

OK DINGHY INTERNATIONAL ASSOCIATION

MANUAL OF MEASUREMENT

Revised Apr 2009

1. GENERAL This manual should be read in conjunction with the racing rules of sailing 2009-2012, the current class rules and measurement form.
The manual will be updated from time to time but may lag behind the publications mentioned above. Where there is conflict between any of these publications, the current class rules shall prevail. In case of doubt, measurers should refer to OKDIA for clarification.
2. THE PURPOSE of the manual is to assist measurers to apply the class rules, to ensure, as far as possible, that all boats are measured correctly and to provide a quick and accurate method of measurement using the minimum of equipment. The methods proposed are not necessarily the only satisfactory method but if they are followed, will give reliable results. The manual itself is a guide and does not form any part of the rules.
It is fundamental to accurate work that the measurements be made in good light and sheltered from the wind which will disturb the instruments. It is therefore recommended that measurers should make every effort to secure the use of a suitable building for the purpose of measurement.
3. JIGS & TOOLS etc. Measurers should be equipped with at least the following:
 - a) One or two calibrated certified weighing machines to weigh the hull and mast. The machine for weighing the hull should be capable of weighing to approximately 100 kg for the hull, 15kg for the mast.
 - b) A steel measuring tape of not less than 6m calibrated in mm. A good fibre tape may be used provided it is checked regularly against a steel one.
 - c) Calipers for the measurement of depths and thicknesses.
 - d) Not less than 3m of 6mm clear plastic tube to form a water manometer for leveling up the hull.
 - e) An accurate spirit level. A laser spirit level is an advantage and cuts out the need for a water manometer. It should be used with a firm tripod
 - f) A plumb bob and line. It may be useful to have several.
 - g) A set square for measuring 90 degree angles
 - h) A 2m (approx.) rigid straight edge.
 - i) A "C" gauge for the determination of sheer points. (see hull measurement).
 - j) A pair of angled gauges for measuring bottom & side panel curvature.
 - k) A thin thread or other device (e.g. Laser Beam or length of aluminium section) to produce an accurate base line.
 - l) A pair of "G" cramps and one or two sand or shot bags to steady the straight edge(s).
 - m) Suitable stools, blocks, wedges, jack etc for the accurate leveling of the boat.
 - n) Masking tape or insulating tape, to use as markers
 - o) Templates of centreboard and rudders (both 15° and 31°) drawn onto suitable sheets of plywood or stable film, with lines whose outside edges mark

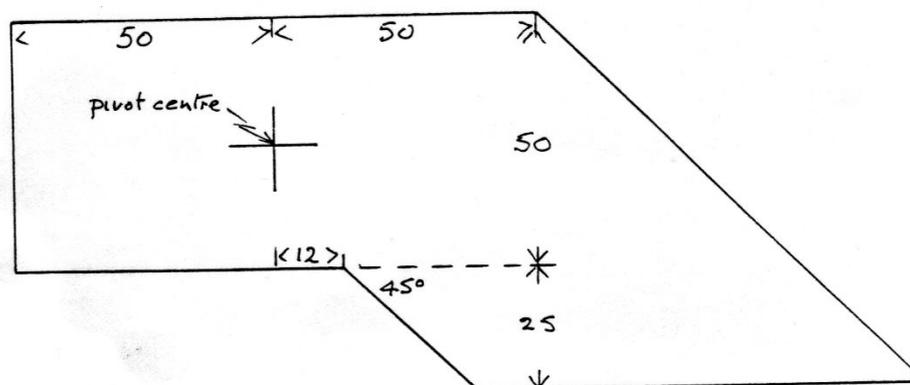
the maximum and minimum dimensions between which the edges of the boards must fit.

The centreboard template can be fitted with a short vertical pin at the pivot centre to locate the board at pivot datum and detail the area above which the arm does not need measurement.

The rudder blade template must have the lines representing the edge which lies parallel to the transom and the water line drawn exactly without tolerance for locating the blade correctly on the template.

Paper templates must NOT be used as these alter dimensionally with humidity.

p) Keel Template cut from two pieces of stable sheet material for determining keel position inside the keel band. A commercially produced profile (Or contour) gauge for floor edging is also an effective and easily used alternative.



Detail of KEEL TEMPLATE 2 off required fixed together at the pivot.

q) A 2m (approx) straight edge to check the sheerline, say 100 x 6mm hard wood or aluminium section should suffice.

4. MEASUREMENT & TOLERANCES

a) PRINCIPLE:- Apart from depths and thicknesses, all measurements are to be taken relative to the base line which shall be horizontal. Measurements are to be taken either horizontally or vertically and at right angles to the base line.

b) MEASUREMENTS:- The units of measurement are millimetres (mm) and kilograms (kg). All measurements shall be carried out so that the dimensions are as accurate as possible

c) TOLERANCES:- The maximum or minimum dimensions MUST NOT be exceeded and where the dimension lies close to the limit of tolerance, great care should be exercised to ensure that the measurement is as accurate as possible. Where a measurement is found to exceed the permitted tolerance, the measurer must check the positioning of the hull and measuring equipment to ensure that there is no error before recording the faulty measurement. He must then endorse the measurers comments section of the measurement form with the item number or detail of the class rule which is infringed.

5. PREPARATION:- The measurer should check that all loose gear, mainsheet, centreboard and rudder have been removed and that the boat is dry and free from sand and dirt in the tanks.

6. SETTING UP:- Great care is needed in setting up the boat correctly for measurement. The hull is set upside down as shown on the measurement diagram and all measurements are referred to the TRANSOM and BASE LINE.

The TRANSOM is *defined* as the point where the aft face of the hull meets the aftermost point of the centre of the KEEL. If the junction is radiused or worn, the surfaces must be extrapolated to the intersection.

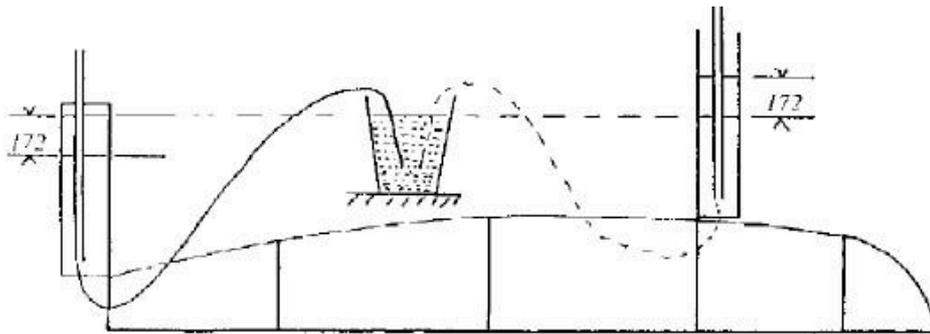
The BASE LINE is *defined* as a horizontal line 200mm vertically below the TRANSOM and 28mm vertically below the keel at station 3.

The KEEL is *defined* as the intersection of the extension of the bottom surfaces of the bottom planks on the centre line, excluding the keel band itself.

To conform with convention used in the rules, the words ABOVE and BELOW are taken to refer to the hull in normal trim so that under the convention, the base line which is fixed over the inverted hull is said to be BELOW the keel.

TO SET UP THE BOAT:-

- a) Chock up the transom with the deck about 400mm off the floor and lift the stem until the transom appears vertical. A small car jack under the stem makes a convenient method of lifting.
- b) Fix a vertical measuring post against the transom and, measuring horizontally, mark the position of station 3 on the keel at 2800mm from the TRANSOM.
- c) The manometer is now used to level the boat exactly (unless a laser spirit level is being used, when the boat will be adjusted so that the beam passes 200mm above the TRANSOM and 28mm above the keel at station 3). This manometer tube has one end taped along a suitable batten and the other immersed in a bucket of water set at a convenient height over the bottom of the boat. Siphon water through the tube to clear any bubbles and then raise the free end of the tube. Be very careful not to kink or trap the tube at any point. Put the heel of the batten on the KEEL at the TRANSOM (make sure to identify the true keel point using the method described in section 7 c.) mark the batten where the water level at the bottom of the meniscus comes in the tube, then put a second mark exactly 172mm under the first. Transfer the heel of the batten to the KEEL at station 3 and wind the stem up or down until the water level coincides with the lower mark. The boat is now level fore and aft. Use the spirit level or manometer to level the boat at the transom chines. If a laser spirit level is being used, the laser beam provides the baseline as shown in the second diagram. The beam can also be used to take all keel, sheerline and chine dimensions, which can speed up the measurement process dramatically.



OR



d) Use a plumb line or spirit level to set up the transom post exactly vertical and note any gap between the post and the TRANSOM at the keel. Allowing for this gap and measuring horizontally from the post, mark measurement stations on the keel.

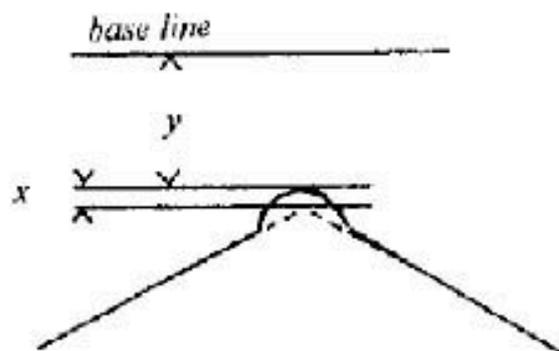
e) Set up the base line exactly 200mm below the TRANSOM and 28mm below the KEEL at station 3. If a thread is used as base line, note whether the top or bottom of the thread is used to mark the true BASE LINE and ensure that the thread is kept taut and is not deflected by the measuring equipment during measuring.

7. HULL MEASUREMENT

a) Before beginning to measure, the measurer must ensure that his straight edge remains true.

b) Measurement stations must be marked onto the chines and sheerguard as well as the keel. If the transom is square, these may be measured from the straight edge placed across the transom. Alternatively they should be marked by means of the plumb bob from the straight edge set at right angles to the base line (or keel) at the station.

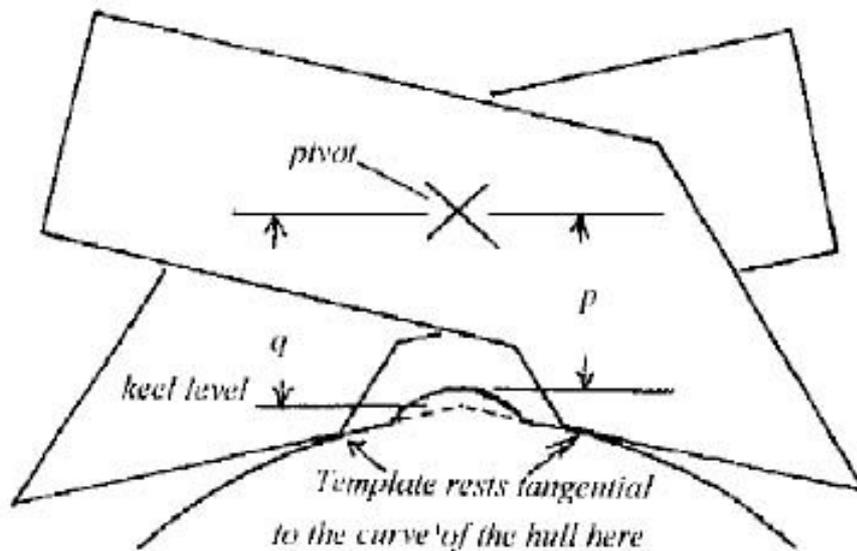
c) Before measuring the keel rocker, it is necessary to determine the position of the keel measurement points relative to the keel band at each station. When the baseline to the underside of the keel = $y + x$, then x is found by means of the keel template or needle gauge



The template is used as illustrated and is designed so that it will just fit over the keel band at station 2 and may thus be used at all stations by adjusting the setting at the pivot so that the lower edges rest tangential to the hull surface as near to the keel band as possible.

The measurement p is made with the template resting athwartships at the station.

The measurement q is obtained by projecting the straight bottom edges of the template to their intersection after removing the template from the boat. A similar calculation can be done with the 'needle gauge' to find x .



USE OF THE KEEL TEMPLATE $q \cdot p \cdot x$

d) The rake of the stem is measured by placing the straight edge along the straight of the stem and measuring along the base line to its intersection with the straight edge. If the upper stem is not substantially straight, the measurement form must be so endorsed.

To measure the curve of the stem, mark the points on the stem band which are exactly 300mm and 180mm above the base line. Measure the horizontal distance between the points marked on straight edge and stem, measuring to the forward face of the stem band. Any forward overhang of the deck is deducted. The measurement point is then the intersection of the extension of the forward face of the stem band with the upper face of the deck. This is found by means of the "C" gauge (see section 7 m.).

e) Centreboard bolt position is measured using a set square and spirit level to mark points on the keel vertically below both the forward and aft faces of the bolt. Measure the horizontal distance of both marks from the TRANSOM and record the mean. If the bolt can be moved, it must be measured in both its forward and aftmost positions.

f) Chines are measured from the straight edge placed across the keel at the

station or secured at base line height. The straight edge must be horizontal and at right angles to the keel or base line. If it is placed across the keel, it may be leveled with a wood chock and held steady by a weight or sand bag.

Use a plumb bob or spirit level to mark the chine measurement points on the hull and on the straight edge vertically BELOW the chine.

Chine heights are measured between the points marked on chine and straight edge and the average recorded after adding the height of the base line below the straight edge.

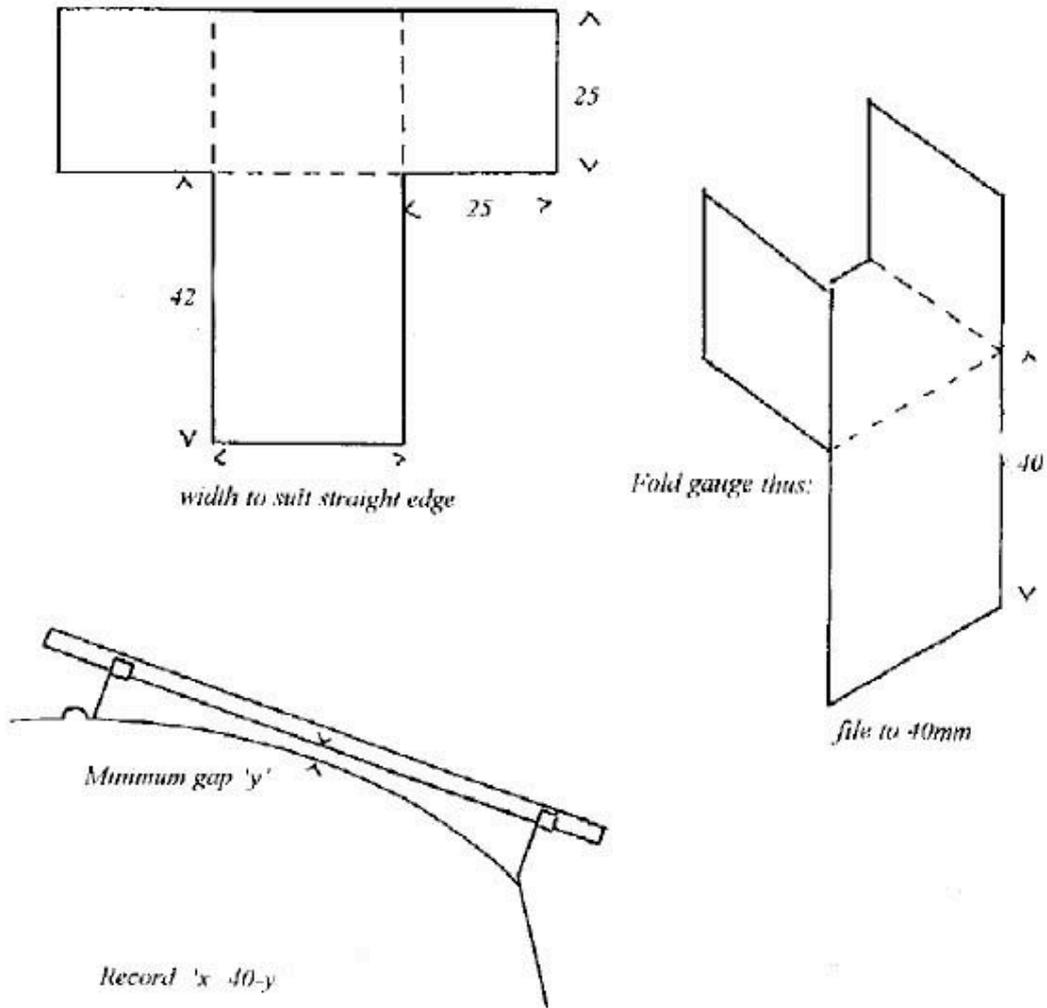
Chine beams are measured between the marks on the straight edge. If the beams do not measure correctly, two wooden arms may be cramped to the straight edge to form a caliper to check the accuracy of the original measurement. If the chine is radiused, the measurement point should be taken as the surface of the chine at the mid-point of the radius.

g) Sheerline height is measured in the same way as the chine height, but when the sheerguard is wide, the height may be measured to the junction of the underside of the sheerguard and the topside panel and the thickness of the sheerguard added.

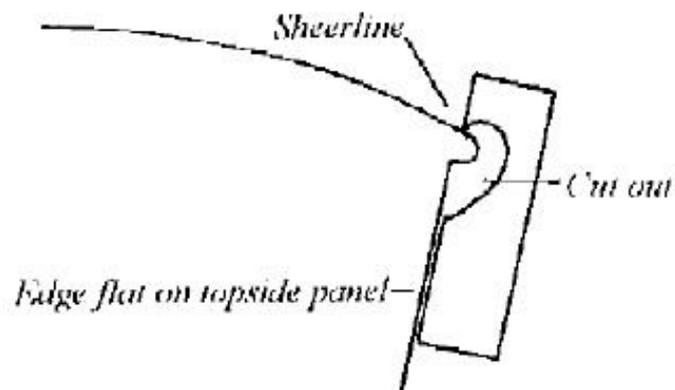
h) Compare the chine curvature with a series of concentric circles to estimate the radius. If it is near to the maximum, press a piece of putty over the chine to obtain a mould and fit it to a 15mm radius disc or washer. A contour gauge can be used as an alternative.

j) The keel band length is measured along the outer face of the band round the curve of the hull.

k) Bottom panel curvature is measured as follows:- fit one angled gauge to the straight edge as shown in the sketch, securing the lugs with a "G" cramp and set it at the junction of the panel and the keel band at the station. Fit the second gauge to the straight edge so that it rests exactly on the chine at the station. Measure the minimum gap Y between the straight edge and the panel and record the result. $X = 40 - Y$



- l) Overall length excludes transom fittings, deck overhang and any permissible rake of the transom but includes the stem band or fitting. It is measured along the baseline from the TRANSOM to the intersection of the vertical straight edge and the base line when the straight edge touches the stem at deck level. Any forward overhang of the deck is deducted.
- m) Beams are measured from sheerline to sheerline, these are found with the "C" gauge as illustrated.



n) Sheerguards are measured vertically and horizontally and NOT parallel and normal to the topside panel. If sheerguards are tapered, the maximum size must be recorded.

o) The side deck assembly is measured relative to the sheerline. Before measuring the side decks, mark four sheer points round the side deck and bend a flexible straight edge round these to check that the sheerline is not roached between stations 1 & 2.

The whole of the side deck assembly must be contained within the permitted tolerances. If the assembly is tapered, both the maximum and minimum measurements should be recorded.

p) The height of deck line at the mast should be checked for all positions of the bearing.

8. CENTREBOARD

The centreboard is laid on the template with the centre of the pivot hole exactly on the pivot point. The whole of the board other than the arm, must fall within the outer edges of the limit lines on the template.

9. RUDDER BLADE

The rudder is laid on the template with the forward vertical edge exactly on the Datum line and the corner exactly on the water line. The whole of the blade below the water line must fall within the outer edges of the limit lines on the template. Lifting rudders must be pinned in the down position. A loose pin must not allow the blade to move beyond the limit lines, cleated downhauls and shock cord are NOT pins.

10. WEIGHT

If a hull is found to be under weight, it should be reweighed after the correctors have been fitted to ensure that it is up to minimum weight. Correctors must be fitted as required by rule 14.2. This is the responsibility of the owner. If more than 5kg of correctors are required, rule 14.3 applies. When weighing the boat, it must be dry and clean. It is permissible to include control lines, fittings & compass but not the mainsheet.

11. MAST

It is not the measurer's function to mark or paint measurement bands etc. but to check their position.

The spar should be checked with a straight edge externally for hollows and visually internally for any webs which are prohibited.

The mast should be either round, oval or of teardrop section. The maximum & minimum diameters should be measured at both deck level and 20mm above the heel point. The cross sectional reduction (Taper) should be uniform from 1000mm above the mast datum point (see section 11c.)

a) The mast datum point (refer to rule 12.4) should be marked on the aft face of the mast (or bearing).

b) The height of the lower limit mark (band) must be measured with the mast stepped in the boat, it is measured along the mast regardless of rake. If the bearings are adjustable the height must be checked over the whole range of adjustment. For bearings on top of the deck, add the thickness of the bearing.

- c) The height of the upper limit mark is measured from the top of the lower mark.
 - d) Remove the mast pin and position the halyard in its racing position prior to C of G check & weighing.
 - e) The centre of gravity should be marked on the spar measured up from the mast datum point. This can be simply measured resting the mast on a knife edge or using a loop of thin line.
 - f) The track dimension should be measured from the aft edge of the spar (extended in necessary) at the deck bearing.
 - g) Not more than 0.6kg of correctors weights are allowable & should be permanently fixed above deck level.
12. **BOOM**
The boom is measured fitted to the mast at right angles to it. Check that it cannot be pulled down below the measurement band on the mast and that the mast and boom rotate as one.
13. **SAIL**
The class measurer must also be a recognized ISAF measurer to be qualified to measure sails The sail is measured in accordance with the racing rules of sailing 2009-2012
14. **BUOYANCY**
Refer to class rules 9.1 – 9.3. Take particular note that:
- a) Hatches are watertight and positively secure.
 - b) All drain holes have bungs (except the drain tube from the mast compartment to the cockpit).
 - c) There is a watertight bulkhead between station 3 and the mast.
 - d) A drain tube, 10-20mm, is fitted between the mast compartment and the cockpit
 - e) There is 0.12cu m of closed cell foam, securely fastened directly to the hull or deck, in the compartment between station 2 & 3 bulkheads. A reasonably accurate check on the size of the blocks of foam can be made by pushing a steel tape through the hatches.
 - f) Underdeck control lines are in watertight tubes.
 - g) Holes for control lines in the deck or bulkhead are within 350mm of the centre line.
 - h) Drain holes in station 1 and 2 bulkheads are not more than 20mm diameter.
 - i) Any buoyancy under the sidedecks does not extend more than 80mm below the sheerline
15. **SECURITY:-** Make a positive check of rudder and mast security.
16. **COMPLIANCE WITH THE RULES** The measurer must study and be familiar with the *current* class rules. If a boat fails to comply with the rules whether or not there is an appropriate item on the measurement form, or if it appears that an attempt has been made to take advantage of the method of measurement to alter or distort the boat, the measurer must so endorse the measurement form.

It is not for the measurer to judge whether or not a distortion, alteration or measurement fault is or is not permissible. His function is to draw the attention of the *appropriate Authority* to the existence of such variation from the design.

The *current* class rules are those in force at the time of measurement.

The *appropriate Authority* will be determined by the national class association. It will either be the National Authority or the national class association itself (rule 1.6).