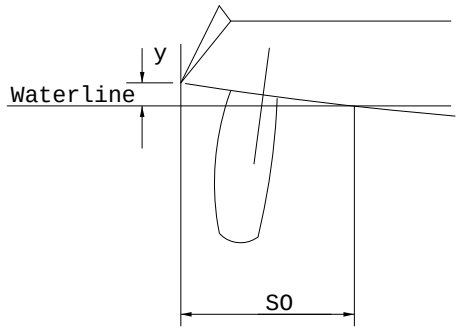
As shown below:



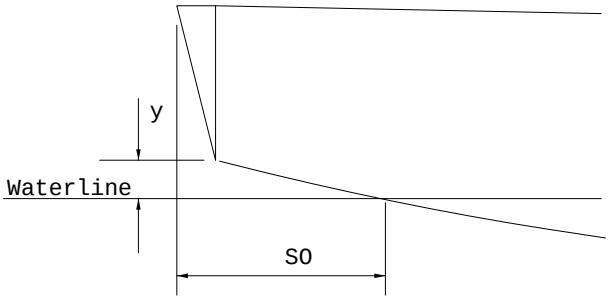
The aft head point is defined in ISAF Equipment Rules of Sailing (ERS) G.5.5:
*The intersection of the **leech** extended as necessary and the line through the **head point** at 90^0 to the **luff**.*

As shown below:

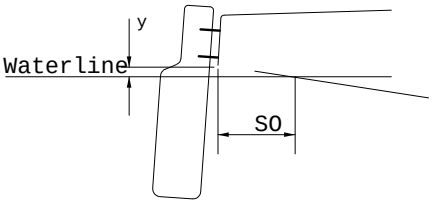




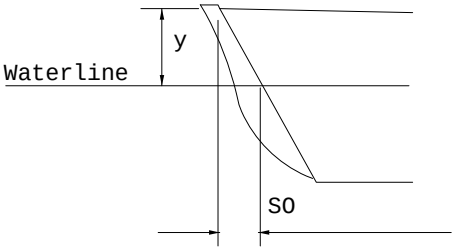
SPADE RUDDER



COUNTER STERN

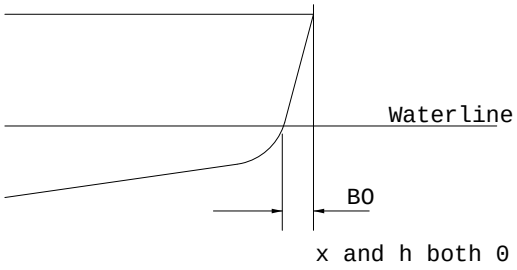


MODERN TRANSOM HUNG RUDDER



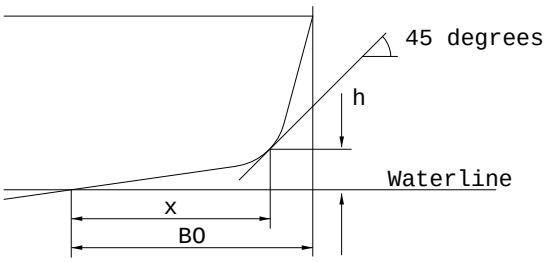
TRADITIONAL TRANSOM HUNG RUDDER

MEASUREMENT OF BO, x, and h.



x and h both 0

TRADITIONAL BOW OR KNUCKLE IMMERSED



FLYING BOW OR KNUCKLE EXPOSED

APPENDIX 1

WEIGHING ON PRESSURE PADS

We now have a bit more experience and understanding of this. So, to put the whole thing onto one piece of paper:

1. There appear to be two types of pressure pads, one of which has the sensor at the top, the other has the sensor at both ends. This latter type is not desirable because it requires a totally flat clean surface underneath as well as on top. If the latter type is to be used, each pad **MUST** be stood on a clean flat steel plate.

2. Flat level ground appears to be important. If not, the load may be unevenly shared between corners (which in itself shouldn't matter) but may also vary during the weighing which will produce false readings.

3. There is also a possibility that non parallel ground/cradle surfaces may introduce errors into the readings from individual cells.

4. The bearing point on each pad must be cleanly in contact with the underside of the cradle. Placing timber or other compressible pads between the load cell and the cradle can result in the load being shared by the structure of the cell rather than only by the load sensitive part.

   Additionally, it is important that the bearing point on each pad bears against a flat section of cradle. Discontinuities in the cradle surface (created by welds, joints etc) must be avoided.

5. Wind can have an effect. Windage on the rig of a boat will change the distribution of load in the cradle and hence the reading on each individual cell. The total net effect should be small, BUT when each cell has to be read individually, they really then need to be read at exactly the same moment.

   The effects of this can be mitigated in the case of individual read-outs by laying out the read-outs in such a way that it is possible to see all of them simultaneously. Cross variation can then be seen and noted.

6. In the case of a load cell read out combining electronically the signals from each corner, windage and uneven ground effects should be minimised. This does not make them any the less undesirable.

7. As ever, dunnage and packing used when the boat is in the cradle must be replaced on the cradle for tare purposes.

8. For practical reasons, the travel lift straps will generally remain around the boat during the weighing. Obviously, care must be taken to ensure that they are slack.

9. Accuracy. Given that we are using 4 cells as opposed to 1 for a single point lift, the potential for inaccuracy is increased. Cells of the highest possible accuracy, rated as appropriately as possible for the gross weight become of greater importance.

10. Range. While for maximum accuracy, we want cells of combined total capacity as close as possible to the gross weight, care needs to be taken because placing the boat in the cradle may result in a very uneven load distribution. This should be taken account of in sizing the cells.

APPENDIX 2

IRC RULE REFERENCES TO AND MODIFICATIONS TO

ISAF EQUIPMENT RULES OF SAILING

8.4 ERS Part II, Definitions, Section G, Sail Definitions, shall apply except as stated by IRC Rules or Appendix 1.

8.4.1 ERS G.2.2, Leech, shall not apply. MAINSAIL, HEADSAIL and SPINNAKER Leech is defined as: The aft edge.

8.4.2 ERS G.2.3, Luff, shall not apply. MAINSAIL, HEADSAIL and SPINNAKER Luff is defined as: The fore edge.

8.4.3 ERS G.4.2 (c) Head Point, SPINNAKER shall not apply. SPINNAKER Head Point is defined as: The intersection of the leech and the luff, extended as necessary.

8.4.4 SPINNAKER Half Luff Point is defined as: The point on the luff equidistant from the tack and head points.

8.4.5 ERS G.7.1(b), Spinnaker Foot Length, shall not apply. SPINNAKER Foot Length is defined as: The distance between the clew point and the tack point.

8.4.6 ERS G.7.5(b), Spinnaker Half Width, shall not apply. SPINNAKER Half Width is defined as: The distance between the half leech point and the half luff point.

8.5 Sails shall be measured in accordance with ERS Part III, Measurement Rules, Section H5, Sail Measurement.

APPENDIX 3

ERS H.5.2, Hollows in Sail Edges

H.5.2 Hollows in Sail Edges

Where the **sail edge** is hollow and a measurement point falls in the hollow:

between adjacent **batten pockets**
between the **aft head point** and the adjacent **batten pocket**
between the **clew point** and the adjacent **batten pocket**
between the **tack point** and the adjacent **batten pocket**
at an **attachment**

the **sail** shall be flattened out in the area of the **sail edge**, the hollow bridged by a straight line and the shortest distance from the measurement point to the straight line shall be measured. This distance shall be added to the measurement being taken.