Measurement for the International Canoe

A Guide for Measurers

This guide is written to clarify and suggest measurement methods for the International Canoe. It has been reviewed by measurers in four countries and is still subject to changes and additions.

General

The measurement rules for the hull have wide tolerances. A simple set up will usually be adequate, for high precision is only needed when a measurement is close to a tolerance limit.

Tools: 25'/ 7.5 m tape; 10'/ 3 m tape; Walter Pollmann sticks (see German measurement diagram) ; 10/20 mm wedge for tolerances. Spring balances: these should be checked with some known weights. Set of saw horses whose height difference is something less than the difference between the height of the deck and the stern deck. A line level. Small levels that can be used to help in squaring templates. Some heavy modeling clay to hold templates in place. Four spring clamps. Masking tape. Waterproof fine point markers. Hammer and nails for sails. String, perhaps in a string reel as used for chalk lines, (75 '/ 22.8 m). For sail measuring on grass, a set of aluminum wire or rod tent pegs at least 6"/15 cm long; they should be driven deeply into the ground so that only the eye shows.

Rules

Have the current copy at hand, and verify each measurement. Do not try to memorize them.

Hull

Invert the hull. Starting from the stern lay out the measurement stations. A tape can be hooked on to the stern and the stations marked out along the keel line. It has been found by experimentation that setting the stations along the hull on the boat itself does not materially affect the rocker measurement. If a measurement is critical, it may be worthwhile to set the stations on the fine cord and plumb down.

Masking tape on the bottom is a good place to mark the stations. Often a station falls on the rudder trunk. It is best to tape over the area tightly and mark the tape.

Using Pollmann sticks: The advantage is that they eliminate string sag problems and the need to stretch the string tightly. The disadvantage, the need to turn the boat on its side. To use them, mark the stations on the canoe as above. Tape the sticks to ends of boat. Stretch the string from one to the other. Turn boat on to side and make the rocker measurements. String sag is not critical.

If you leave the boat inverted, you need to anchor posts at either end strongly enough so they do not move when the string is tensioned. You can do this by positioning the boat between posts of convenience, by using angle iron posts at each end clamped to extra saw horses, or to cinder blocks.

The advantage of leaving boat inverted: If you position the boat so that datum string, and thus the waterline is exactly horizontal, it is much easier to set up the templates square on the hull, something that may be critical. The disadvantage is string sag. Even if it is quite tight, it can be a mm or two. Positioning the string is made easier by tying one end and using a spring clamp on the other.

While the boat is still inverted, or while the Pollmann sticks are in position, the canoe's length should be measured. Stem height and stern deck height should also be measured at this time.

Template positioning must be done after string has been removed. Boat should be as level as possible.

This can be achieved by sliding the forward saw horse forth and back. Some small wedges: 5 cm or so can help adjusting the stern height.

Templates with spacers can be set to contact the hull with the set screws. However, it is easier often to do without. The spacers or something similar can be used as feeler gauges to measure beam by using spring clamps to hold them in place, with the ends touching the hull. The template is carefully lifted off and the beam is measured.

Beam is easy to measure on boats that have no rubbing bands. If there is a rubbing band and the hull skin can be seen in between the deck and band, that gives a good measurement point. Otherwise, the projection of the line of the hull needs to be estimated by the measurer. Given the maximum size of the rubbing band, a point at the underside of the rubbing band may be used; the projection of the hull at that point is generally no more than a mm or so. It is a difficult spot to measure and some judgement may be needed if the spot is near the limit.

Squaring the templates: The templates must be square to the waterline and to the beam of the boat to get an accurate section. If the boat has been leveled, a level can be used to ensure that a template is vertical. If modeling clay is not available, a spring clamp and a square sitting on the keel can be used to position the template. Square to the keel by using two tapes to triangulate to the stern or bow of the boat. Sweden has worked out where the beams hit at the deckline and, going around the hull at the deck line, beams are measured and marked on the edge of the hull. This provides reference points for the bottom of the templates. However, these circumferential distances need to be checked as these can vary, depending on the shape of the boat.

The template can be set on the boat and a wedge that is 20 mm on it can be used to check the shape. The template is made 10 mm too big. When it is set on the hull either one of two things will happen.

Case 1: Contact at two points on either side of boat. Then gap at top and at sides should be no greater than 20 mm.

Case 2: Contact only at top, directly on keel. Then use spacer or wedge, lift template so it is 10 mm above hull at keel. Check gap elsewhere..

Once template is square and perpendicular to the keel, then the beam can be measured as described above.

Templates may be made from the Mylar template drawing available from the Chair of the ICF Sailing Committee or from certified master aluminum templates. These should be checked by each countries National Measurer. Certified templates should be marked and signed as such.

Seat

Seat extension can be measured by finding the boat's centerline using a string, two pieces of aluminum and a bead, to make a gauge to mark the seat carriage at the centerline. Bend two pieces of aluminum which are 1-2 cm wide, about 4 cm long to 90 degrees or a little more. Drill holes at one end. Attach a fine string about 25 cm longer than the boat is wide. Double it and thread the doubled string through a bead. The fit should be tight. The string is then adjusted to so that both legs are the same. This aluminum pieces area hooked to the edges of the canoe and the bead is slid down the mark the centerline at the carriage.

For checking a large number of extensions, a measurement frame can speed the operation.

Marks to verify seat extensions (2005 Rules) will need to be checked. If these are painted or tape, small scribe mark(s) can prove useful for future checking. For seats with an underseat carriage, the verification marks may need to reference the sheer line at the point where the measurement is taken. The seats

restraint should be set so that the seat can not go past this mark. Check both sides.

Dagger Board

Dagger boards should be marked visibly with a mark at the deck or top of cassette to show that they are extended no more than one meter below the boat. Stops should be incorporated into the board to prevent further extension. If the design is such that the board goes below the top of the trunk, the trunk should be marked.

Dagger boards must be fitted with a restraint line that keeps the it from falling out of the boat if pushed all the way up in the trunk from below.

Bowsprits

For asymmetrical spinnaker equipped canoes, a contrasting paint or tape mark should be placed around the spar when extended to the measurement limit. Stops should be incorporated into the design to prevent additional extension.

Spars

Mast height should be measured along the mast from the keel line point below the mast step. Any raking of mast should be disregarded. The measurement is the maximum potential height. The intent is that the height is measured perpendicular to the hull measurement datum line.

Additive method: When determining the deck height, measure also the distance of the mast step from the top of the deck. If the floor is level, while the canoe is still upside down, use a level to square out the keel to the floor, and measure that distance, then measure from the floor up to the base of the mast step and the deck. This provides the thickness of the hull at the mast step and the deck height. The thickness of the hull at mast step is then added to the mast length at the main and jib halyard to check these heights.

If the boat is assembled and a wall is available the boat can be set so the keel at the mast step is touching the wall. The mast is then leveled and the distance is measured out from the wall and squared down to the mast. Check to see that the mast is approximately perpendicular to the waterline when doing this.

If many boats are being measured, a big U shaped square can be made that will go over the hull when it is on the side. A tape is then hooked to it and the size of the square is added to the tape length. Make the square size something easy to add, e.g. 1000mm

Rotating mast: to measure the area of a rotating mast which is tapered, stretch a fine cord down the mast 50 mm forward of the luff grove. Measure as much as possible as a rectangle and then consider the rest as a triangle or ellipse depending on its shape. A mast with the same fore and aft dimension at top as at bottom can be considered as a rectangle. If it is apparent where the mast changes from a rectangle to a taper, then the fine cord is not needed.

Weight

The boat can be weighed using a simple bathroom scale, by weighing first one end, then the other. Boat must be dry, inside and out and should be checked. Any scale used should be checked for accuracy with known weights close to a boat's weight.

All equipment including buoyancy bags will be weighed with the boat. Sails must be removed. The boat and lines must be dry.

Corrector weight mass and position should be noted on the measurement certificate. Weights must be mounted on top of the deck or on the seat carriage or under the deck in contact with it. If under the deck they should be visible to the measurer. If mounted to a centerline web they should be in contact with the deck. If mounted to the underside of deck hatches, these hatches should be marked and they must be used when the canoe is sailed.

Buoyancy

The intention of the rule is for the canoe to be completely flooded and still support 75 kg of weight. For the manufacturer to be able to certify this, in the case of foam sandwich hull, the floatation of the core must be calculated using its area, thickness and density. This should come to enough to float the boat (approximately 90-95 kg all up weight) in addition to the 75 kg specified by the rule.

Sails

The overriding philosophy is the accurate measurement of projected area, as if the sail was a flat plate.

Strings are run past the ends of sails to the projected meeting point of, for example, luff and leech lines on jib. Generally these areas are too small to be significant, but they are significant with a large clew board or a 'fat' head. When in doubt, measure the cloth, or deduct for what is not cloth.

The ellipse measurement is less accurate than a triangular measurement. If the same area is measured as a triangle and two ellipses it will be larger than the ellipse approximation. Thus it is best to keep ellipse measurements at a minimum. Triangles may be measured using the traditional formula: Area=1/2 B x H or by measuring all of the sides and using Hero's formula : Area= $\sqrt{s\,(s-a)(s-b)(s-c)}$ where s = (a+b+c)/2. This has the advantage of not requiring heights to be measured on all of the triangles, and a spreadsheet can be set up to do the calculations. A sample spreadsheet is available from the ICF Sailing Committee in electronic form and will be posted on Web sites.

Sleeve sails are measured to the forward edge of the sail. Double luff rope sails have the luffs laid on top of each other and tensioned together. Fairings are considered to be part of the mast or sail must meet specific requirements as such.

Numbers and country abbreviations are to conform to ISAF rules. Note also that IC rules require the letters **IC** in red as the Class symbol, the national letters and registered number to be clearly visible, legible and of a single colour that strongly contrasts with the sail and in roman style (upright), without serifs. "Computer style" lettering is not acceptable.

String Layout:

The string layout will vary according to the sail plan form. The general rule is to go up the leech so that the second triangle, above the line from head to clew is as large as possible.

It is most accurate to release the tension from the battens, but to leave them in the luff of the sail, rather than withdrawing them, and folding the luff over.

The most difficult part of a laydown is the foot round on the main which has a tendency to curl up. Try to push the foot straight down.

Headboard:

For sails with "square" tops, the angle between the head and the fine cord that runs from tack to head should be less than 98 degrees or if measuring from the bolt rope less than 105 degrees.

Boat Marking:

While not required by rules, canoes should be permanently marked with their number when a number is issued. This can be done by builder or measurer. The best method is to write the number inside the hull where it can be seen by removing an inspection port. If a canoe is sold to another country and issued a new number, that number should be added.

Measurement Documentation:
Owners should request and be given copies of boat and sail measurement data. Copies of boat measurements should be sent to the National Measurer. Older canoes that may have been measured prior to the use of formal measurement drawings, should at least have a measurement certificate.

Measurement Organization:
Each nation's canoe sailing federation should have a National Measurer or Chief Measurer. That person is, in turn, responsible for training measurers in their country, and ruling on measurement decisions or passing these to the ICF Sailing Committee.

NOTE to Builders: Check ideas out ahead of time. If in doubt contact your National Measurer. If an unusual feature appears which is not in clear contravention of the rules, any doubt should be in favour of the competitor pending a review at the next ICF Sailing Committee meeting.

Suggestions for changes, clarifications and additions to this document should be submitted to National Measurers.

For the ICF Sailing Committee,

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