International A Class Measurement Procedure

A suggested method

Preamble

These notes document the method that has evolved in the Gosport MYBC, GBR, under the guidance of John Smith who was the author of the original document on which this edited version is based.

Grateful thanks are due to John for allowing us to evolve this version.

Some of the photos used to illustrate the process are of free sailing A Class boats.

References - 1

The following documents are referred to in the slides

- A Class Rules – IRSA International A Class rules 2018.
- ERS – Equipment Rules of Sailing 2017-2020

References - 2

The following documents will give valuable additional insight into the measurement process for the A Class as well as for any other class.

- International Measurers Manual – published by World Sailing
- Guidance for Equipment Inspection (event measurement) – published by IRSA

Contents

The process has been broken into a number of phases

- Preparation
- Measurement (without any jigs)
- Hull measurement (in the tank)
- Hull measurement (in the dry jig)
- Other measurements
- Sail measurements

PREPARATION

Preparation - 1

1 By the boat owner/presenter of the boat for measuring.

2 By the measurer/measuring team.

Whilst it is possible for an A Class boat to be measured by an **official measurer** acting alone, the task will not only be easier, but can be checked and validated if undertaken by a team of 2 (or more) **official measurers**.

- Prior preparation by the OWNER presenting the boat for **certification measurement**.
- This is out of the control of the **official measurer** except that it should be in a ready to race condition – feel free to reject any boat that is not .

- Prior preparation by the **official measurers**.
- This requires that the necessary equipment, tools, jigs etc. are available and in good working order and that the working space is clean and comfortable.

Preparation - 2 Paperwork

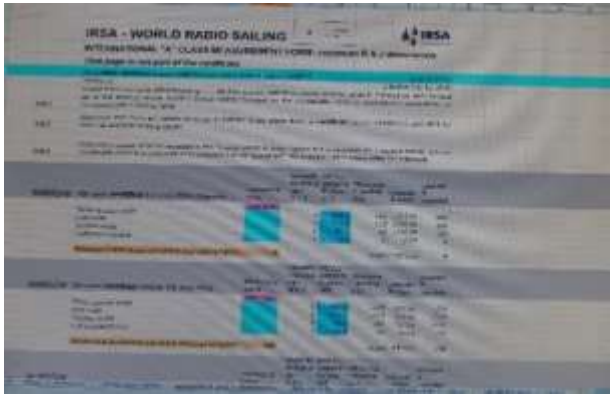
IRSA A Class Rules – electronic or hard copy

Print a blank copy of measurement forms to facilitate recording critical measurements.

Pen and paper for recording other data

- IRSA A Class Rules – electronic or hard copy

- Set of IRSA A Class Measurement Forms & Certificate (electronic copy for calculation and hard copy for recording data). The page concerning sail sizes is shown here.



- Pens/pencils for recording/marking.

Preparation - 3 Equipment

NB This is not a definitive list of all the equipment needed.

There may well be suitable alternatives for some stages of the process.

- Measuring tank adapted to facilitate establishing the flotation waterplane of the boat
- Scales for weighing the boat
- Jigs to aid measurement of QBL, freeboard, draught etc
- Steel tapes for taking measurements
- Vernier gauge and straight edge rules in lengths of 50 mm, 300 mm, 600 mm & 1 metre.
- A selection of different colour adhesive tapes (possibly including some double sided)
- Some lead sheet or strip (for possible use with double sided tape)

Measurements
(without any jigs)

Weighing - 1

Weighing scales need to be of sufficient *resolution* to permit the weight of the boat to be established with confidence.

Scales that read the weight in increments of 20 grams or better have sufficient *resolution.*

Accuracy is established by using calibration weights of a sufficiently high *accuracy* standard. This is M1 or better.

The calibration weights are used before and after the boat weighing process to establish what correction may be needed.

If using a support bracket (as illustrated) ensure the reading is zeroed AFTER adding the support and BEFORE the boat is weighed.

Weighing - 2

Ensure the boat is complete WITH all on board rc equipment, rigging, mast and booms but WITHOUT sails.

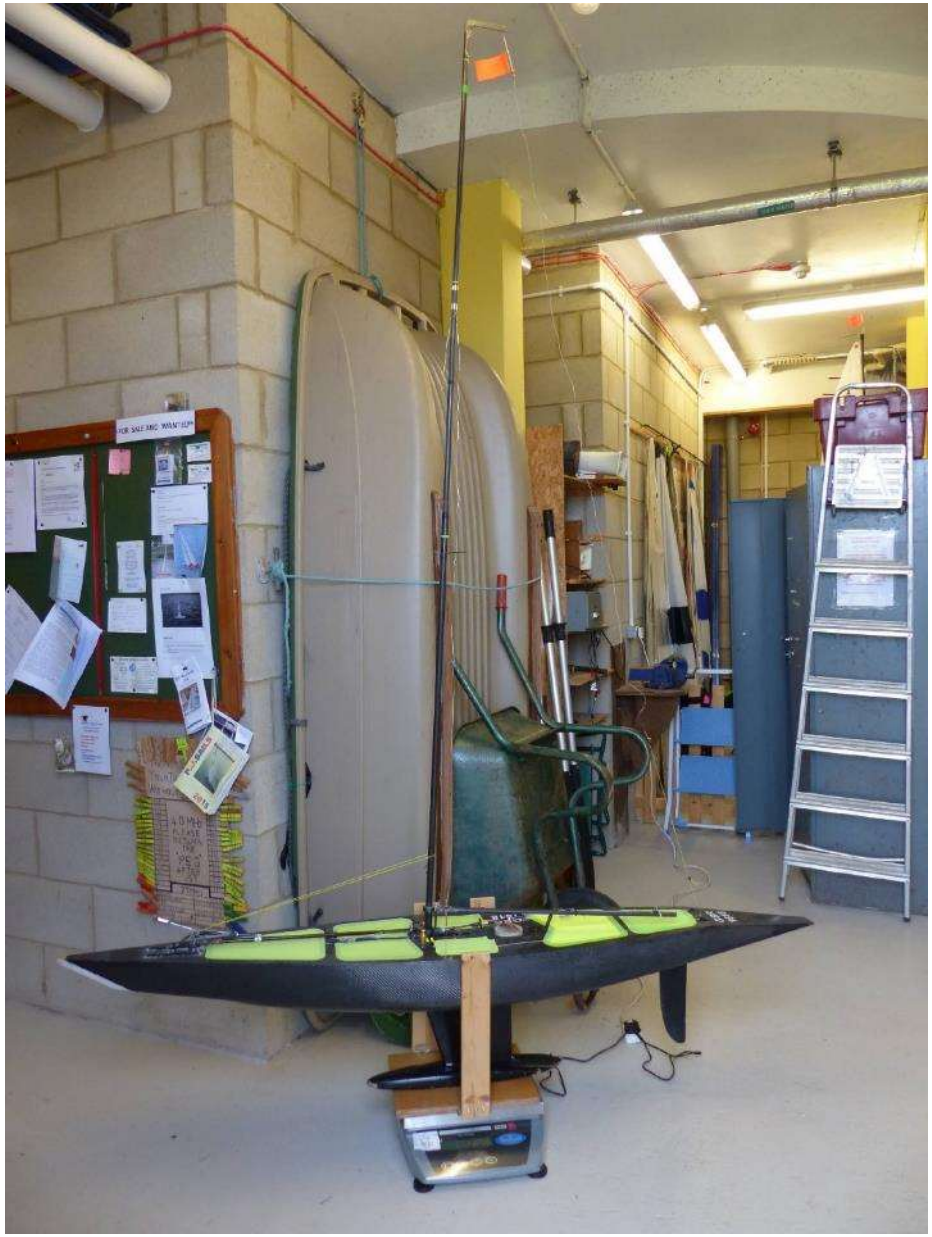
Instead of sails there should be 2 x 50 gram weights placed one each side of the mast in its central position.

Weighing - 3

Rigging shall be slack.

The **mast** shall be upright.

If the mast box permits the mast to travel fore and/or aft, some form of very lightweight restraint may be used to hold the mast upright. As shown in this photo the mast ram steadies the mast forwards and a length of elastic maintains sufficient tension to keep it upright.



Weighing - 4

A 20 gram or better resolution of the scales is needed to ensure the boat's sail area can be maximised – this optimisation is not really the **official measurer**'s task but the owner will be grateful and happier.

A boat found to be 12.75, 12.76, 12.77, 12.78 or 12.79 will be rounded up to 12.8 kgs giving a larger sail area.

Weighing - 5

This boat, with weight, recorded as 12.8, could weigh between 12.7 and 12.9 kg at an event and be compliant with the IRSA A Class rules.

C.10.1 (a), H.6.3 & H.6.4 apply.

NB The tolerance is not so that the owner may add 0.1 kg to the boat but to allow for error in the original and subsequent weighing.

Weighing - 6

Had this boat weighed 12.74 kg, for example, then rounding would mean a recorded weight of 12.7 kg.

At an event the compliant weight would then be 12.6 – 12.8 kg

Please take the opportunity to explain the consequences of this rounding effect to the owner.

Weighing - 7

Given that most boats take on some weight over time, a wise precaution for the owner of a boat weighing, say, 12.74 kg would be to add 10 grams to increase it to 12.75 thus permitting recording at 12.8.

The lead sheet mentioned earlier as part of a measurer's equipment can be used to add weight to the boat – ensure it is bonded or fixed into the hull somewhere.

Lower mast limit mark

Check that the upper edge of the **mast lower limit mark** is in line with an extension of where the upper edge of the **main boom** spar cuts the **mast**.

On this boat the **mast** spar is not visible at this point so the **lower limit mark** is placed on the fitting.

C.7.4 & F.3.3(b)(3) & J.10

Take and record the following measurement:

Height from the deck to the upper edge of the **mast lower limit mark**.

Foretriangle height limit mark

Measure and record the dimension from the deck to the lower edge of the foretriangle height **limit mark**.

This dimension shall not exceed 1625 mm.

See CR F.3.2

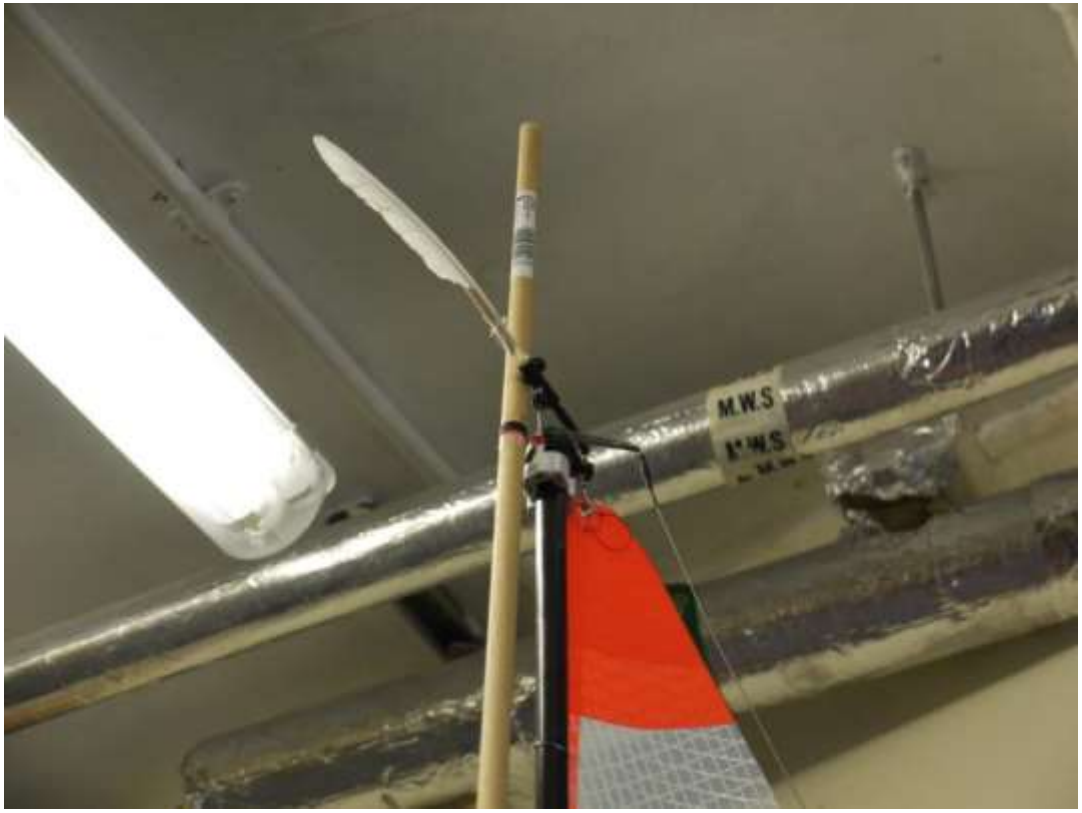
Mast upper limit mark

Measure and record the dimension from the deck to the lower edge of the **mast upper limit mark**.

This shall not exceed 2167 mm.

Here a timber gauge with a mark at 2167 mm is used as an aid to measurement.

F.3.2 & F.3.3(b) (1) & (2)



Mast deck limit marks - 1

If the boat has been presented with deck **limit marks** for the foretriangle and **mast** these dimensions can be measured and recorded.

H.4.1 & H.5.11

NB A **main boom limit mark** is no longer required; the ‘B’ measurement is found from the mainsails.

Alternatively both the J and B dimensions are found as output from the measurement process and become information used for specifying the sails.

Mast deck limit marks - 2

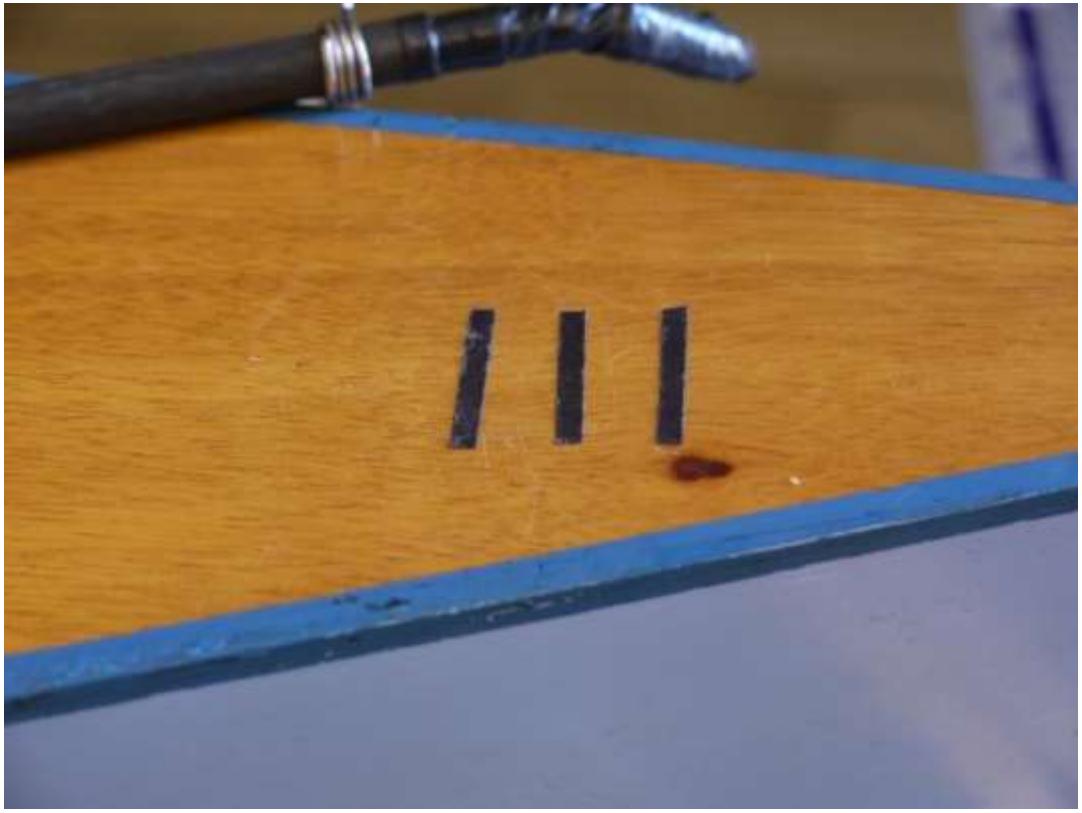
The aft edge of the foretriangle deck **limit mark** and the foremost edge of the **mast** deck **limit mark** are used for measurement.

D.2.4(b)(3) & (4)

If the **mast** may be moved fore and/or aft there shall be 2 additional **limit marks** at the foretriangle position and **mast** position, placed at plus and minus 13 mm intervals as shown here, to show the limits of movement.

Limit marks are required to be long enough to be clearly visible when the boat is afloat.

Whilst it is not the measurer's responsibility at **fundamental measurement**, it is good practice to ensure that the owner understands that the downward extension of the headsail luff should fall within the 'J' mark corresponding to the relevant mast position.



Hull measurements
(in the tank)

Ideal tank - 1

This tank has weirs set in from the extreme ends. Their height, relative to the water surface, is adjusted by wedges under the tank.

It is beneficial to smear a little solid or liquid soap onto the horizontal surfaces of the weirs as this helps to break the surface tension in the water.

This precaution effectively avoids any significant impact of the meniscus on measurements.

Ideal tank - 2

A jig for measuring the forward and aft overhangs is illustrated here. A piece of 'U' section aluminium is supported with an adjustable length leg at its outer end to ensure it is level with a spirit level.

An engineer's square is placed in the 'U' channel in readiness.

It is ideal to have a similar jig at both ends of the tank.

Ideal tank - 3

This tank has been configured such that the weirs are parallel in both planes and the ‘U’ channel aluminium is shown attached at each end via a small clamp.

Pulleys are shown in their lowered position but are adjustable to be used for a line to draw the boat forwards to the weir to measure the forward overhang, and backwards to measure the aft overhang.

Ideal tank - 4

The tank also has viewing windows which can assist with any underwater checking routines (draught and rudder or appendage clearance).

Ideal tank - 5

Pulleys are in the lowered position but will be raised and locked in place to facilitate drawing a boat to the weir at very slow pace without handling, thus avoiding rocking or undue hand pressure.

An adjustable cranked mirror facilitates underwater viewing of the contact between hull and weir. Be careful to minimise water level disturbance and compensate for any loss.

Measurements taken with the boat afloat

- All ‘wet’ measurements are especially critical and it is therefore essential that sufficient time is given to these stages, avoiding where possible movement of the boat which might influence the measurements found.

Forward overhang - 1

The tank is filled to just short of weir level before the boat is placed in the tank, in measurement condition, in order that any surplus water breaches the weir.

The boat is drawn forward so that the forward flotation waterline length measurement point is reached when the hull ‘kisses’ the weir under the pulling power [weight] of 2 small plastic clothes pegs and a length of line.

An engineer’s square is placed in contact with the foremost point of the bow.

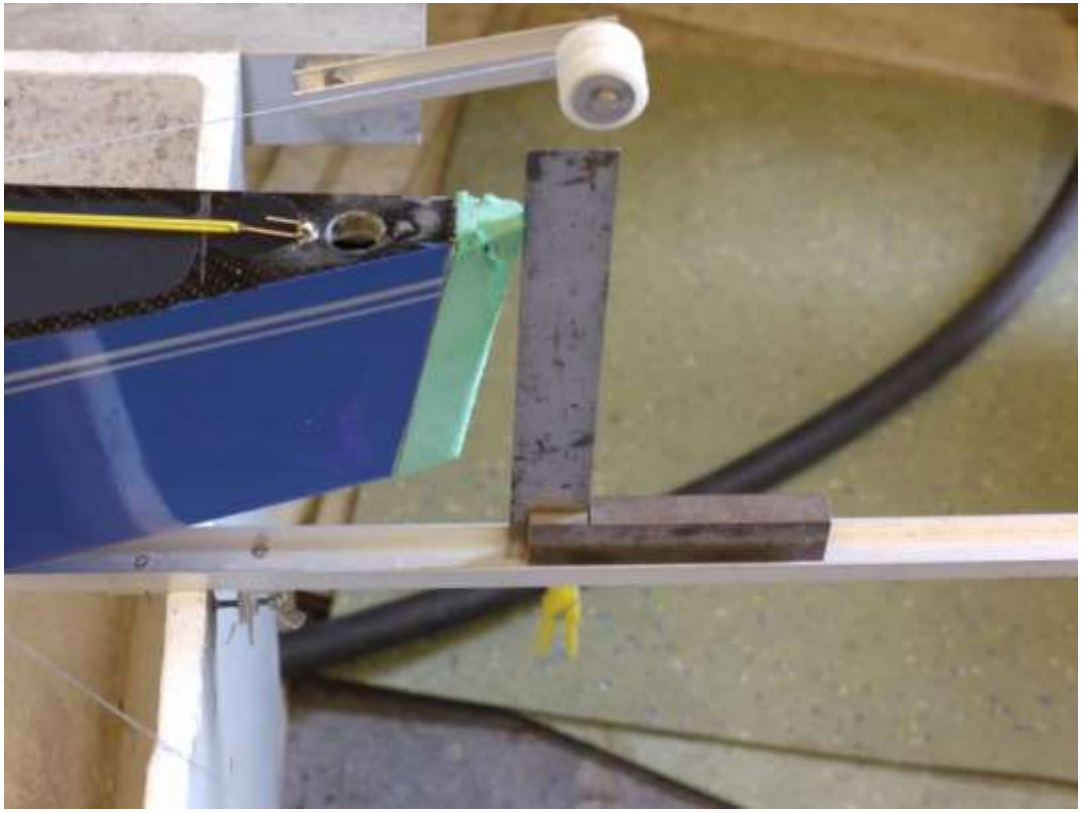
The drawing forward process is repeated a number of times to find the most repeatable position.

Adjust the pulley positions vertically so that the line from the boat to the drawing pulley is parallel to the waterplane to avoid any upward or downward force.

Forward overhang - 2

Care is needed to ensure that the underside of a bow, especially if it has a shallow profile, does not foul the channel holding the square.

Equally, if it becomes clear that the boat has a very slippery underside and there is the prospect that even under the very light weight of the plastic clothes pegs, the bow (or stern) may ride up the weir, an additional peg might be used from the opposite end to slow the progress of boat movement.



Aft overhang

The principle and method are the same as for the forward overhang although, as can be seen from this illustration, an additional jig, comprising 75 mm wide stainless steel plate, is suspended at water level in contact with the weir.

This enables the measurer to check and ensure that when the boat is drawn backwards, the rudder does not prevent a contact with the weir/water level at the rear flotation waterline length point. It also enables the measurer to establish that the rudder itself does not cut the flotation waterline.

Alternatively rotate and/or drop the rudder until it does not foul the weir (and check it does not cut the waterplane in its central position).

The plate here is made from 2 mm thick plate. A refinement is to reduce the thickness of the plate to 0.5 mm in the centre. The additional section protrudes 25 mm thus making the adjustment of any calculations for the ‘false’ length of the tank very simple.

Overall length - 1

Establishing the flotation waterline length in this procedure relies on deducting the forward and aft overhangs lengths from the overall length.

Care should be exercised if attempting to measure overall length using a steel tape measure.

A more accurate method is to determine the overall length with the boat floating in its measurement trim.

The ‘aft shortfall’ jig, illustrated here, has a ruler suspended at water line level with a plate in both horizontal and vertical planes set at right-angle to the rule zero datum point.

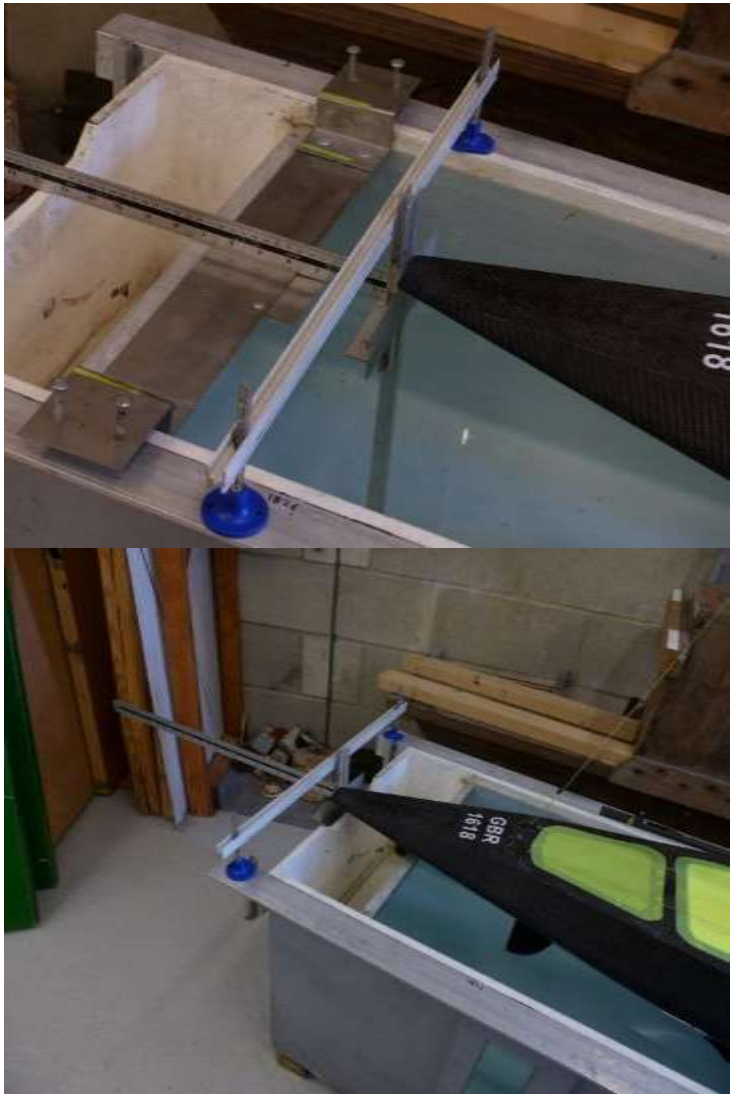
Overall length - 2

The ‘aft shortfall’ can simply be read from the rule at the weir.

The upper photo illustrates measuring the ‘aft shortfall’ during measurement of the forward overhang.

The lower photo simulates the situation where there is an ‘aft excess’

As a further check, the same method is adopted when measuring the aft overhang to establish the ‘forward shortfall’ or ‘forward excess’.



Overall length - 3

A spreadsheet is not needed for this fundamentally simple calculation.

It does need thinking through as some hulls, when drawn to the forward water line mark will have an aft and/or forward 'shortfall' to the weir whereas some longer hulls will have an 'excess' beyond the weir.

Measurements will be taken to calculate the overall length in both conditions as a cross check.

The water line length can then be established by subtracting the sum of the forward and aft overhangs from the overall length.

FWL = flotation waterline length

Measure Forward Overhang (FOH)

Measure Aft shortfall (ACL)

Measure Aft Overhang (AOH)

Measure Forward shortfall (FCL)

If necessary measure Forward Excess (FXS) or Aft Excess (AXS)

If not already known, measure length of tank between weirs. (W)

Overall Length = FOH + FWL – ACL

Check with

Overall Length = AOH + FWL – FCL

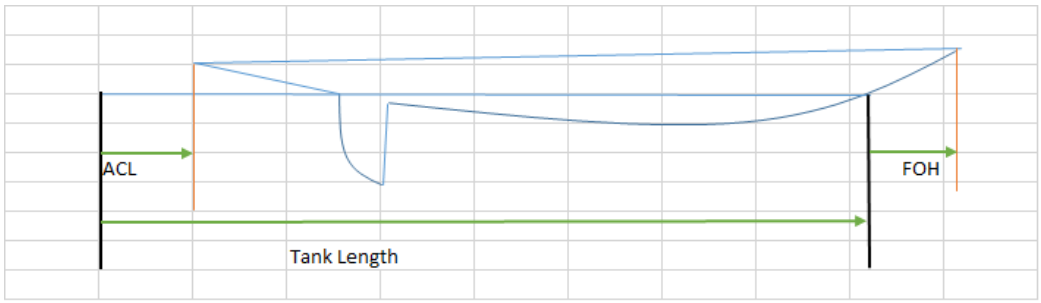
If there is an excess rather than shortfall

Overall Length = FOH + FWL + AXS

Check with

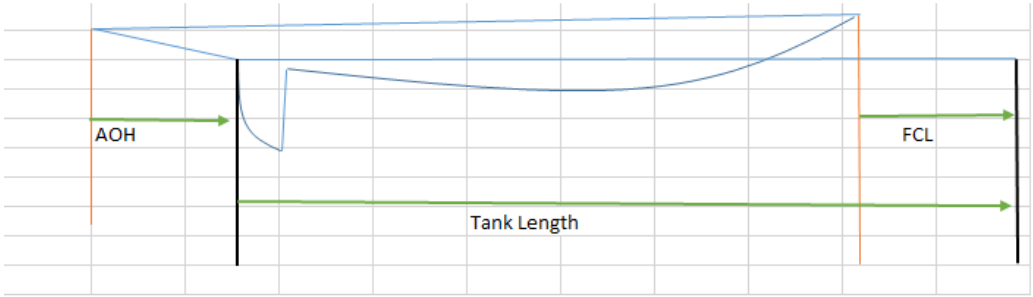
Overall Length = AOH + FWL + FXS

Measuring overall length where there is aft and/or forward clearance



Fore (FOH) overhang measured in normal manner.

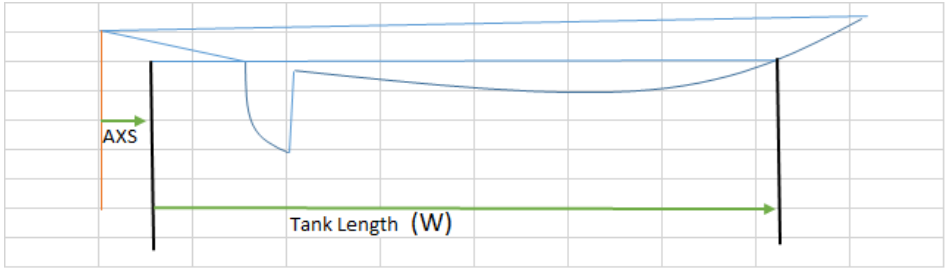
Aft clearance (ACL) measured using appropriate jig.



Aft overhang (AOH) measured in normal manner.

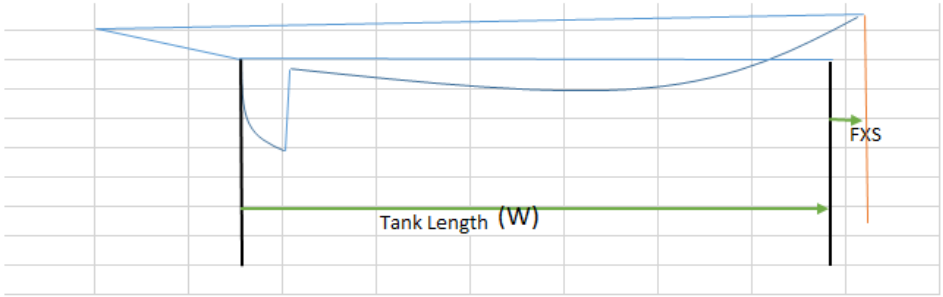
Fore clearnace (FCL) measured using appropriate jig.

Measuring overall length where there is aft and/or forward excess



Forward overhang measured in normal manner.

Aft excess (AXS) measured carefully



Aft overhang measured in normal manner.

Fore excess (FXS) measured carefully

Establishing overall length - 4

Where the forward and the aft waterline length measurement points on the hull are determined directly, the following process works extremely well:

- Place the boat on the dry measurement jig.
- Adjust the jig so that the forward and the aft waterline length measurement points coincide with the virtual waterline endings.
- Use a set square to project the extreme ends of the bow and stern down onto the waterplane.
- Measure the forward overhang, waterline length, aft overhang, and overall length directly.

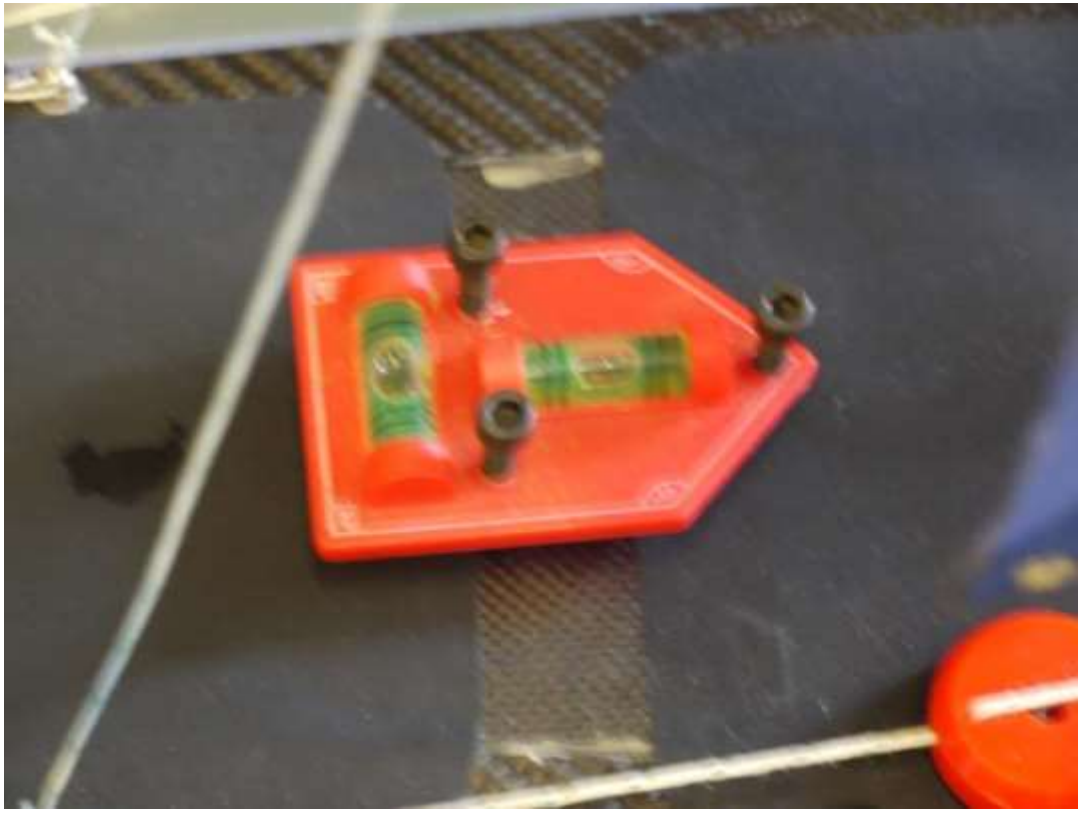
Flotation trim - 1

In order to achieve an accurate representation of the boat as it is afloat when it is subsequently placed in the ‘Dry Jig’, it is necessary to know it’s **measurement trim** attitude.

This can be achieved by placing a 3 legged spirit level at a firm and known point on the hull. Adjust the legs until level is achieved laterally and longitudinally.

Remove the spirit level without further adjusting the legs and the **measurement trim** can be reproduced in the ‘Dry Jig’ later.

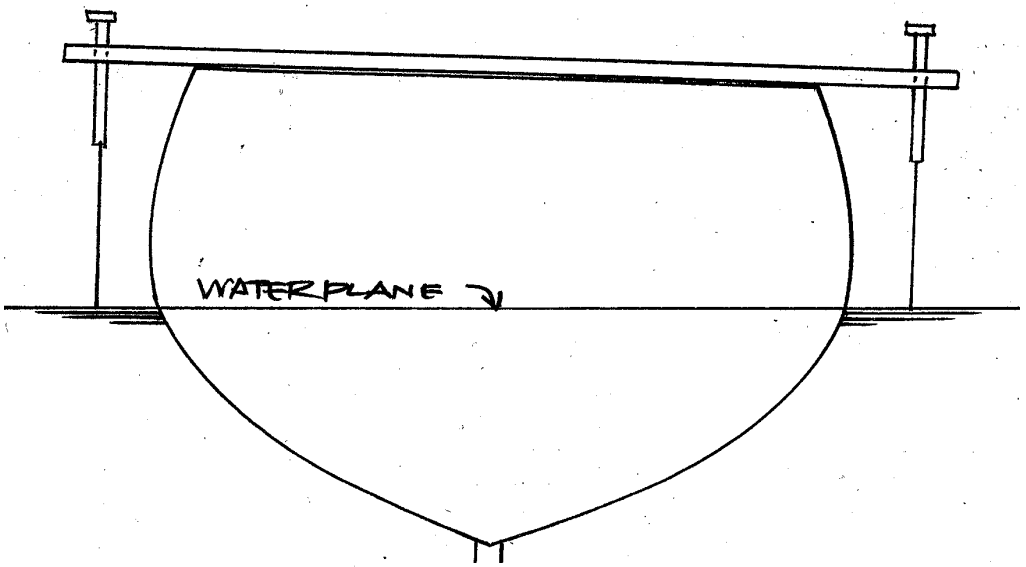
(Remember where you placed the level!)

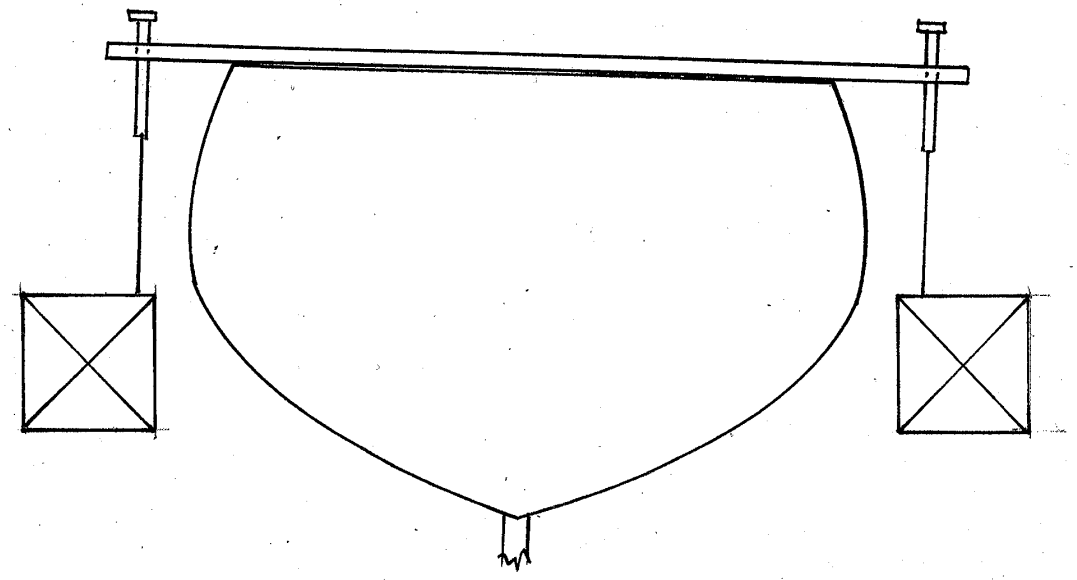


Flotation trim - 2

A more sensitive method is to use a light balsa beam with two plastic adjustment screws extended with 1 mm diameter wires, to measure the freeboards when afloat, port and starboard, near midships.

The same attitude can then be re-created on the dry jig at a later stage.





Draught - 1

This illustration shows the draught gauge in place in the tank.

Set the gauge level using the inbuilt spirit level and subsequently adjust each side to maintain the lateral beam in a level condition.

Draught - 2

Run the boat slowly (using the pulling weight of the clothes pegs gives a very steady draw) fore and aft adjusting the level equally each side until the lowest point of the keel kisses the gauge.

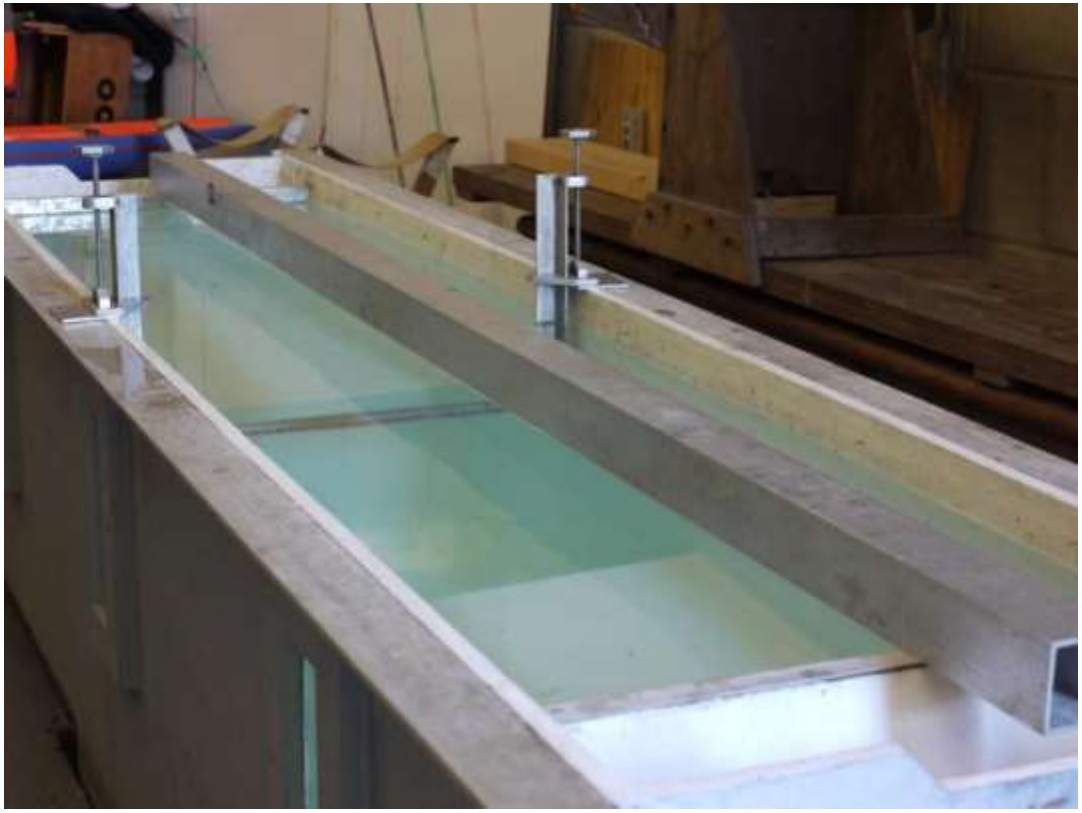
Check to ensure that the rudder (or any other appendage) will clear the gauge.

Draught - 3

Remove the boat from the tank and place a straight and rigid beam from weir to weir.

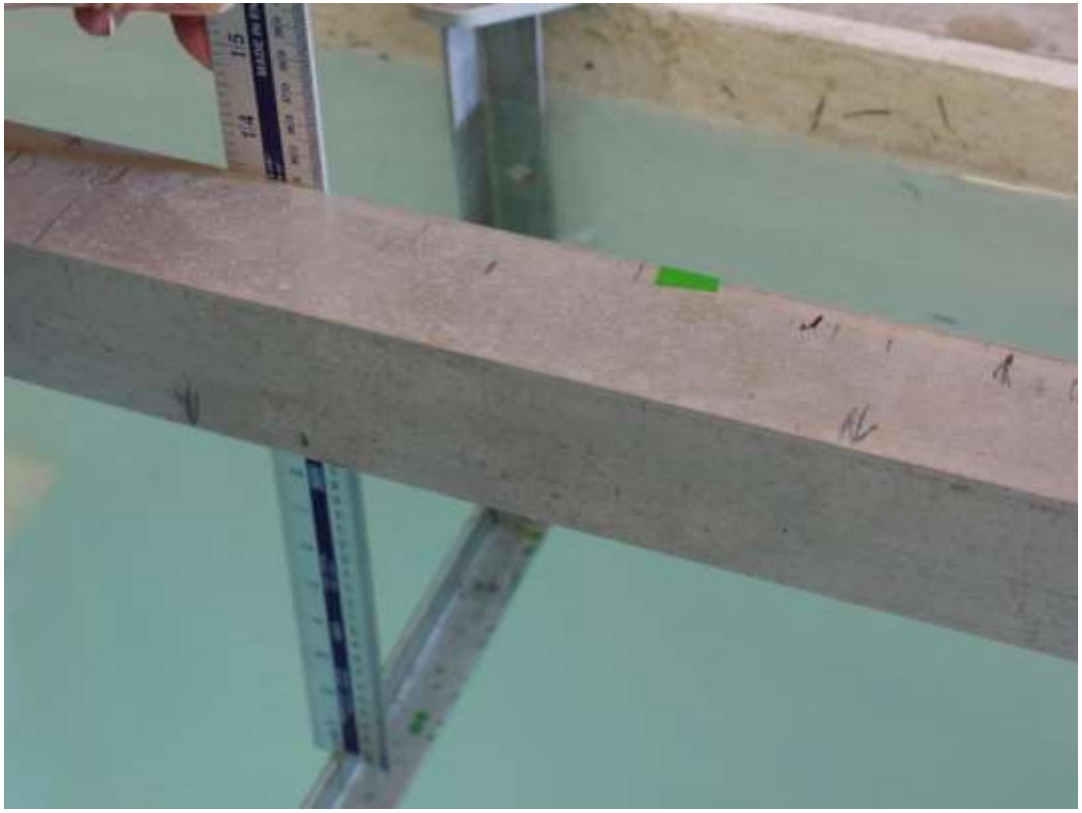
Measure the draught to either the top level of the beam (and adjust for beam depth) or to the lower level of the beam (with the boat out of the tank this must be the waterplane level).

Alternatively, with the boat in the tank, measure from the water surface to the upper edge of the draught gauge (each side of the boat) – use a soap solution to minimise the meniscus at the rule.



Draught - 4

It is easier to read, and therefore likely to be more accurate measuring to the top of the beam. Then deduct the depth of the beam to arrive at the draught measurement.



Draught measurement is a particular area for CARE, time and patience as a poorly measured draught could have serious consequences. A draught penalty has a major negative effect on permitted sail area. A falsely low value fails to penalise where appropriate to do so.

Consider marking the position on the rule so that this depth can be reproduced later when setting up the dry jig.

Hull measurements (in the dry jig)

Preparing the dry jig - 1

The main components of the jig are the fixed bed and two uprights.

The upright to the right is fixed and is used for the bows.

The upright to the left is a travelling one and is used for the stern.

Preparing the dry jig - 2

Having checked to make sure the jig base itself is level, …

… the spacing between the uprights is initially set at the waterline length as measured and calculated in the tank.

Preparing the dry jig - 3

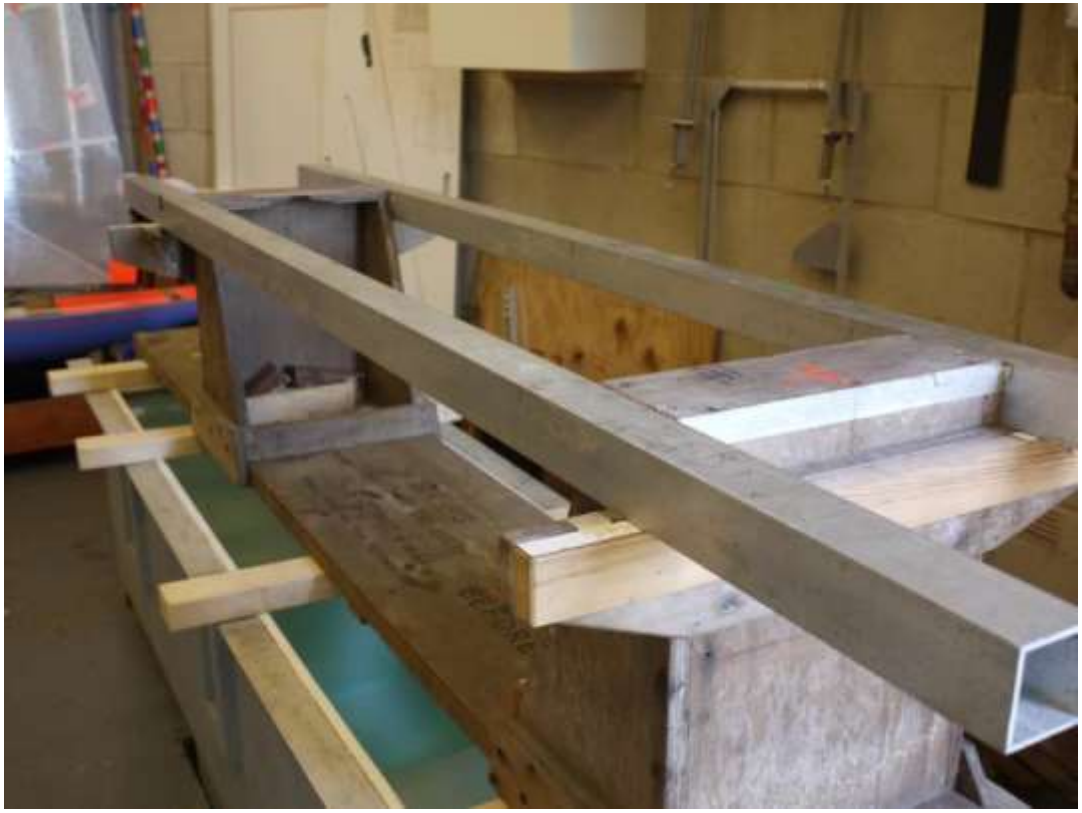
Having the boat correctly placed in the dry jig is critical as it can affect freeboard and QBL measurements. Therefore, once the boat has been settled on the dry jig, check the waterline length (distance between uprights) on the jig again. Adjust as required.

Once this dimension has been checked and adjusted, a locking mechanism is used to ensure the flotation waterline length will remain stable throughout the remainder of this phase of the measuring.

Jig design - 1

Both the fixed upright and the travelling upright have horizontal extensions to either side set at 50 mm below the waterplane level.

These extensions carry straight and rigid 50 mm square section aluminium beams to simulate the waterplane level.



Jig design - 2

When set on the side extensions, the upper face of the beams will be at the waterplane level.

When a beam is set on the upper central level of the jig, the underside of the beam will be at waterplane level.

Both faces will be used.

The photo illustrates the ease with which the true draught can be reproduced if the rule had been marked from the ‘wet measuring’ stage.

The lower edge of the rule rests on a height adjustable table.

Jig design - 3

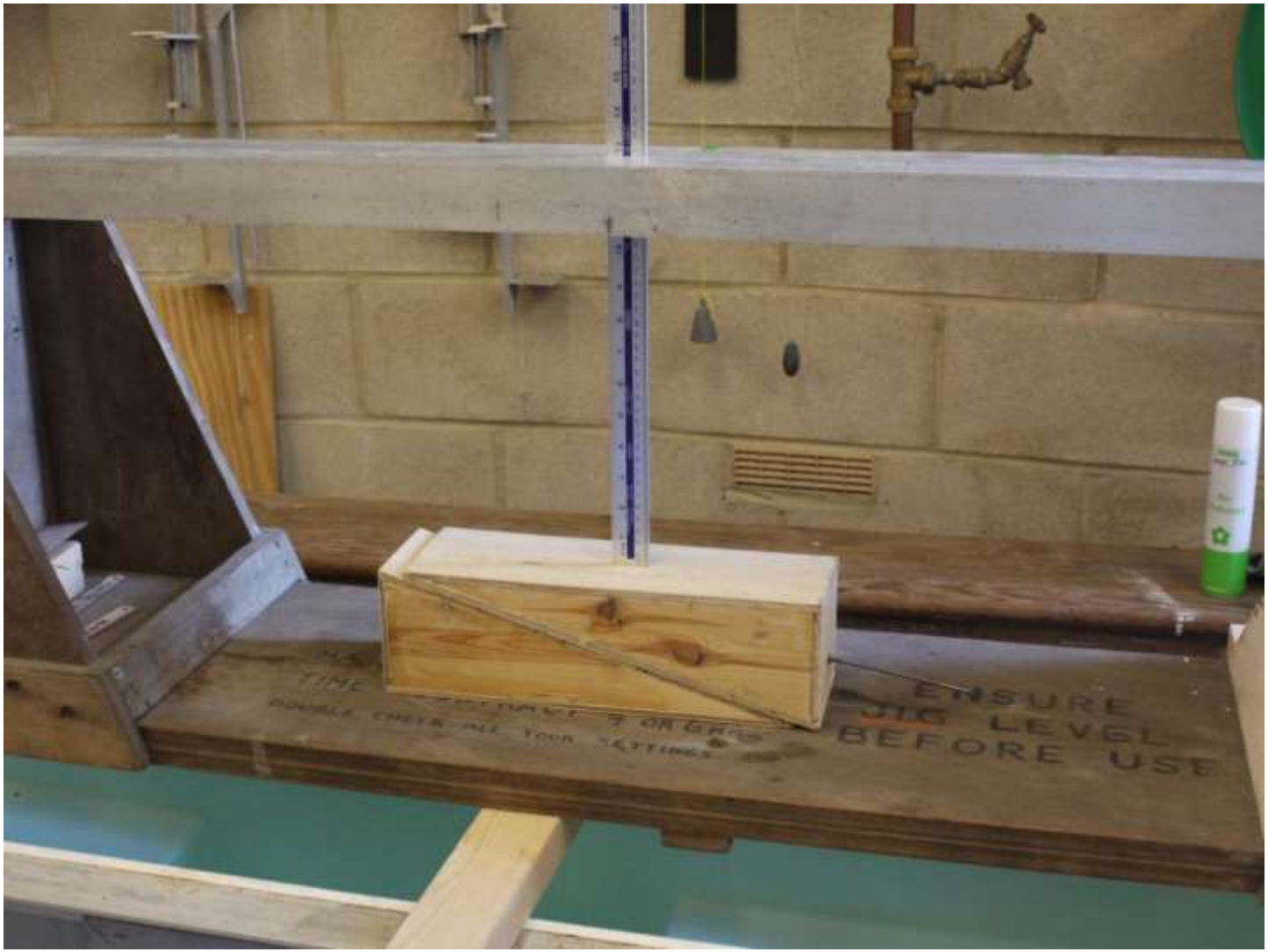
Firstly use the beam on the upper level, then measure down and set a base level at the measured draught level.

In due course this will support the keel.

If using the screw jack style board illustrated ensure that it is level by checking the draught at the forward and aft extremities.

Jig design - 4

An alternative keel support system is the ‘parallel wedge jig’.



Jig design - 5

The use of angled surfaces, when drawn together using studding with wingnuts, lifts the horizontal surface evenly and gradually.

Although capable of being made in a variety of sizes, in practice two, one shallow and one deeper, are sufficient for a large range of draught.

Fore and aft position of the hull on the dry jig

- Remove the rig from the boat and set the boat on the dry jig. Locate the boat so that the previously established forward and aft overhangs are reproduced.
- If, as on some hulls, the aft flotation waterline length measurement point is at the rudder stock, placing the boat on the jig in its correct fore and aft position is easy. However, achieving the correct attitude of the boat is less easy when the aft flotation waterline length measurement point is on a vertical surface e.g. the aft face of the rudder stock.
- Use of the 3 legged spirit level, or the alternative beam system used at the stern, is essential to achieve the correct positioning and attitude of the boat on the jig when the aft flotation waterline length measurement point is on the vertical face of the rudder stock. This, together with ensuring that the keel support is set at the correct draught level, aids achieving the correct attitude of the boat. Small wedges may be needed under the transom area to stabilise the boat.
- If, however, there are no distinct points to easily locate, then careful measurement and adjustment are necessary.

Transverse attitude of boat

The transverse attitude of the boat in the dry jig should match that achieved when the boat was afloat. See **Flotation trim – 1** and **Flotation trim – 2**.

This can be done by using a light balsa beam, long enough to extend across the hull at midships, and equipped with a screw adjustable vertical wire at each end. With the beam at a known point on the hull, the wires are adjusted until their tips just touch the water surface. – see **Flotation trim - 2**.

When the boat is placed in the dry jig at a later stage the beam can be replaced on the hull which may then be levelled to reproduce the same flotation trim.

Alternatively, measure the freeboards at the midships positions when the boat is afloat and reproduce them when the boat is on the dry jig.

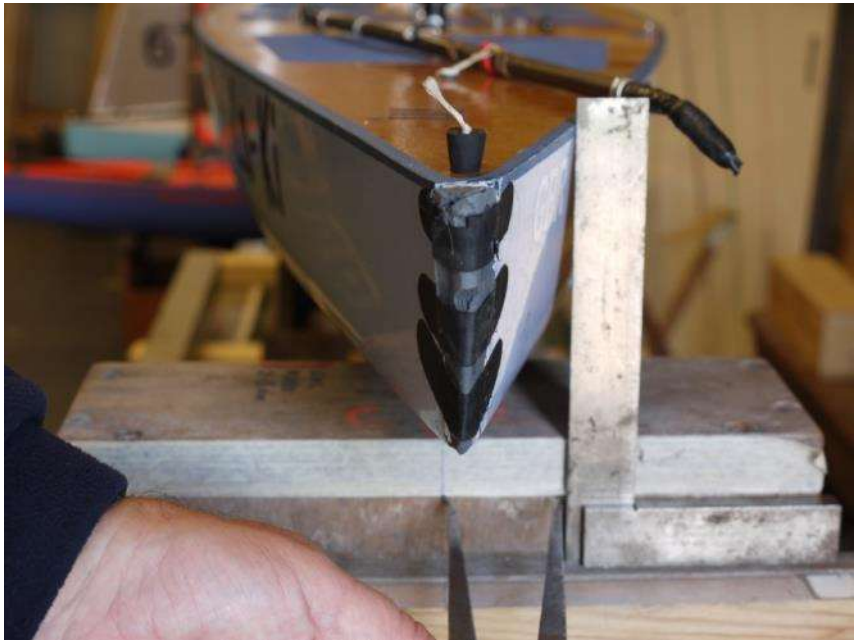
Centralize the hull

Although most measurements are taken on port and starboard sides, with mean values used for the rating, it is best to centralize the boat on the jig.

The class rules set a maximum limit on the difference between port and starboard QBL. The lateral position of the hull will affect this.

The photos show the use of an engineer's square and dividers to centralise the boat. Keep an eye on the 3 legged spirit level.

The boat should now be in its measurement trim.



Set the aluminium beams - 1

With the measurement trim established, and with the upper edges of the beams at waterplane level, place the beams such that they are parallel to the centreline and just making contact with the hull at the maximum beam.

Bring the beams into contact with the hull carefully and slowly.

Check contact either with the aid of torchlight or try to pass a sheet of paper between the beam and hull.

(It shouldn’t pass!)

Set the aluminium beams - 2

Measure the distance between the beams at either end of the jig, both to establish the distance (waterline beam) and to ensure that the beams are parallel.

Record the waterline beam measurement (there is no place on the measurement forms for this dimension).

Beam Extenders to accommodate narrow hulls.

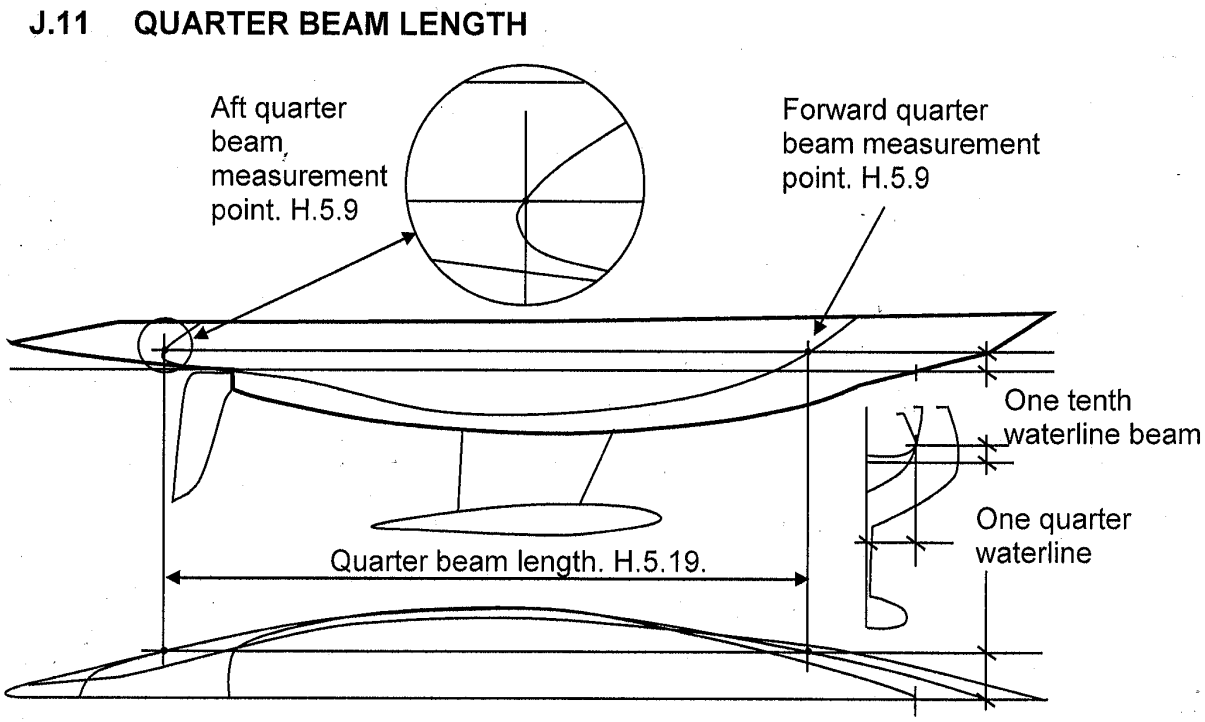
Depending upon the limitations of the width of the dry jig, it may be necessary to attach ‘extenders’.

These are made of 50 x 50 mm aluminium angle.

Take into account the impact of the extenders when establishing the waterline beam.

Measuring Quarter Beam Length (QBL)

The objective is to measure the fore and aft distance between two points on the starboard side and then to measure the distance between two on the port side.



H.5.9 QUARTER BEAM MEASUREMENT POINTS

The quarter beam measurement points are located on the external surface of the **hull** shell one tenth of the waterline beam above the waterplane and one quarter of the waterline beam from the centreplane.

Setting the QBL jig - 1

This jig has been engineered and adjusted so that the pointed end of the probe extends one quarter of the waterline beam from its working face.

If the boat is so narrow that extension sections on the beams have to be used, the probe should be adjusted accordingly.

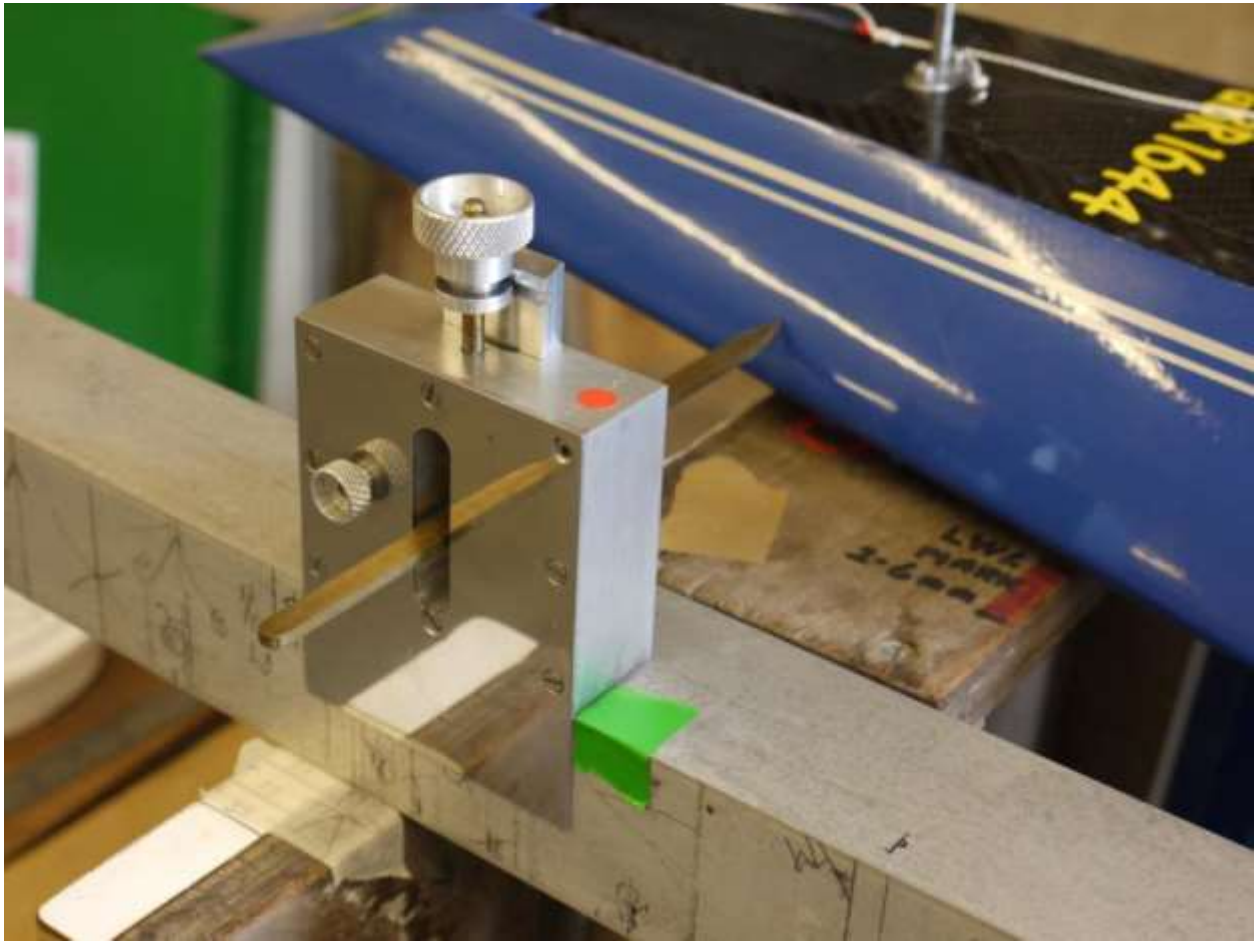
Setting the QBL jig - 2

And its height is then adjusted to one tenth of the waterline beam.

Setting the QBL jig – 3

The jig is then slid along the beam until the point of the probe comes into contact with the hull.

The easiest way to establish the point of contact is by using a torchlight and marry the point of the probe with the point of the shadow it casts.



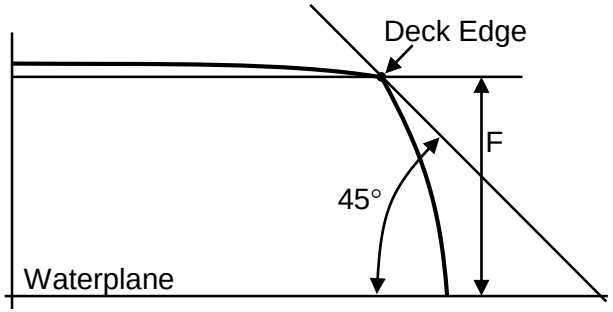
Setting the QBL jig - 5

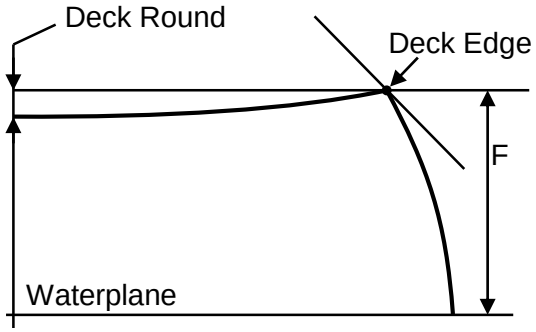
- Once the QBL point is found, mark the position of the jig on the beam.
- The process is repeated for each end of the boat and on each side.
- The length between the marks is measured and recorded (for port and for starboard).
- Check that the QBL measurements do not differ by more than 25mm. If they do, the ‘centralised ‘ positioning of the boat needs to be adjusted and the measurements taken again. The waterline beam will remain the same. QBL measurements can also be affected by asymmetry of the hull introduced during the build process.
- Unless it is clear that there are no hollows within a 50 mm radius of the QBL point, it is also prudent to apply a little tape, or ink, at the points to check this later. Class rule D.2.3 (d) (3).

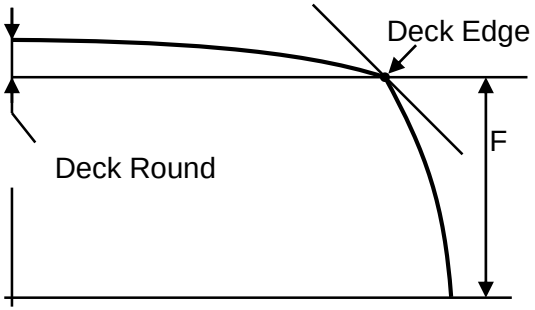
Measuring Freeboard - 1

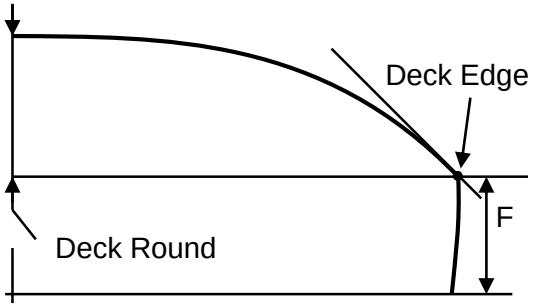
Reference may be necessary to the A Class rules which clarify the precise point to be used if there is any deck round at each of the freeboard measurement stations – class rules H.5.7.

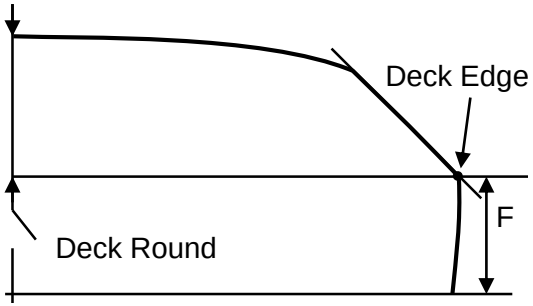
Diagrams are from class rules J.5 & J.6











Measuring Freeboard - 2

Use a fine adjustable rocker height gauge to establish the points on the deck edge that are vertically above the measured waterline length measurement points and at a point midway between them.

NB The difference between the measured waterline length and flotation waterline length is that the former includes any additions due to bridged hollows or extensions.

Measuring Freeboard - 3

Six freeboard measurements are taken and recorded. (fore, aft and midway between these two on each side of the boat)

Flotation waterline length limit marks - 1

Unless these have already been added and can be verified as correct, the easiest way to ensure the **limit marks** are placed at the correct point is to stick some coloured tape on the underside of the hull so that it butts against the jig uprights.

The **limit marks** can then be applied to butt against the tape before removing the tape.

Flotation waterline limit marks - 2

When the hull is removed from the jig, the **limit marks**, perhaps strips of deck patch material between 2 and 6 mm wide, can then be butted up to the tape before it is removed.

These flotation waterline **limit marks** should be long enough to be ‘clearly visible’ when the boat is afloat.

Where there is concavity in the bow profile - 1

Where there is concavity in the bow profile the designer and builder will normally have arranged for there to be no concavity in the bow profile forward of a point 20 mm below the waterplane.

The following slides assume there is no hollow in the bow profile and checks are made using a jig to test this is so.

D.2.2 MEASUREMENT (a)

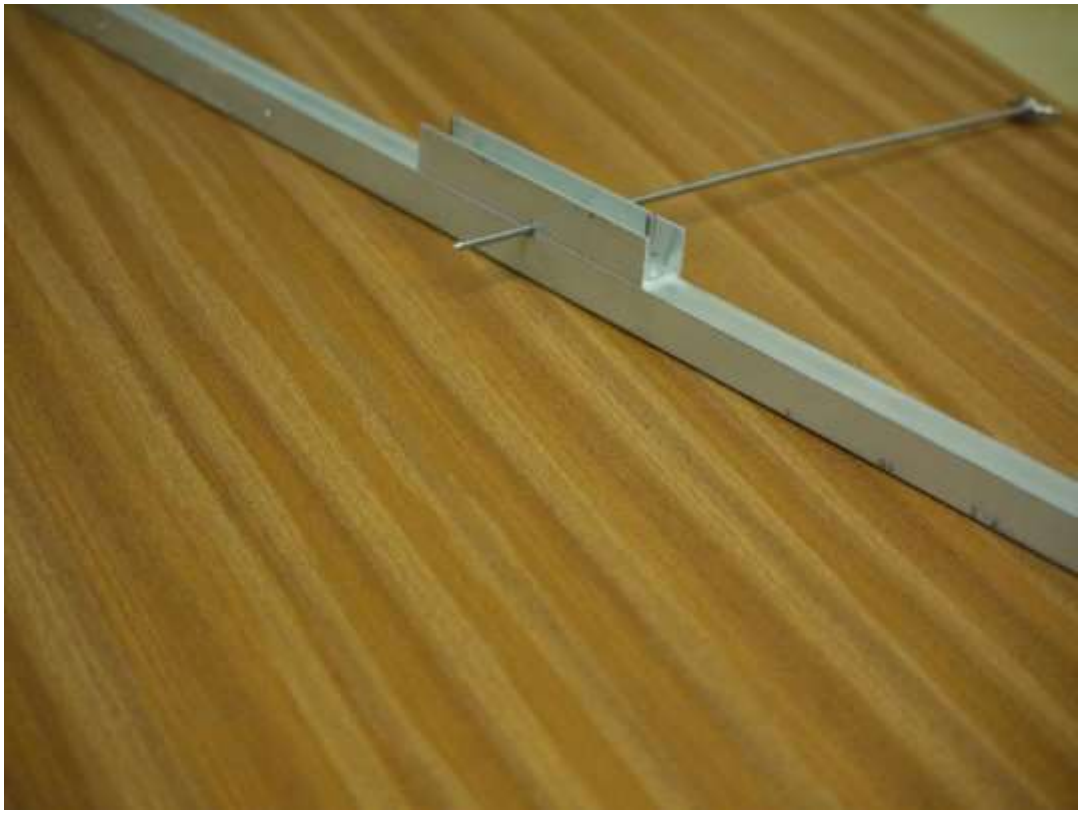
Where there is concavity in the bow profile across the forward flotation waterline length measurement point, the measured waterline length measurement point shall be taken as the intersection of the waterplane and a bridging line.

A method for dealing with concavity in the bow profile is described later in this presentation – see slides **Bow concavity -1** to **Bow concavity -11** at the end of this presentation.

Where there is a concavity in the bow profile - 2

Height gauge

The height gauge is constructed from ‘U channel’ aluminium. After joining a short length back to back with the long length, a central hole is drilled and tapped to accept a length of M3 stainless studding that has a point formed on the end.



This jig enables the measurer to establish the depth below the waterplane of points on the hull. The fore and aft distance of the point of contact from the waterline ending can also be found.

Where there is a concavity in the bow profile - 3
Max 20 mm BELOW waterline!

In this illustration the gauge has been set at 30 mm (to be 20 mm below the waterplane) as the jig will be suspended from the underside of the 50 mm side beams.

Where there is a concavity in the bow profile - 4
Does it create a hollow that needs to be bridged?

The height gauge has been set so the point is 30 mm from the transverse beam. This will be 20 mm below the waterplane when the jig is placed on the underside of the 50 mm deep fore and aft beams.

20 mm is the closest the bow bustle (a hollow formed by it) may be to the waterplane without bridging (see A Class rule D.2.2(b)).

The jig is carefully adjusted fore and aft until contact with the centre underside of the hull is achieved.

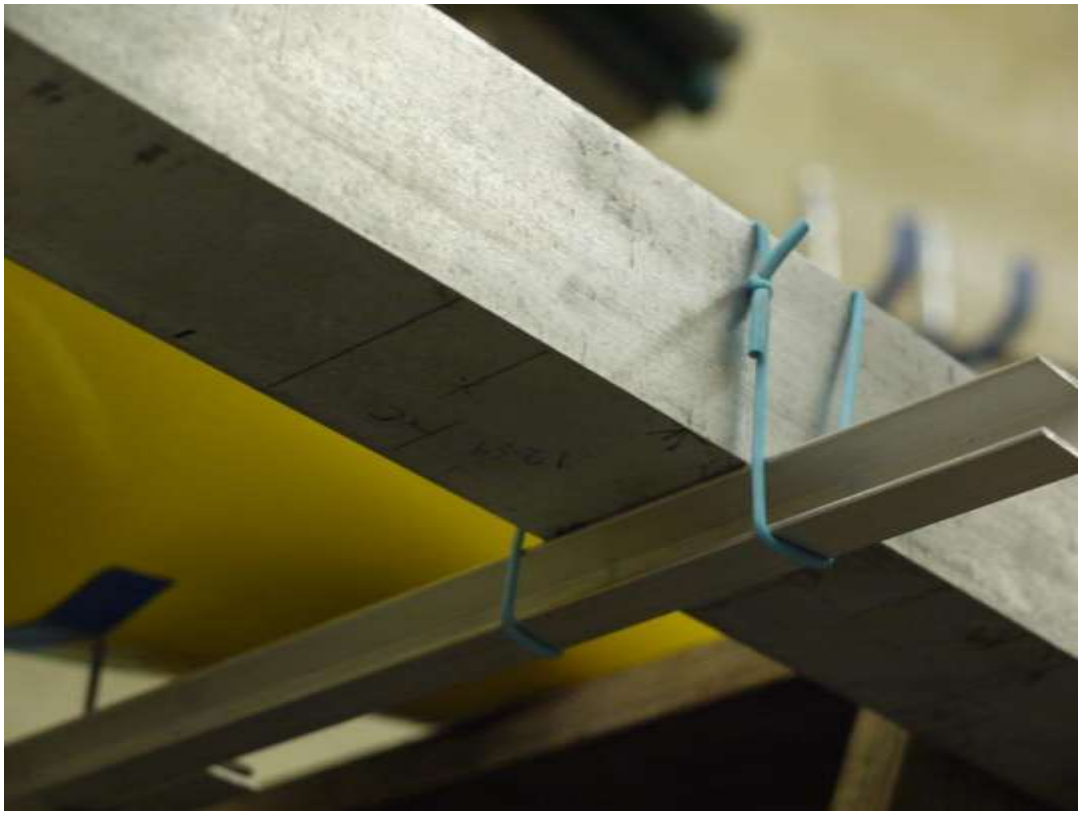
Tape would then be applied immediately aft of the height gauge point of contact. When the hull is lifted a straight edge can be applied from the forward edge of the tape to establish if there is any concavity .

Where there is a concavity in the bow profile - 5
Jig suspension method

Another view of the jig in use after the tape has been applied.

The elastic maintains sufficient pressure to hold the transverse beam against the underside of the fore and aft beams.

Out of focus can be seen the tape placed adjacent to the point of contact of the height gauge with the underside of the hull.



Other Measurements

Check for hollows - 1

Look for two types of hollow as set out in D.2.3(d)

Use a 300 mm straight edge to test for any hollows in the surface of the hull between the waterplane and 10 mm below the sheerline.

Here one end of the rule is placed on the forward edge of the aft waterline **limit mark** and shows there is a hollow aft of that point.

NB Hollows forward of the forward flotation waterline length measurement point are permitted.

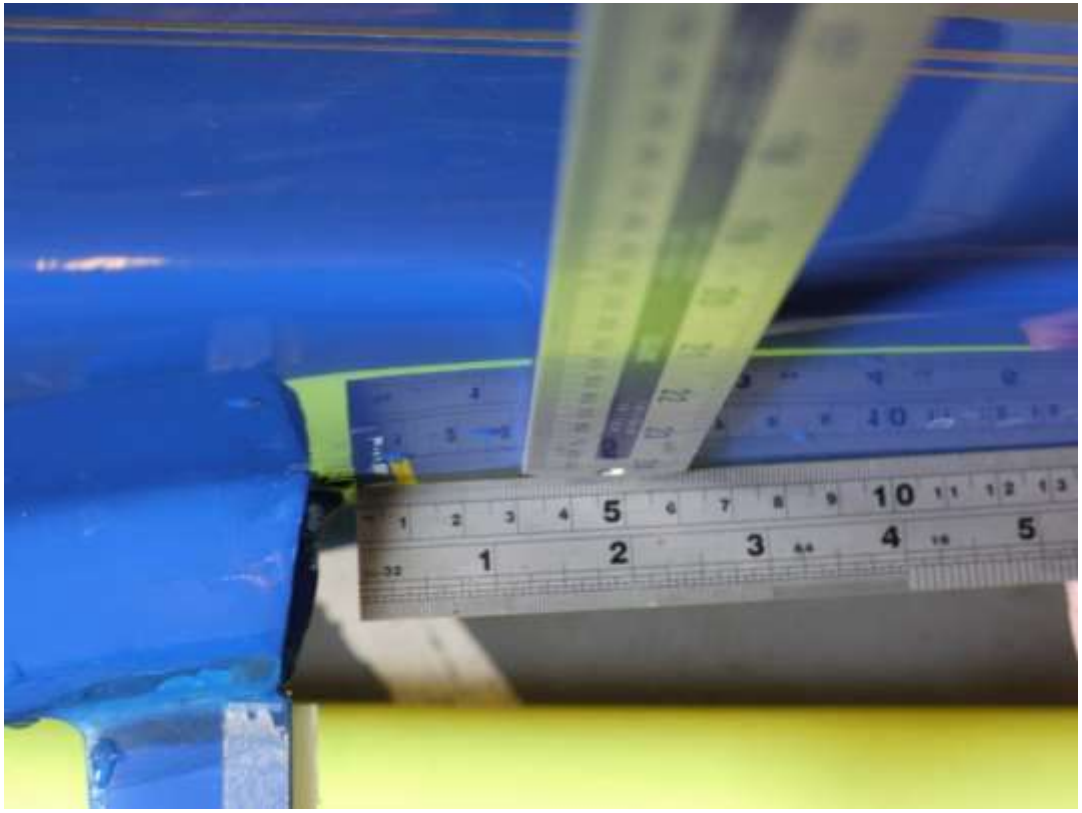
Check for hollows - 2

The thickness of the flat rule is 2 mm and will not pass through the hollow, which by definition is less than 2 mm.

2 mm of hollow in any 300 mm length is the maximum permitted by the class rule D.2.3 (d)(2).

Similar checks should be made at the waterline beam contact points and the QBL points

In these cases the permitted limit on hollows is no more than 0.5 mm within a 50 mm radius of the measurement point when checked with a 50 mm straight edge. Class rule D.2.3 (d)(3).



Measurement form (spreadsheet) calculations

If there is any bow concavity see the bow concavity slides at end of this presentation – otherwise proceed as follows.

- Enter the data found into the A Class measurement form spreadsheet and adjust the B and J dimensions to give a Rating of 1000.

- If the sails are not yet made

  the outcome of the measurement procedure will be the B and J dimensions that determine the sail sizes

  these dimensions provide the informatiuon needed by the sailmaker

  when the sails are made they may be certified as described in the following slides.

- If the sails already exist

  they should be measured as described in the following slides to establish the minimum B and J dimensions with which they comply

  check whether their B and J dimensions are smaller or equal to those permitted for the boat

  certify the sails accordingly.

Measuring Sails

Mainsails - 1

Measure and record the spacing between:

- **head point** and end of upper batten,
- adjacent battens and
- **clew point** and end of lower batten

The largest dimension should be no more than 40 mm more than the smallest.

Class rule G.3.3

Maximum batten length

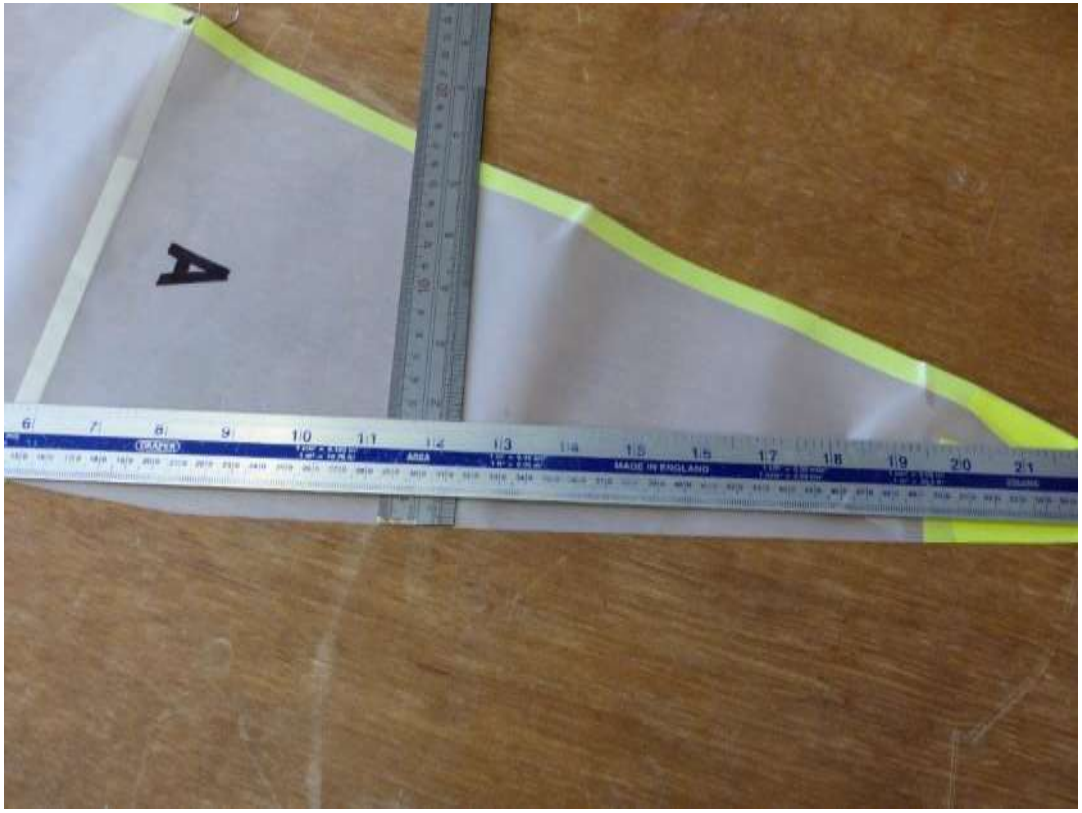
- top batten - 150 mm
- others - 200 mm

Class rule G.3.3

The photo shows a line (edge of the rule) between the centreline of the top batten and the aft corner of the headboard (headboard limit zone). The **leech** shall not be more than 10 mm aft of this line.

Class rule G.3.2(e)

NB See note on next slide regarding wrinkles in sail.

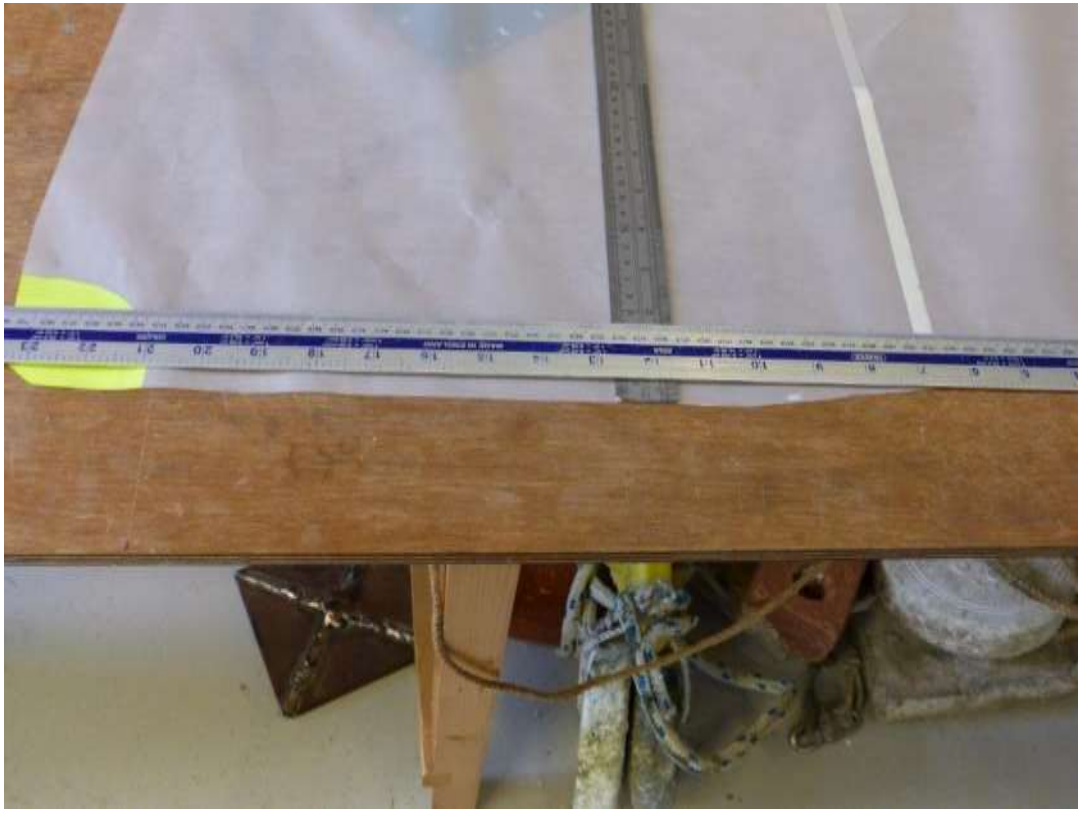


Mainsails - 2

The same consideration applies to a line between the centreline of the bottom batten and the **clew point**.

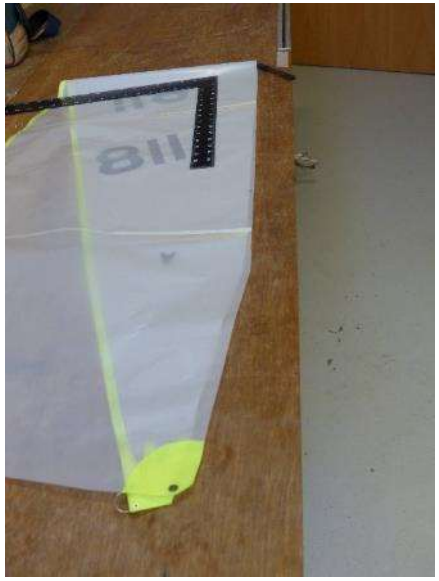
The **leech** shall not fall more than 10 mm aft of this line.

NB The sail here and on the previous page is tested in a wrinkled condition which is contrary to Section H 5.1 of the ERS – use masking tape, or deck patch material, to tension the sail sufficiently along the line of measurement to remove any wrinkles.



Mainsails - 3

Fold the **leech** in half (**clew point** onto **head point**) and mark where the mid point found. This is the **half leech point**. If a small crease offends the owner use a 10 mm diameter rod and estimate the mid point.



Repeat this process for the 2 halves to establish the **quarter leech point** and **three-quarter leech point**.

*NB The top left hand photo shows the **clew point** incorrectly placed on the aft end of the headboard. The lower photo shows the **half leech point** incorrectly matched to the aft end of the headboard.*

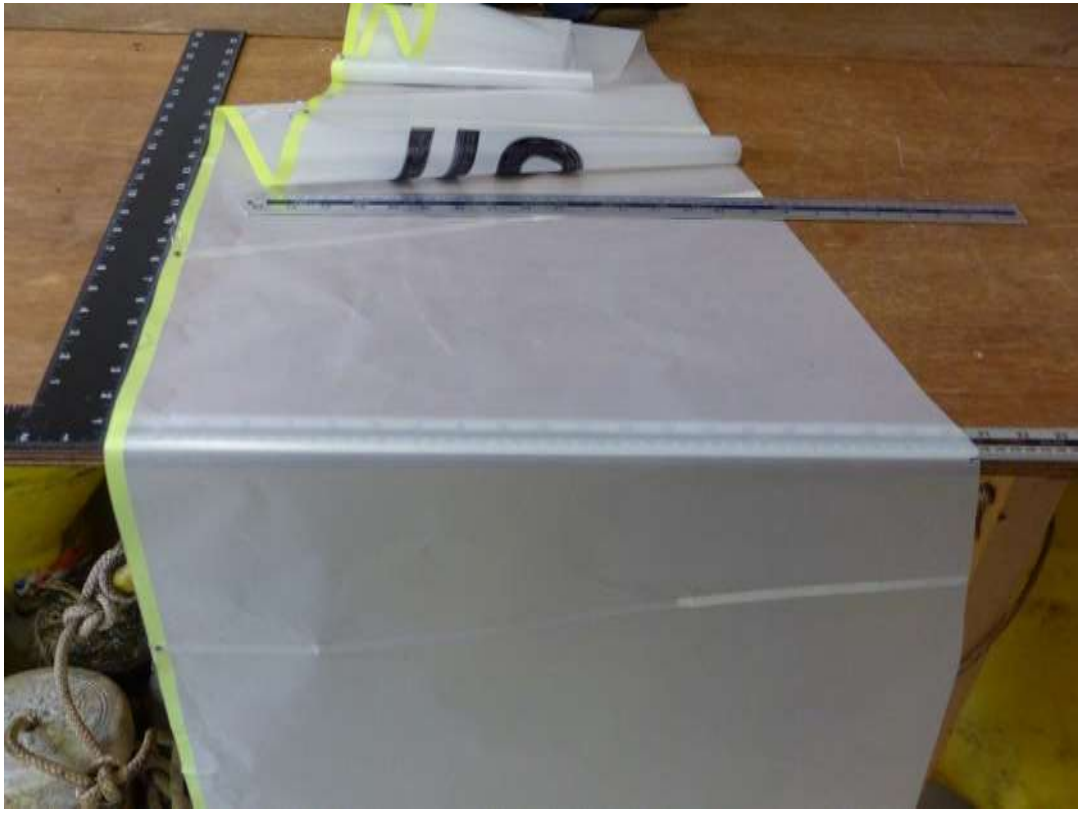
Mainsails - 4

Measure and record the shortest distance from the **leech points** to the **luff**. The measurements can be entered into the measurement form spreadsheet to determine the smallest B dimension to which the sail complies.

Once the minimum B dimension with which the **mainsail** complies is found (see the measurement form spreadsheet), the sail may be **certified** by marking it with the minimum B measurement, the date and the measurer's signature in the **tack**.

A **mainsail** may be used on any **boat** where its B measurement is smaller or equal to the B dimension permitted for the **boat** (and the **mainsail** sets within the **limit marks** on the **mast**).

Check the size of class insignia.



Mainsails - 5

Check that the **foot** does not extend more than 25 mm below a straight line between **clew point** and **tack point**.

Class rule G.3.2 (f)

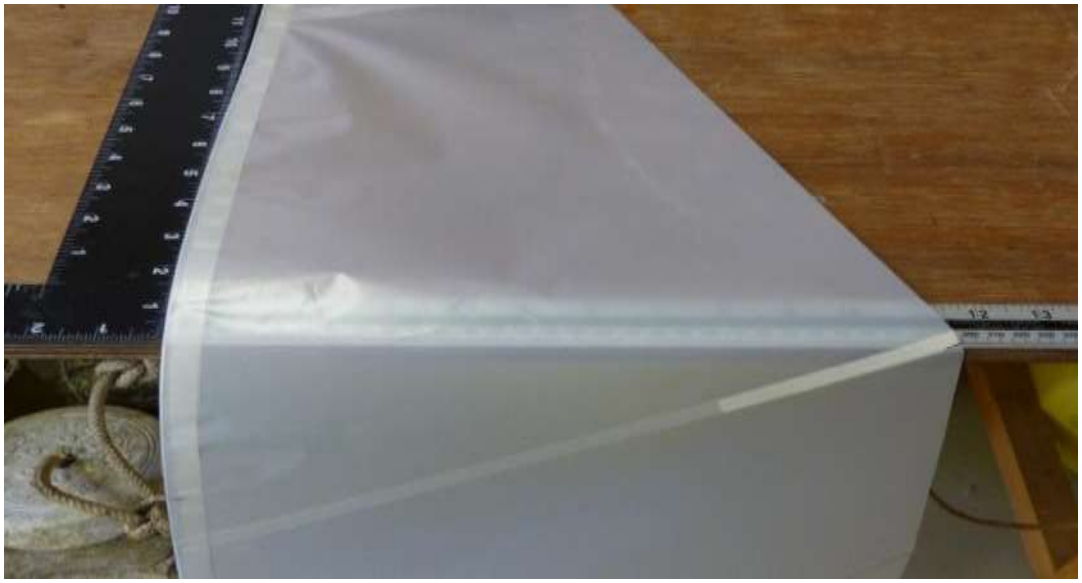
Headsails - 1

The class rules require only that **headsails** be **soft sails** and that the **half width** does not exceed 0.5 x the J dimension plus 50 mm.

Measure the **half width** from the **half leech point** to the nearest point on the **luff**. Find the **half leech point** in the same way as for the **mainsail**. *(NB The same error is made on this sail as on the mainsail)*

The measured dimension allows the minimum J dimension with which the **headsail** complies to be found (see the measurement form spreadsheet). The **headsail** may be **certified** by marking it with the minimum J measurement, the date and the measurer's signature in the **tack**.

A **headsail** may be used on any **boat** where its J measurement is smaller or equal to the J dimension permitted for the **boat** (and the **luff** sets within the **limit marks** on the **mast** and deck).



Other Checks

- When progressing through completion of the measurement forms other checks will be prompted for confirmation.

The most common other considerations are:

- Registered number painted, engraved, bonded, moulded on to an easily visible location on a non-removable part of the **hull**? Class rule D.1.3.
- Registered number at least 20 mm high and visible on the external surface of the **hull**? Class rule C.5.2.
- Owner’s flag, 70 mm wide x 60 mm high, flown in the rigging? Not required for measurement but must be in place when racing. Class rule C.9.3.

Bow concavity - 1
Where there is concavity in the profile at the forward waterline ending

Where there is concavity in the profile of the bow at the forward waterline ending the class rules require the concavity shall be bridged with a straight line to determine the measured waterline ending position.

The following slides present a method for accurately carrying out the bridging and measurement process so that the boat's rating (sail area) will be correctly calculated and that, if repeated at a later stage, there is a high chance that the original measurements will be reproduced.

Bow concavity – 2
Where there is concavity in the profile at the forward waterline ending

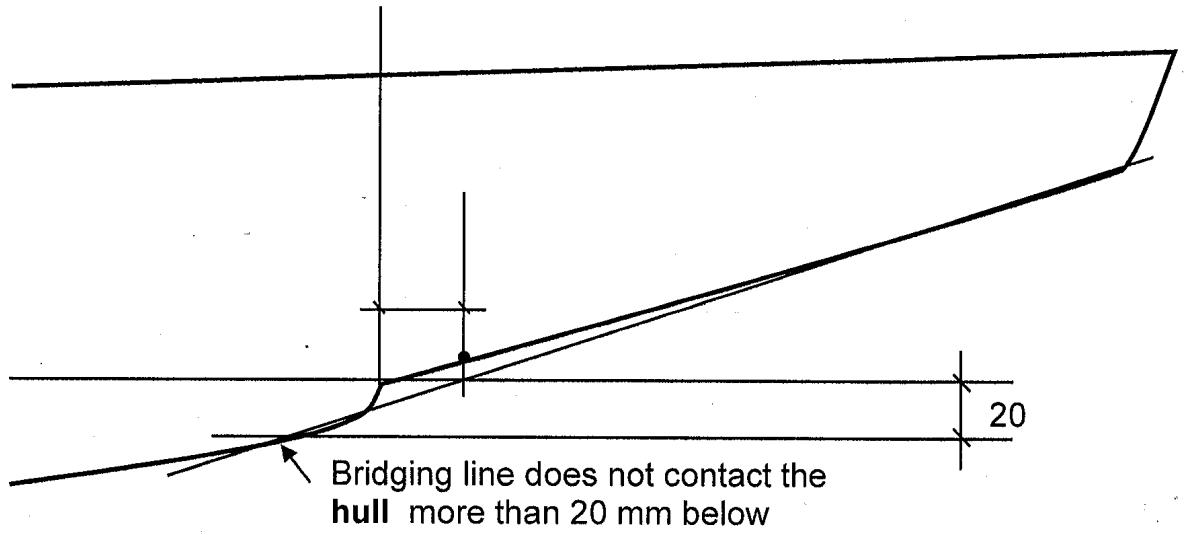
Establishing that precise position with the boat floating in a tank may not be impossible but is likely to be difficult to attain accurately.

These slides describe a simpler, more accurate and more repeatable way to calculate the additional waterline length adjustment during the dry jig measuring phase.

Bow Concavity - 3

A Class rules D.2.2 (a) & (b) illustrated in J.3 & J.4 dictate that :

J.4 BOW BRIDGING B – bridging line contacting hull less than 20 mm below waterplane

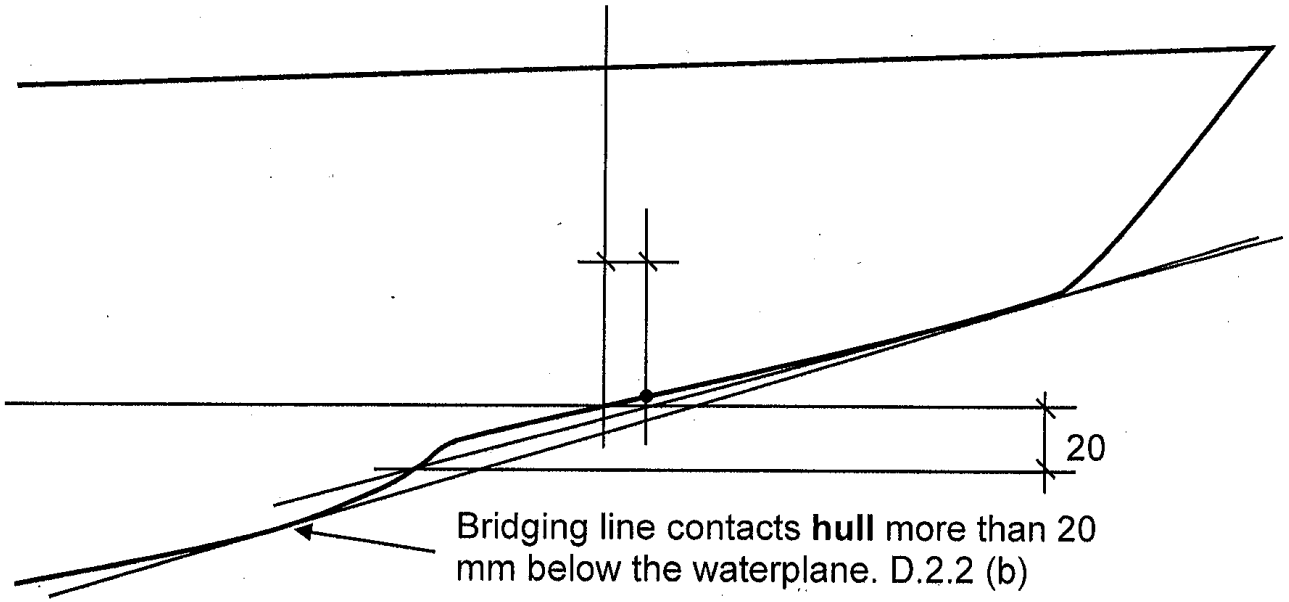


Where there is concavity in the bow profile across the forward flotation waterline length measurement point, the measured waterline length measurement point shall be taken as the intersection of the waterplane and a bridging line.

Bow concavity - 4

However, the A Class rules go on to say that:

J.3 BOW BRIDGING A – bridging line contacting hull 20 mm or more below waterplane



If the bridging line contacts the bow profile more than 20 mm below the waterplane, the bridging line shall be shortened so that the lower point of contact of the bridging line with the **hull** is 20 mm below the waterplane

Bow Concavity - 5

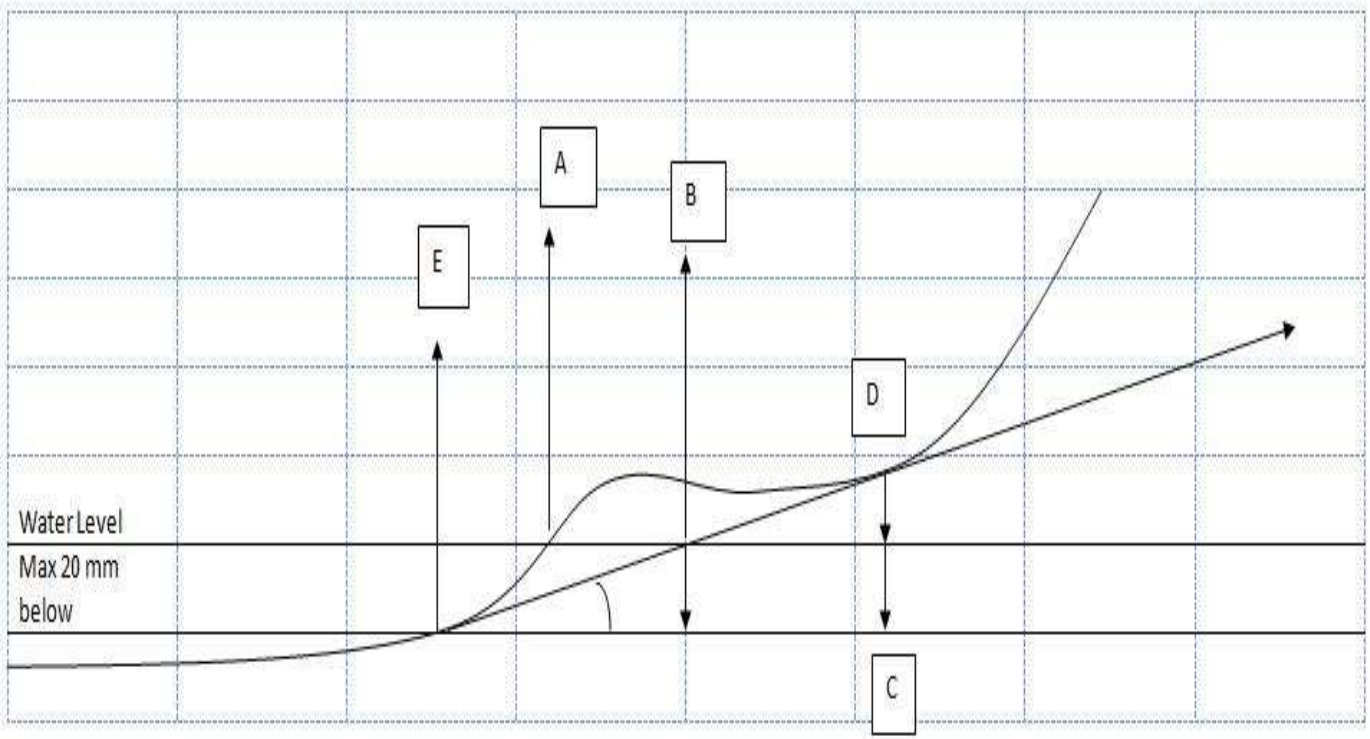
The principle of the method

The class rules require that the forward measured waterline length measurement point shall be taken as the intersection of the bridging line with the waterplane.

This point can be found by taking the measurements shown on the following slide and using the method provided on measurement forms to convert those measurements into useful output.

Bow Concavity - 6

In this illustration, the size of the concavity in the underside of the bow profile has been exaggerated for the ease of identifying relevant points.



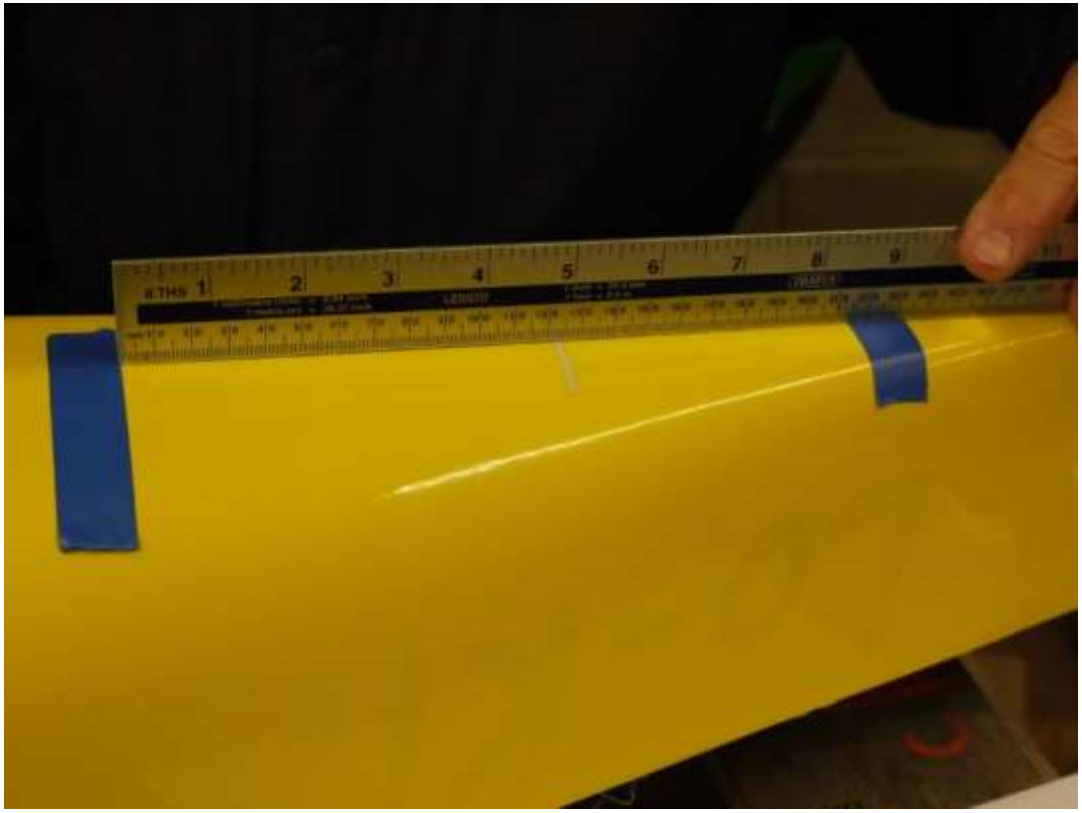
Identification of measurement points:
A = the forward flotation waterline length measurement point as identified by measurement in the tank.
B = the intersection the waterplane and a line bridging the concavity between point E and point D on the hull.
C = is a reference point for the purpose of this diagram and is directly below D.
D = the forward tangential contact of the bridging line.
E= the aft tangential contact of the bridging line SUBJECT TO the requirement that it shall not be more than 20 mm below the water line. It may be LESS than 20 mm below the waterline.

Bow concavity – 7 Marking the tangential contact points

Tape is placed to mark the extreme ends of the tangential contact between the straight edge and **hull**.

These are points E and D shown in the previous slide.

Faintly visible is the forward flotation waterline length **limit mark** that marks point A in the previous slide.

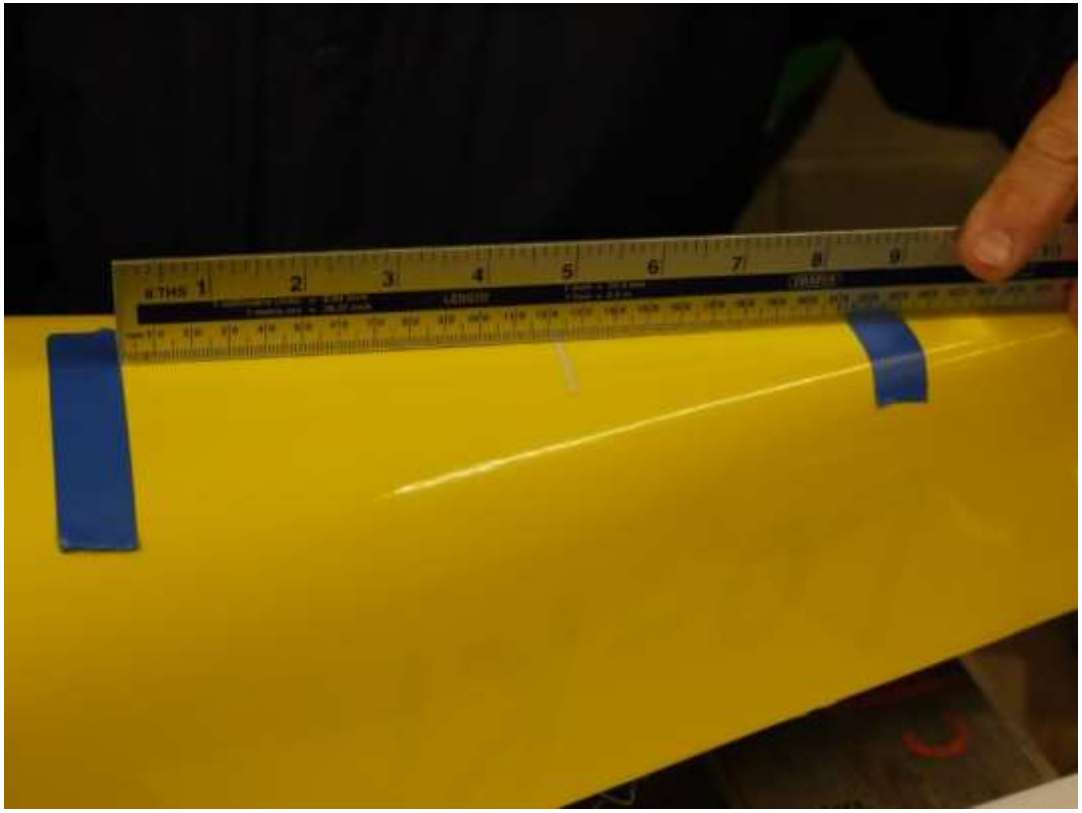


Bow concavity – 8
Re-check for concavity from the point 20 mm below waterline

The same slide as before but – in this case imagine there is a deep bow bustle aft of the aftermost piece of tape AND that the forward edge of the aftermost piece of tape marks point E where the hull is 20 mm below the waterplane.

The distance to the forward tangential contact, point D, is illustrated here at 212 mm on the rule. This is a diagonal distance.

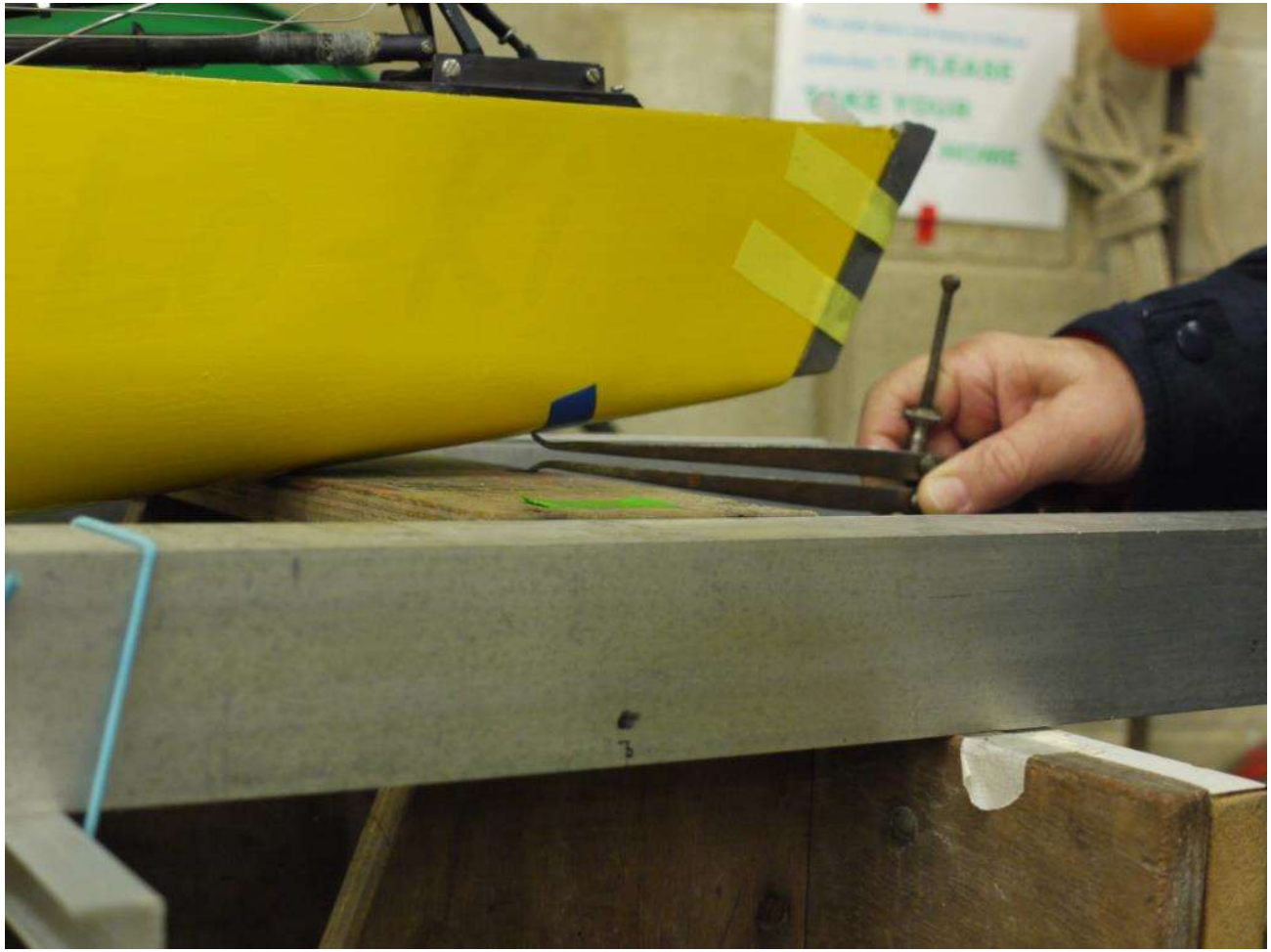
The boat would then be returned to the dry jig for the remainder of the ‘concavity’ measurements to be taken.



Bow concavity – 9

Vertical height of tangential contact

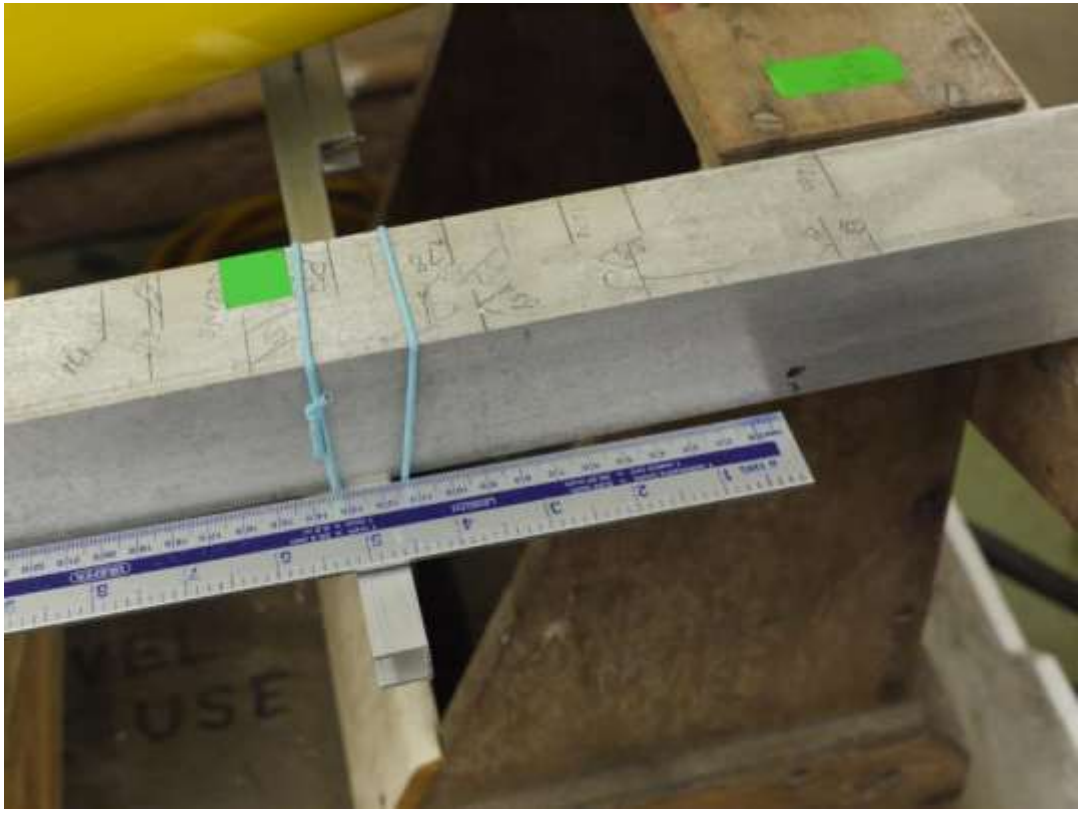
The height of the forward tangential contact point, point D, above the waterplane is measured. Dividers are being used here but if the distance is much smaller, feeler gauges may be necessary.



Bow concavity – 10

Fore and aft distance between flotation waterline length ending and the after tangential contact point E

The fore and aft distance is measured between the centre (upright) face of the dry jig, the forward flotation waterline length measurement point, point A, and the aft tangential contact point, point E.



This is measured on both port and starboard side to obtain a mean, which represents the actual distance required.

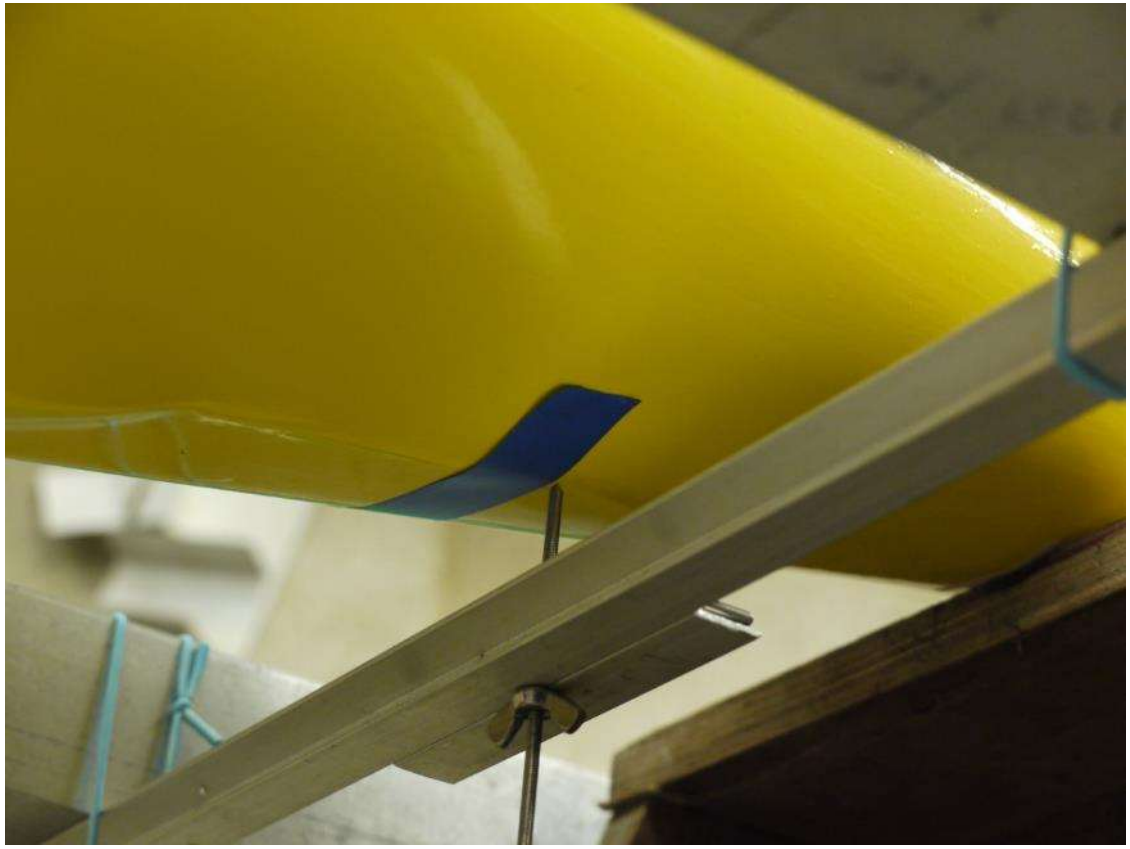
Bow concavity – 11

Tangential contact point - distance below waterline

With the **hull** on the dry jig, the height gauge is temporarily fixed UNDER the side beams. The elastic holding it in place can be seen in this photo.

The threaded studding is screwed until the point is in contact with the hull at the aft end of the tangential contact. In this case there is a bow bustle but it is well below 20 mm below the waterplane and does not affect this procedure.

The studding is locked in place (wing nut). The jig is then removed and the length of studding projecting from the jig is measured. This length, deducted from 50 mm (depth of side beam), establishes how far BELOW the waterplane the tangential contact point is.



Bow Concavity – 12
Reminder of the principle

You should now know:

a) Vertical height of forward tangential contact point (point D) above waterplane.

b) Diagonal distance between tangential contact points E and D.

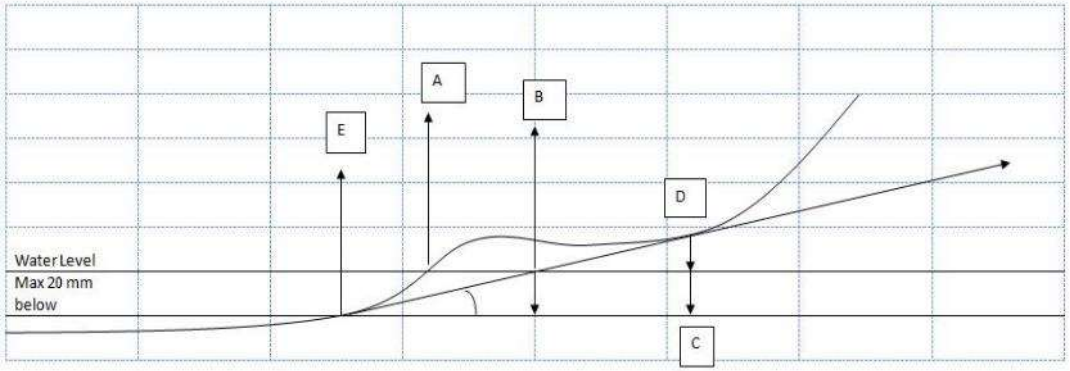
c) Horizontal distance between aft contact point and forward flotation waterline ending (fore and aft E to A).

d) Depth of aft tangential contact point below waterplane (but greater than 20 mm).

Enter these 4 values into the relevant worksheet of the measurement form spreadsheet and this will determine the additional waterline length adjustment.

Remove the boat from the jig and place the additional forward measured waterline ending **limit mark**. Leave the forward flotation waterline length **limit mark** in place.

In this illustration, the size of the concavity in the underside of the bow profile has been exaggerated for the ease of identifying relevant points.



Identification of measurement points:

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B = the intersection the waterplane and a line bridging the concavity between point E and point D on the hull.
C = is a reference point for the purpose of this diagram and is directly below D.
D = the forward tangential contact of the bridging line.
E= the aft tangential contact of the bridging line SUBJECT TO the requirement that it shall not be more than 20 mm below the water line. It may be LESS than 20 mm below the waterline.

end