



IRC MEASUREMENT

1. Introduction

This version, IRCMEAS12-1, has been revised and re-issued in January 2012. Significant changes are marked by a left marginal sidebar.

The changes to IRC Rules for 2012 relevant to measurement are:

- Deletion in Rule 21.5 of the historic minima for mainsail widths.
- Deletion in Rule 21.7 of the historic minima for headsail widths.
- Clarification of the definition of LP for cutter rigs.
- Re-wording of the definitions of h and y for improved clarity without practical change in meaning.

2. General

The guide is intended to ensure good and consistent measurement practice by IRC measurers around the world. 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' measurers and also owners self measuring their own boats.

Official Measurers should note the following:

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 the same thing..

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 IRC Rating Authority (via your local IRC Rule Authority) for clarification.

Always explain what you are doing and show the owner the measurement 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. Measurers should NOT however discuss the effect on TCC of changes. Owners should be advised to contact the IRC Rating Authority through their Rule Authority.

In the particular case of measurement for Endorsement, owners and/or measurers should contact their local IRC Rule Authority first and direct the owner to an official measurer.

A specific point to note:. We have had a couple of cases recently where owners have been misled by unofficial comments by measurers. Official measurers should **NEVER** interpret IRC rules. If an owner asks you to interpret, or you are in doubt, contact the IRC Rating Authority through your local Rule Authority. Measurers do not have the authority to interpret IRC Rules. That right lies solely with the IRC Rating Authority.



3. Documentation

Measurers will need to have available to them:

Document	Source
IRC measurement documentation	http://www.icrating.org/en/technical-a-certification/measurement.html
IRC Rules	http://www.icrating.org/en/technical-a-certification/rule-a-definitions.html
ISAF ERS	http://www.sailing.org/documents/isaf-equipment-rules.php

Now that IRC Rules incorporate ERS, we have adopted the convention used within ERS that a word printed in IRC Rules in **bold** is being used in its ERS defined sense. This has then been extended such that a word printed underlined is being used in its IRC defined sense. IRC definitions are contained within IRC Rules as Appendix A. ERS definitions are not repeated in IRC Rules. Apart from direct quotes from IRC Rules or definitions, this convention has NOT been followed in this manual

4. 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 (50 metres for large boats)
	Wooden (floating!) rulers:	1m and single hinge 2m
	Spirit level with 45° 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	Optical (Dumpy) level
	Basic tools: pliers, screwdriver, PVC tape	

5. Accuracy

IRC Rule 8.10 states

8.10 *Rated Dimensions*

- 8.10.1 *Values stated on certificates for **LH, Hull Beam, Draft**, x, P, E, J, FL, MUW, MTW, MHW, LLmax, HHB, HSA, PY, EY, LLY, LPY, SPA and STL are maximum values.*
- 8.10.2 *Values stated on certificates for **Boat Weight**, BO, h, SO, y, and **Internal Ballast** are minimum values.*
- 8.10.3 *If during **Equipment Inspection** by an **Equipment Inspector**, or during measurement carried out under Rule 13.6, any rated dimension is found to exceed a maximum value or to be less than a minimum value, then the **boat** is not in compliance with her certificate.*
- 8.10.4 *Attention is drawn to Rule 13 and to RRS 78, Compliance with Class Rules; Certificates.*

This defines clearly when a boat is not in compliance with her certificate. It is relevant to a measurer acting as an Equipment Inspector at an event.



The introduction to IRC Rule 9 states:

9 *Rating review*

Rule 9 does not apply to **equipment inspection** at an event.

In a few instances in the past, attempts have been made to take the protest limits of IRC Rule 9.8 as measurement 'tolerances'. In other words, measured linear dimensions are adjusted by the protest limits. This is NOT the purpose of IRC Rule 9.8. Measurers shall report the actual measurements found which will be used for rating the boat.

To be clear, who applies IRC Rule 9? Answer: the Rating Authority. Who applies IRC Rule 10 (which refers to IRC Rule 9)? Answer: the Protest Committee and the Rating Authority. A measurer never has any decision to take in the application of IRC Rules 9 nor 10.

The measurer's aim must always be to achieve the best possible result.

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 IRC Rating Authority uses load cells with a quoted accuracy of $\pm 0.2\%$ of maximum capacity, ie, for a 10 tonne cell ± 20 kg, or for a 20 tonne cell, ± 40 kg. 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.

Similarly, the Rating Authority uses EC Class II tape measures.

6. **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 behind the plumb line 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 plumb line. The required measurement is then clearly marked by the tape.

Never measure between two plumb lines, always between each plumb line and a 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 was not floating 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.

7. **Previous Measurements**



Many boats will have had either IMS (ORCi), ORC Club, or certificates under other local measurement rules in the past. With care, some of the figures on the most up to date certificate may be directly useable. Others will require checking. In general, hull measurements will not have changed, unless the boat has been modified. Others, such as rig and sail measurements will often need physically checking. Care should be taken to ensure that the data on a boat's certificate under another rule is real data as opposed to 'class standard' data which may be the case under for instance ORC Club and some local rules. Additionally, IRC definitions are in many cases not the same as definitions under other rules. Great care should be exercised in this respect. The following may be used as a guide:

	IRC	IMS/ORCi	Comment
Values likely to be unchanged:	LH Hull Beam	LOA BMax	Unlikely to change, but has been known.
	Engine weight J	EW J	See 2011 IRC Rule change
Values which may have changed:	STL	SPL	Note that IRC defines STL differently
	P E Draft	P E D	May have changed, either as result of keel modifications or re-ballasting.
	Sail data	Various	Note variation in definitions of dimensions.

8. 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 IRC Rating Authority or the local IRC Rule Authority. Obviously, an officially owned load cell is to be preferred whenever possible. Experience over the years has shown that weighings using officially owned or 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!

When a boat is weighed, the overhangs should always be measured simultaneously. A weighing report should be produced defining what was on board and what was not, quantity of fuel and water, and overhang measurements.

The IRC Rating Authority's strongly preferred method of weighing is hanging the boat from a single point beneath a load cell. This may be either using a boat's built in lifting point or straps around the hull with or without a lifting frame/spreader bars. Provided that the weight of whatever lifting gear is used is tared off, it doesn't matter which. Experience over the years has shown that single point lifting to be by far the most reliable and repeatable method of weighing boats.

An alternative acceptable method is the use of 3 or 4 compression load cells to weigh the gross weight of the boat in a cradle. By then deducting the weight of the 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 local IRC Rule Authority before going ahead.



For very large boats, generally longer than 30.5m, the Rating Authority may approve calculation of weight from freeboards. See Appendix 2 for more information.

Currently weighing a boat hung in a travel lift rolled onto compression load cells is **NOT** an approved method of weighing. The Rating Authority is experimenting with a view in the future to permitting this method. To date however the results have not proved sufficiently reliable.

Historically, weighing on compression load cells was generally acceptable for an endorsed certificate. With effect from 2010, for the purposes of endorsement, this method has been moved to 'at the discretion of a Rule Authority'. This change was made firstly as a result of concerns over general reliability and secondly because the local IRC Rule Authority is the only body in a position to properly review the proposed process in each case.

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.

For very large boats (generally weighing in excess of 20 tonnes) for which weighing is impractical, an acceptable alternative is flotation followed by calculation and declaration of weight by the Rating Authority. The Rating Authority may delegate this task to the designer. If this approach is to be taken, the IRC Rating Authority must first be contacted to discuss the proposed method.

Attention is drawn to the table in paragraph 4 of Appendix 4, IRC Endorsement. This clearly defines the various acceptable methods of establishing the weight of a boat and also those methods which are not acceptable.

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

It is absolutely essential that the boat is EMPTY (see measurement condition in IRC rule 17). 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.
- Portable electronic equipment (laptop computers etc.)
- Safety gear: horseshoe rings and Dan buoys on the transom.
- Gas bottles (and spares!).
- Fire extinguishers.
- Are removal cockpit boxes on board?
- Fenders and mooring lines as the boat is lifted.
- Running rigging shall be slack.

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

It should be noted in the weighing report cushions that were on board or not on board and if removable cockpit boxes were on board or not. The number of batteries on board should also be noted.

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 0.85, ie 1 litre weighs 0.85 kg.



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 (if there are an unusually large number of batteries, check that they are actually connected!), and the quantity of internal ballast. 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, if the boat is to be lifted from the water, the slings should first be immersed. On some load cells, this weight can be zeroed out. It is left to the measurer's discretion whether he does this or notes 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. 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. Ideally, weighing should be carried out in light winds, preferably 10 knots or less and dry weather. It is recognised however that this will often not be practical. With care, satisfactory results can be achieved in stronger winds. It is also sometimes possible to find a sheltered location. It is therefore left entirely to the discretion of measurers when to abandon a weighing because of conditions. Measurers must always report actual conditions to the IRC Rating Authority.

The shackles for the load cells have to be carefully sized, not only for strength, but for match to the holes in the load cell. A minimum freedom of movement has to be allowed, otherwise any torsion or twist when lifting will be directly transmitted into the load cell, giving a potentially erroneous answer. If too much freedom of movement is given, the measurement can also be wrong.

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.

9. Hull

9.1 LH

This is best done ashore. Owners should be informed in advance that the boat has to be set up level with the waterplane in Measurement Condition, which is a task that has to be performed before the measurer arrives. 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 LH.

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

DO NOT: Measure LH 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 LH. Measurers are quite within their rights to require that the boat be re-levelled.



If necessary, LH 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.

9.2 Hull Beam

Inspect for maximum hull 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 hull beam (ignoring rubbing strakes) measure inboard to a convenient point on the deck of the boat. Repeat from the other side. This method is not recommended as it is far less precise than ashore.

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.

9.3 Draft

The boat will need to be seen by the measurer both ashore and afloat. It doesn't matter which is first. It is better to start ashore to determine the lowest point of the keel. As with overhangs, draft is measured in IRC measurement condition (see IRC Rule 17).

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 the boat is in level trim both fore and aft and athwartships. If doing the afloat measurement first, mark the reference points on the hull as above.

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.

9.4 Overhangs

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

The boat should first be inspected to ensure she is, as required by IRC rule 18, in measurement condition (rule 17).

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.



If the upper end of the rudder is above the waterline, it is preferable to measure SO on both sides.

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 ruler 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. Repeat 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

As an alternative to direct measurement of BO, x and SO, if the bow and stern profiles are known (or have been measured ashore), then measurements of y and h (the easier and more accurate measurements to take directly) can be used to find BO, x and SO by either calculation or graphical methods.

10. Spars

Spar and rig measurements are straightforward. P and E are exactly as other rules, with the exception that if there are no measurement 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.

Hoisting a tape on the main halyard and judging its position by eye from on deck is not an accurate method. For Endorsed certificates, this is NOT acceptable. If the rig is up, sending a man aloft with the tape is the only method.

With effect from December 2010, an IRC definition of Forestay has been added and the definitions of J and FL amended to read:

Forestay *The ERS definition of **forestay** shall not apply. Forestay is defined as: Permanently attached **rigging** providing forward support for a mast **spar**.*

FL *The forestay length measured from the forward end of J to the forestay rigging point.*

J *The longitudinal distance between the intersection of the fore side of the mast **spar**, extended as necessary, and the deck including any superstructure; and the intersection of the centreline of the forestay, extended as necessary, and the deck, or bowsprit **spar**.*

The substantive effect of these changes is that FL and J are always measured to the permanent forestay.

In addition, Rules 21.3.3 and the definitions of Headsail and LP have been amended:

21.3.3 *RRS 50.3(a) is amended to the extent that a spinnaker or a headsail may be tacked to a **bowsprit**.*



Headsail *RRS 50.4 shall not apply. Any **sail** tacked down forward of the foremost **mast** which does not meet the definition of a spinnaker. A headsail may be hoisted from above the forestay rigging point.*

These changes clarify that a headsail may be hoisted and tacked from outside the foretriangle.

There is also a detail change to the definition of LP relevant to the measurement of cutter rigs. In this definition, the previous wording *to the foremost **forestay*** has been replaced by *to the foremost headsail luff* which may be set simultaneously while *racing*.

J is therefore measured in exactly the same manner as for other common rating rules. Note that J is measured horizontally. A spirit level to project upwards from the forward measurement point to the height of the mast at deck level is nearly always necessary.

FL can be a little more complex depending on the detail of the forestay attachment. What is required 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 go up the mast.

At the bottom of FL, the measurement point is as for J. The diagrams attached show all of the above.

Measurers should be clear that we want the real forestay, not a thin cable that is declared as permanent, but which clearly achieves nothing when it comes to holding the rig up.

P and FL may also be measured with the rig down. In both cases however, measurement will be to a reference mark on the mast/forestay for later correction to the actual lower limit of P/FL.

STL is slightly different from ORCi/ORC Club. 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 **spar** to the extremity of the **spinnaker pole, whisker pole or bowsprit**, or the horizontal length from the forward face of the mast **spar** 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.

11. Sails

The complete incorporation of ERS makes no changes to the measurement of sails under IRC which was already carried out in accordance with ERS.

IRC Rules do not 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, 5 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
	Top Width	HHB
Spinnakers:	Luff length	SLU
	Leech Length	SLE



Foot Length
Mid Width

SF
SHW

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

IRC definitions define a spinnaker as

*Spinnaker: 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**) equal to or greater than 75% of **foot length** and without battens.*

Thus, if a sail satisfies the definition of a spinnaker (ie half width is equal to or greater than 75% of foot), then 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 however 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.

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:

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

Historically, HHW and HTW were never taken as less than 50% & 25% of LP respectively for the purpose of the calculation. With effect from 2012, these minima have been removed. Measurers should therefore measure HHW and HTW for all headsails so that boats get the rating benefit of any general leech hollow. Measurers should however be aware that it is very common for the leech of a sail to be hollow between battens. Measurers should check all sails and bridge any hollows between battens found as described by ERS (see Appendix 3).

The actual dimensions of the largest area headsail, (not just HSA) are needed.

The IRC definitions of HHB, LL, LLmax and LP now include: *and which may be used while racing*. This then formally covers the situation of a boat rated with a single roller furling headsail carrying other sails on board as permitted by Rule 21.8.4 without affecting her TCC.

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 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.

For mainsails, the only dimensions required are the three widths. Note that with effect from 2012, the historic minima for mainsail widths have been removed.

Attention is drawn to the quick reference guides to sail measurement included as Appendices 5, 6 and 7 to this manual.

IRC does not include any rules regarding sail reinforcement.



The historic rules relating to sailcloth have now effectively disappeared. While IRC Rule, 21.4 refers to 'exotic materials' in sailcloth, the current exotic list is none.

IRC Rule 21.8 gives a rating credit to boats rated for a single roller furling headsail. To be eligible, (with the exception of boats with LH greater than 30.5m and IRC DLR greater than 60) rated LP must be greater than $1.3 \cdot J$. The Rating Authority 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 IRC definitions:

Storm Jib A headsail of area not greater than 5% **foretriangle height squared**, **luff length** not greater than 65% of **foretriangle height**, and not containing aromatic polyamides, carbon or similar fibres.

HWJ Heavy weather jib. A headsail of area not greater than 13.5% **foretriangle height squared**, and without reef points.

Note that a No.3 headsail is NOT a Heavy Weather Jib. In relevant cases, IRC certificates show the maximum permitted heavy weather jib area.

Finally on the subject of sails, be aware that sail cloth can shrink/grow with time, use and sometimes moisture. The fact therefore that a sail has a measurement stamp on it does not guarantee that it measures. For Equipment Inspection at events, the only sure way is actually to measure the sail.

12.0 Other Issues

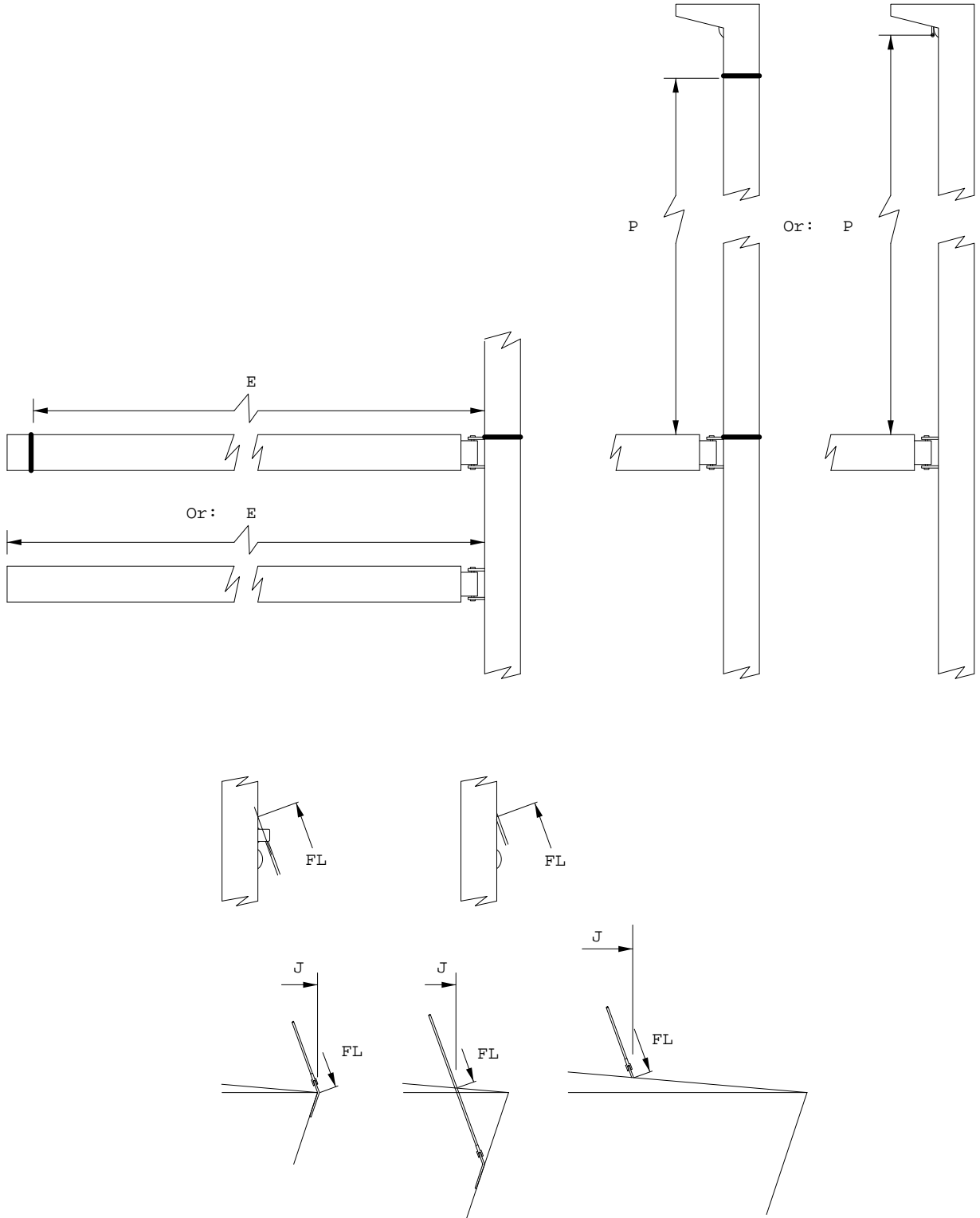
Measurers should be aware of other IRC rules issues and are asked to report as much additional detail as possible for recording in a boat's file. For instance:

- Which version of the design? Mk I? MK II? Deep draft? Shallow draft? Etc.
- Has furniture been removed from below and not reported in contravention of IRC rule 22.1?
- Are removable cockpit boxes on board?
- Are the correct number of spreaders/jumpers/runners/checkstays declared?
- Is the mast aluminium or carbon?
- Is the standing rigging wire, rod, or composite materials. Specifically, what is the forestay material ?
- 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 15.
- Does the boat have on board systems (other than conventional turnbuckles) to adjust the forestay or the mast foot? If so, will the boat use these systems while racing?

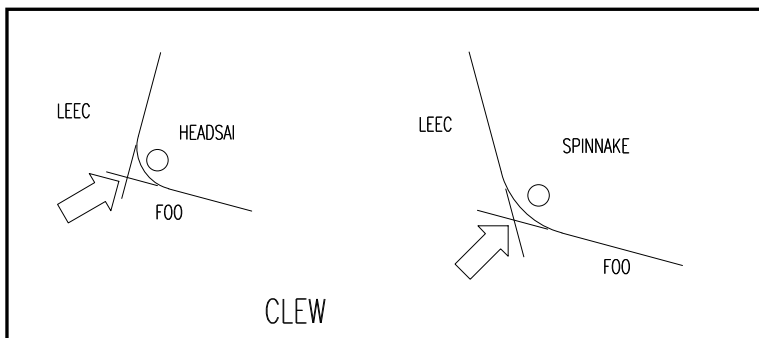
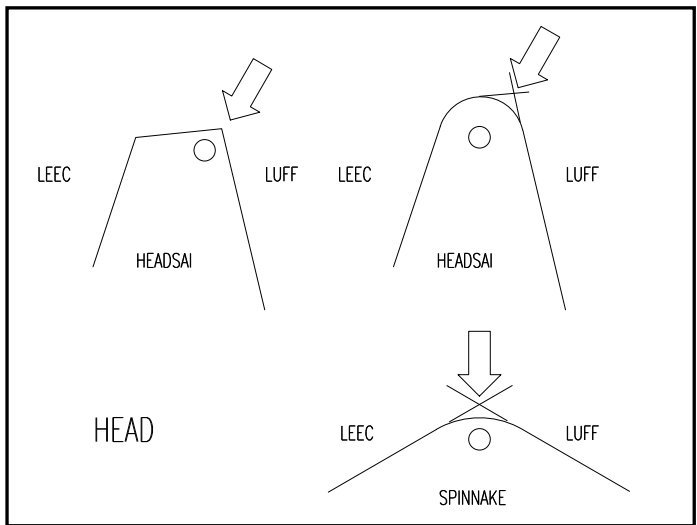
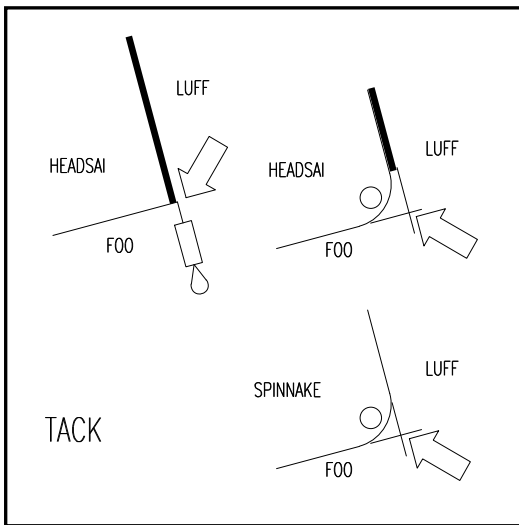
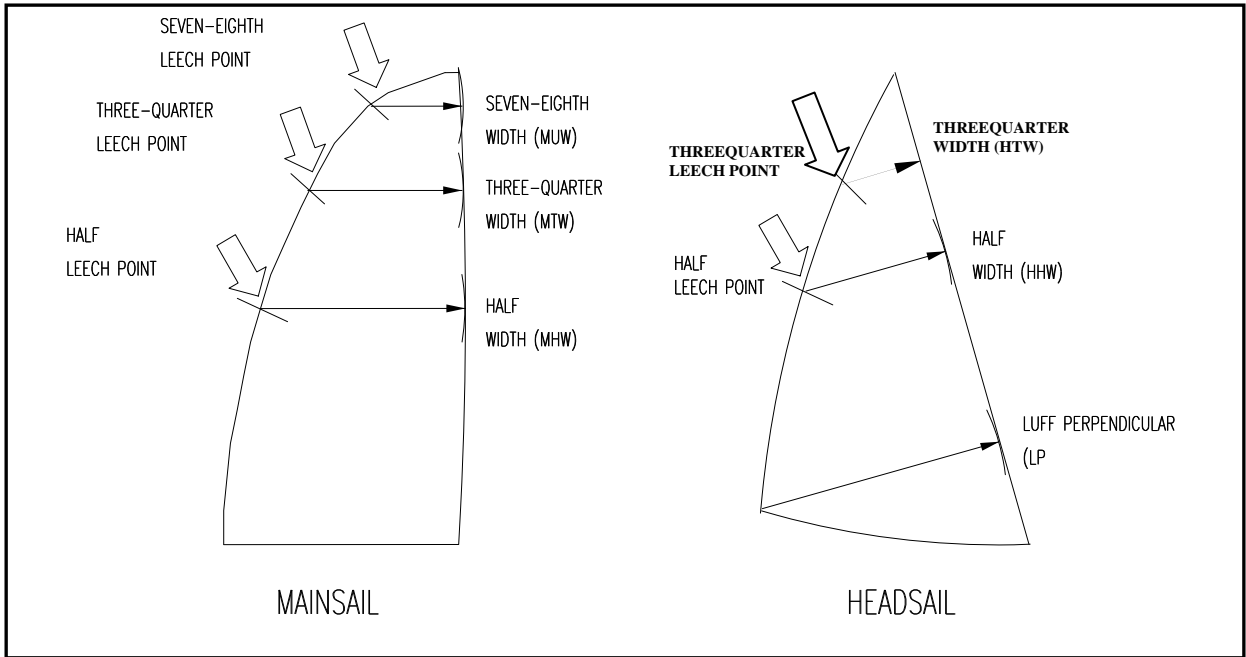
It is impossible to detail every point. Measurers are simply asked to check whatever detail is possible whenever possible.

When measuring one-off boats, or endorsement generally, measurers are asked whenever possible to take photographs (keel, rudder, interior, etc) for inclusion in the boat's file.

RIG MEASUREMENT POINTS



SAIL MEASUREMENT



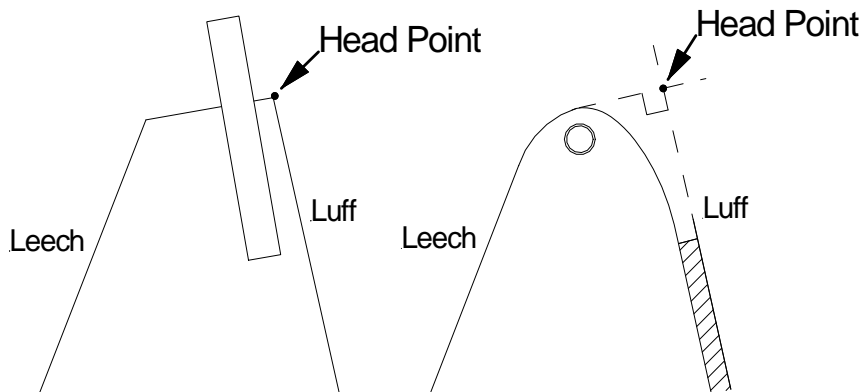
Measurement of Headsail Top Width (HHB)

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° to the **luff**.*

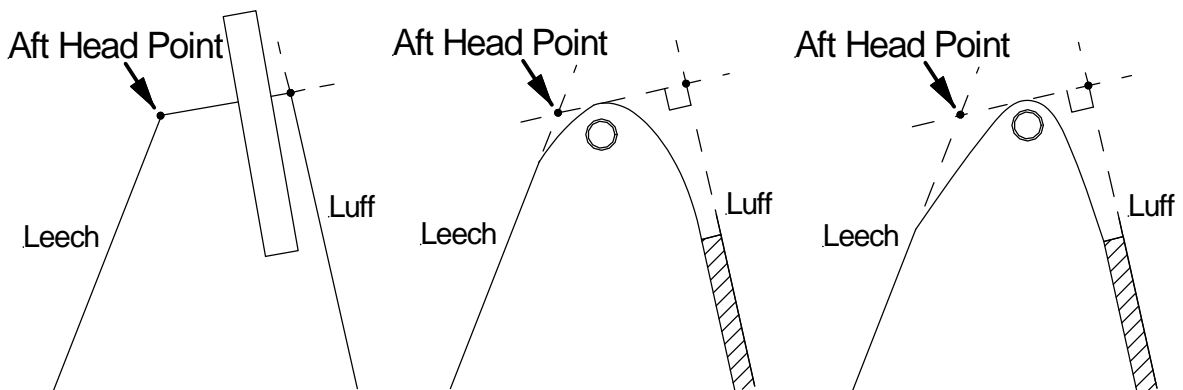
As shown below:



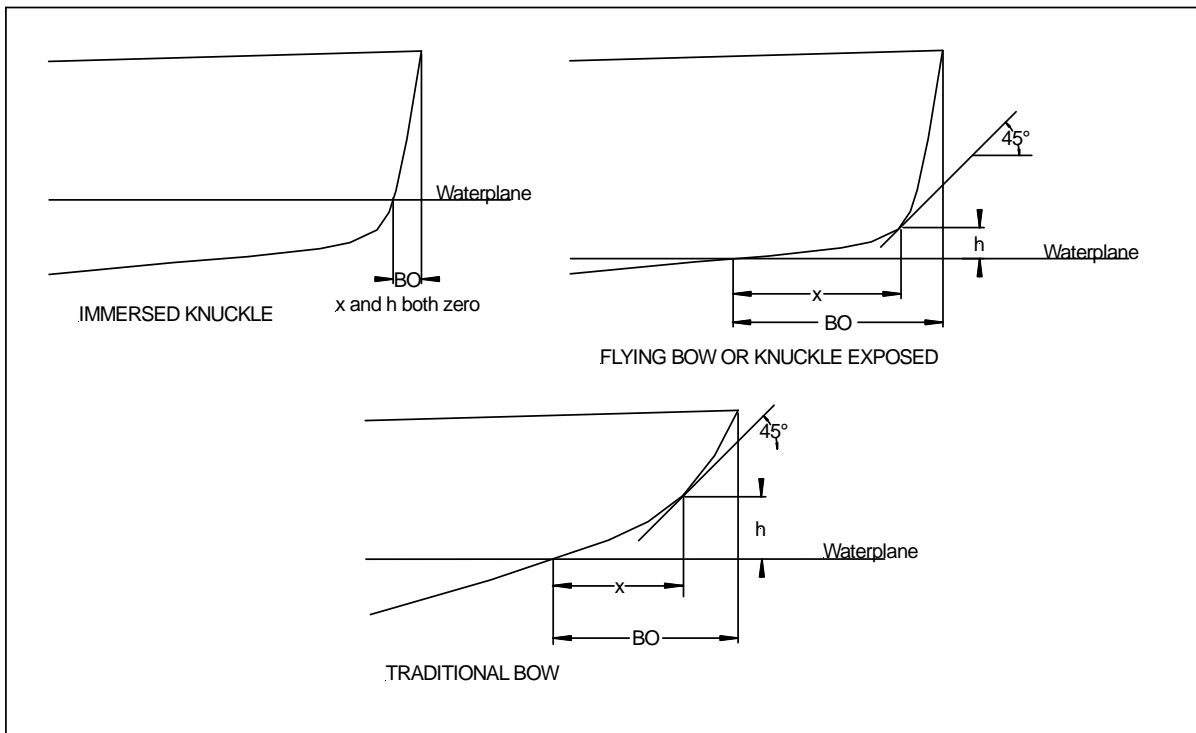
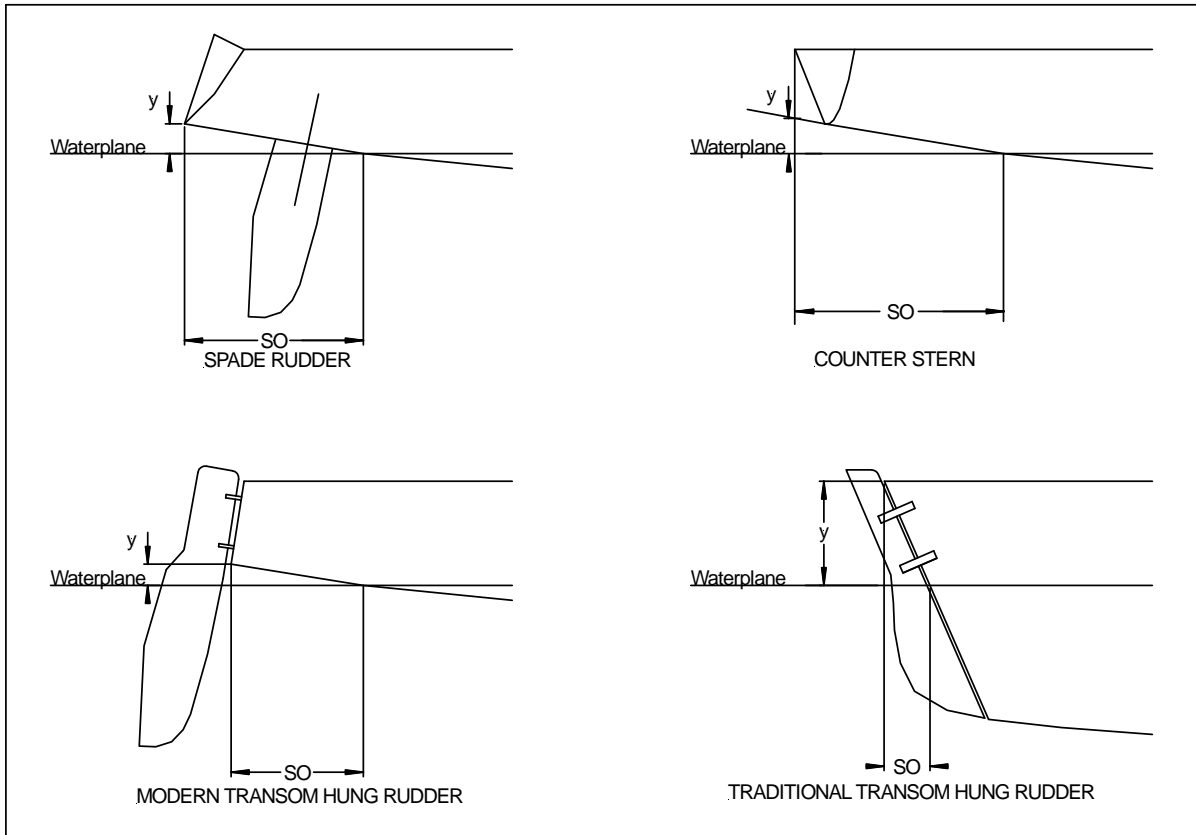
The aft head point is defined in ISAF Equipment Rules of Sailing (ERS) G.5.5:

*The intersection of the **leech** extended as necessary and the line through the **head point** at 90° to the **luff**.*

As shown below:



Bow and stern overhangs





APPENDIX 1

WEIGHING ON COMPRESSION LOAD CELLS

It is recognised that weighing on compression load cells is becoming more and more attractive from a logistical and financial perspective. However, where possible it is always recommended that single point lift be the preferred option. Event organisers may require competitors to be weighed prior to an event. In such cases the recommendation is that such boats are weighed using the single point lift method.

As with all measurement, accuracy and repeatability is paramount. There are 2 distinctly different methods of weighing on compression load cells: lowering the boat into a cradle supported on compression load cells and driving a travel lift onto pressure pads. Only the first method, lowering the boat into a cradle is acceptable for IRC weighing. Driving a travel lift onto pads and weighing the combined weight of the travel lift and boat, then deducting the weight of the travel lift is not acceptable but is currently under review.

1. There appear to be two types of compression load cells, 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 cell **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.
4. The bearing point on each cell must be cleanly in contact with the underside of the cradle. Placing timber or other compressible material 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 cell 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. If possible use equipment with the read out from each of the four cells electronically combined. Read (if possible record) the read out at regular intervals so that a mean reading can be found.

In the case of a load cell read out combining electronically the signals from each cell, 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, when the boats is lowered into a cradle 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 3 or 4 cells are used 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

OVERHANGS & WEIGHING OF SUPERYACHTS

It is recognised that for very large boats, with **Hull Length** of 30.5m and greater, it is generally impractical to bring the boat into measurement condition, and not possible to weigh the boat by single point lifting. It is also extremely difficult and costly to weigh the boat on pressure pads, as this may require a dry dock and extremely substantial custom built cradle. As such the following alternative is permitted with prior approval of the Rating Authority for these very large boats. It may also be used for smaller but very heavy boats with the prior approval of the Rating Authority.

As with all measurement, accuracy and repeatability is paramount. This method takes time, so accept that and don't rush it. It is imperative that the condition of the boat is recorded accurately as outlined below:

1. Ensure the Rule Authority is aware of the method being used, and that the Rating Authority has sanctioned it.
2. Ensure that a set of hull lines are provided by either the designer or from an ORC IMS measurement or similar, in a format that can be used to calculate the displacement and trim changes in the appropriate software. Discuss this with the designer and Rule Authority first.
3. Ensure that the boat captain is aware of the process and the time required to complete the work. Also make the boat captain aware that the closer to empty the boat is, the less chance for error there is. So ask them to empty the boat as far as reasonably possible. If sails, or other heavy items which cannot be easily weighed are to remain on board, ask the boat captain to provide weights for these items. For very large sails the sail maker will have a record of the delivery weights at least, and will probably have a record of the fully dressed sail weight. Remember to include battens where necessary. Ask that any bow anchor be dropped to the seabed if possible with a lanyard left attached only for recovery, ensuring that there is no weight on the line.
4. In an ordered manner record the fore and aft location as well as the weight of everything that should not be included in measurement condition. It is best to start at the bow and work aft, first above decks and then below decks, or vice versa, provided no location is overlooked. Fore and aft location can be recorded relative to the mast for simplicity. Multiple items, such as drinking water bottles can be counted and multiplied by the volume. Tankage can be recorded from the gauges, but remember to also record the location of each tank. It is best to compile this record on a spreadsheet so that the mean longitudinal location of the combined weigh can be calculated relative to the mast.
5. Once all is recorded the mooring lines should be eased as much as possible and the measurements y and h are recorded at the bow and stern as accurately as possible. For this the conditions have to be at least as good as a normal overhang measurement.
6. Provide the full information to the designer and Rule Authority so that the measured displacement and overhangs can be calculated. From this the recorded weight can then be deducted from the calculated location and the weight and overhangs adjusted and recorded for use in the IRC calculation.
7. Record as much as possible with a camera, with the boat captain's permission. Also recognise that the crew may live on the boat full time. Respect their privacy in areas of the boat where their personal belongings are kept, as well as the privacy of the owner.
8. This is a costly and time consuming process. As such ensure as much as possible is prepared beforehand, and ensure that the Rule Authority is fully aware of what you are doing. The Rating Authority will be at hand to answer any questions whenever possible. Do not be afraid to ask.



APPENDIX 3

ERS H.5.2, Hollows in Sail Edges

H.5.2 Hollows in Sail Edges

Where there is a **sail edge 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 **sail edge hollow** shall be 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.



APPENDIX 4

IRC Endorsement

Process, Measurement, and Data Standards

1. Preamble

An 'endorsed' IRC certificate is one for which the data on the certificate has been audited and if necessary verified by measurement (official measurers) or other methods. The 2005 IRC Congress agreed that a set of common standards for the IRC Rating Authority and Rule Authorities to apply when endorsing a boat's IRC certificate should be developed and published.

Generally, IRC is a self-measurement system. There is thus no general requirement for an owner to have his boat officially measured or weighed unless either he chooses to do so, or his Rule Authority (ie his local IRC body) and/or an Organising Authority for a race requires official measurement, generally resulting in an endorsed IRC certificate.

As a part of this, in future, the nomenclature on an endorsed IRC certificate issued by either the RORC Rating Office or the UNCL Centre de Calcul will be:

ENDORSED

meaning that the data has been audited by a Rule Authority with any measurement by a measurer recognised by the Rule Authority.

Within the guidelines below Rule Authorities are given some options for sources of data. This recognises that circumstances vary from country to country, that some owners are prepared to expend more time and effort than others, and that for instance weighing a large boat may be impractical. The options offered cater for these while at the same time not generally compromising the validity of a boat's data and hence her endorsed certificate.

It is a fundamental prerequisite of this that responsibility for appointment and training of measurers and quality of measurement data generally lies with each Rule Authority. Attention is drawn to the IRC Measurement Manual available from the IRC website, www.ircrating.org. Additional material to aid Rule Authorities and measurers is also available direct from the Rating Authority.

2. Process

An owner wishing to have his certificate endorsed first contacts his local Rule Authority. **The Rule Authority carries responsibility for auditing the boat's data file and for defining what, if any, data is to be verified.** In doing this, the data and measurement standards below shall be applied. If these standards are not applied, then the Rating Authority must be advised and an endorsed certificate will not be issued

On return of the data from the measurer, or other defined source, the Rule Authority will review the data and confirm that it is satisfied that an endorsed certificate can be issued. The data is then forwarded to the Rating Authority accompanied by a request to issue an endorsed certificate. Only then will the Rating Authority issue an Endorsed certificate.

The Rating Authority reserves the right at its absolute discretion to refuse to issue an endorsed certificate if it is not satisfied in any respect with the data submitted by a boat through her Rule Authority.



3. Measuring Equipment

While measurement methods are generally beyond the scope of this, the following shall apply.

3.1 Load Cells

Load cells for single point lift weighing shall have a quoted accuracy of $\pm 0.2\%$ of maximum capacity or equivalent and discrimination of not less than 10 kg. ie, a 10 tonne load cell should have a quoted accuracy of ± 20 kg, and a 20 tonne cell, ± 40 kg. Load cells shall be calibrated at least once per year.

A load cell should not be used to weigh a boat weighing less than 15% of the maximum capacity of the load cell, ie 1500 kg for a 10 tonne cell. Rule Authorities may waive this requirement on an individual case basis.

Compression load cells should generally follow the above standards. It is however recognised and noted that the ultimate accuracy of weighing on compression load cells is a function of the combined accuracy of all the cells rather than the accuracy of each individual cell and also of the methodology adopted. Rule Authorities are therefore advised to exercise care in approving compression load cells.

3.2 Linear Measurements

Tape measures and measuring rules built to CE category 2 or equivalent standards are acceptable.

Tape measures should be steel. Fabric tapes are not generally acceptable.



4. Sources of Data

4.1 General

Generally Acceptable	Weight	Hull and Appendages	Rig	Sails
Measurement carried out by an authorised measurer using equipment complying with defined standards.	N/A	✓	✓	✓
Single point weighing carried out by an authorised measurer using a load cell complying with defined standards.	✓	N/A	N/A	N/A
If available, standard design data and light weight defined by the Rating Authority.	✓	✓	✗	✗
Data supplied by an approved sail measurer.	N/A	N/A	N/A	✓

Acceptable at the discretion of a Rule Authority	Weight	Hull and Appendages	Rig	Sails
Weighing on compression load cells carried out by an authorised measurer using load cells complying with defined standards.	✓	N/A	N/A	N/A
Measurement carried out by a specially appointed (by the IRC Rule Authority) measurer or sail measurer.	N/A	✓	✓	✓
Single point weighing or weighing on compression load cells carried out by a specially appointed measurer using load cells complying with defined standards.	✓	N/A	N/A	N/A
Weight derived from freeboards measured by an acceptable method, calculation and declaration by the naval architect.	✓	N/A	N/A	N/A
IMS DSPM minus measurement inventory only if a measurement inventory is available	✓	N/A	N/A	N/A
Data derived from an in date or recently expired IMS or other measurement certificate.	N/A	✓	✓	✓

NOT acceptable	Weight	Hull and Appendages	Rig	Sails
Owner or manufacturer declaration.	✗	✗	✗	✗
Registered Tonnage.	✗	N/A	N/A	N/A
Weighing on crane built in Loadcell.	✗	N/A	N/A	N/A
Weighing in travel hoist.	✗	N/A	N/A	N/A

4.2 One Designs Previously Approved by the Rating Authority

One designs previously approved as such by the Rating Authority may have their certificates endorsed without further measurement on declaration by the owner that the boat holds and is in compliance with her one design class certificate.

5. Retention of Endorsed Status

When a boat changes any data, to retain the endorsed status of her certificate, the changed data shall be verified by a method approved by the Rule Authority and included in paragraph 4.1. above.

APPENDIX 5

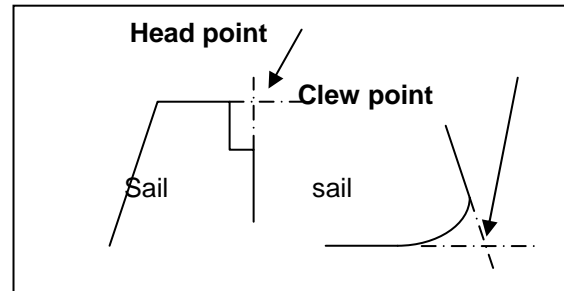
Mainsail Measurement

What is being measured? **Half width, three quarter width and upper width.**

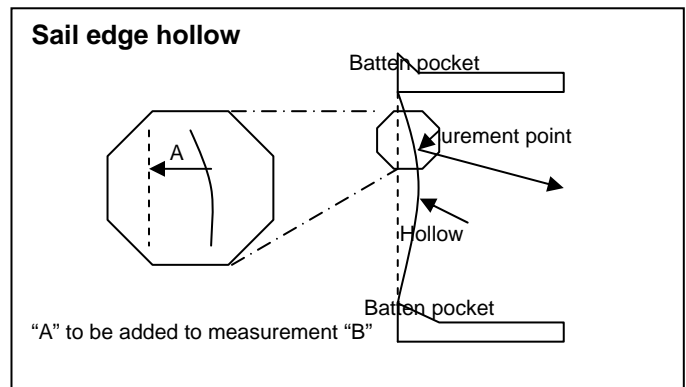
What are these? The distances from the **half, three quarter, and upper leech points** to the **luff**.

In practice:

1. Lay the sail out flat on a suitable floor.
2. Establish **head point** and **clew point** as shown by the diagram.
3. Fold the **head point** to the **clew point**. Mark the fold in the **leech**. That is **half leech point**



4. Fold the **head point** to the **half leech point**. Mark the fold. That is **three quarter leech point**.
5. Fold the **head point** to the **three quarter leech point**. Mark the fold. That is **upper leech point**.
6. Measure from each **leech point** to the nearest point on the **luff**. These distances are the **mainsail widths**.
7. Check for **sail edge hollows**



8. Add any **hollow (A)** to each measured **Width (B)** to get the final **widths**.

References:

Equipment Rules of Sailing. <http://www.sailing.org/documents/isaf-equipment-rules.php>.

G.4.1 and G.4.2 define **clew point** and **head point**.

G.5.2 and G.5.3 define **Half Leech Point** and **three quarter leech point**.

IRC definitions define **upper width** of the **mainsail** as:

MUW The **upper width** of the **mainsail**, the **upper leech point** being the point on the **leech** equidistant from the **three-quarter leech point** and the **head point**.

G.7.5, G.7.6, and G.7.7 define **half width, three quarter width** and **upper width**.

G.2.4 and H.5.2 address **Sail edge hollows**.

APPENDIX 6

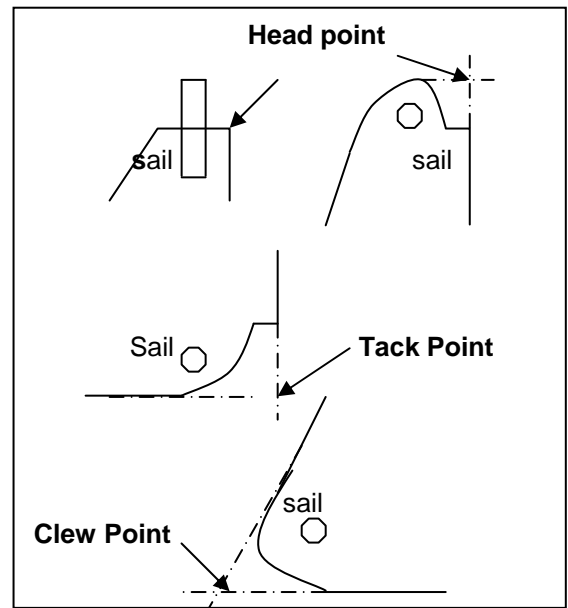
Headsail Measurement

What is being measured? **Luff length, luff perpendicular (LP), half width and three quarter width.**

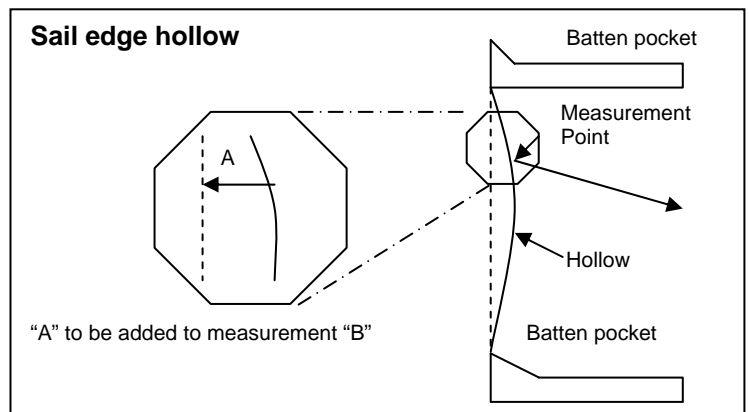
What are these? The length of the **luff**, the distance between the **clew point** and the **luff**, and the distances from the **half** and **three quarter leech points** to the **luff**.

In practice:

1. Lay the sail out flat on a suitable floor.
2. Establish **head point**, **tack point** and **clew point** as shown by the diagram.
3. Straighten the **luff** and pulling firmly measure the **luff length** between the **head point** and the **tack point**.
4. Measure **LP** from the **clew point** to the nearest point on the **luff**.
5. Fold the **head point** to the **clew point**. Mark the fold. That is **half leech point**.
6. Fold the **head point** to the **half leech point**. Mark the fold. That is **three quarter leech point**.
7. Measure from each **leech point** to the nearest point on the **luff**. This will give the **half** and **three quarter widths**.
8. Check for **sail edge hollows**.



9. Add any **hollow** (A) to each measured **width** (B) to get the final **widths**.



References:

Equipment Rules of Sailing. <http://www.sailing.org/documents/isaf-equipment-rules.php>.

G.4.1, G.4.2 and G.4.3 define **clew point**, **head point**, and **tack point**.

G.5.2 and G.5.3 define **half leech point** and **three quarter leech point**.

G.7.3 defines **luff length**.

G.7.5 and G.7.6 define **half width** and **three quarter width**.

G.7.11 defines **luff perpendicular**.

G.2.4 and H.5.2 address **sail edge hollows**.

APPENDIX 7

Spinnaker Measurement

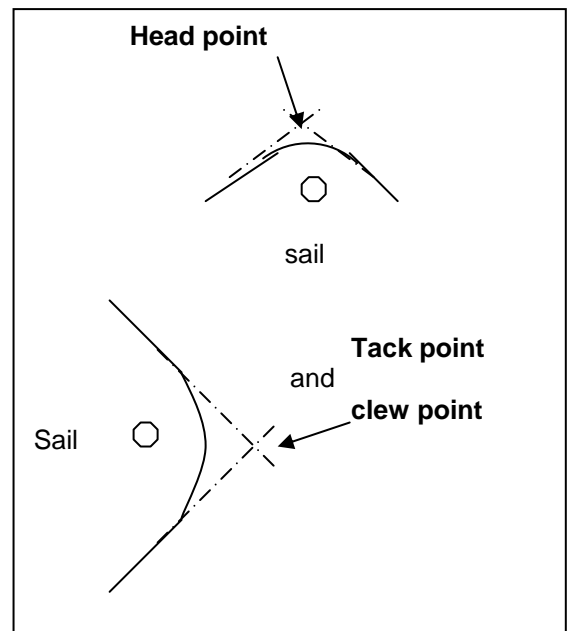
What is being measured? **Luff length, leech length, foot length and half width.**

What are these? The lengths of the **luff**, **leech** and **foot** and the distance from the **half luff point** to the **half leech point**.

In practice:

1. Lay the sail out flat on a suitable floor.
2. Establish **head point**, **tack point** and **clew point** as shown by the diagram.

Note that for a symmetric spinnaker, **luff/leech** and **tack point/clew point** are interchangeable.
3. Straighten the **luff** and measure the **luff length** between the **head point** and the **tack point**.
4. Straighten the **leech** and measure the **leech length** between the **head point** and the **clew point**.
5. Straighten the **foot** and measure the **foot length** between the **tack point** and the **clew point**.
6. Fold the **head point** to the **tack point**. Mark the fold. That is **half luff point**.
7. Fold the **head point** to the **clew point**. Mark the fold. That is **half leech point**.
8. Measure from the **half luff point** to the **half leech point**. This will give you **half width**.



References:

Equipment Rules of Sailing. <http://www.sailing.org/documents/isaf-equipment-rules.php>.

G.4.1, G.4.2 and G.4.3 define **clew point**, **head point**, and **tack point**.

G.5.2 defines **half leech point**.

G.5.7 defines **half luff point**.

G.7.1, G.7.2 and G.7.3 define **foot length**, **leech length** and **luff length**.

G.7.5 (b) defines **half width**.