

# Building the Wood/Epoxy Optimist



**An Unofficial Guide**

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## *An Unofficial Guide*

The following Guide describes one method of building a wood/epoxy International Optimist.

It is based on work by Tony Thompson of Canada to whom the International Optimist Dinghy Association (IODA) is deeply grateful.

Neither IODA nor Tony is responsible for any errors. Builders who find such errors are asked to contact the IODA Secretariat. Note that any changes to this Guide can be found on the internet at [www.optiworld/epoxy.html](http://www.optiworld/epoxy.html)

You don't have to use this Guide. Any method of building permitted by the Class Rules is allowed.

Fifty years after it was created by Clark Mills of Clearwater, Florida, the specification for the wood/epoxy Optimist was revised with effect from 1 March 1997. It is intended to bring the Class back to its roots, an affordable boat which can be constructed by anyone with woodworking ability.

Careful consideration of the Class Rules for wooden hulls by the IODA was aimed at making the boat as similar as possible to the GRP Optimist. The new wood/epoxy specification has exactly the same shape as the GRP version; the side decks are wide and comfortable, there are no tanks and the boat can be built to the minimum weight.

Wooden boats have the advantages that each boat is unique: each builder adds his taste and craftsmanship to the final boat. Another advantage not overlooked by parents who pay the bills is longevity and strength. The sides and bow transoms made of 6 mm plywood are far more robust than any GRP hull.

This Guide must be read together with the Optimist plans and Class Rules for the Wood/Epoxy Optimist which may be bought from the IODA Secretariat for US\$40.

## *Construction Method*

The rules allow several options in the construction of the boat, due to the different weights of plywood available in different parts of the world.

The description which follows is based on the use of relatively lightweight plywood which permits 12mm plywood to be used for the bottom panel.

**It should not be used unless 12mm plywood of a maximum weight of 6 kilograms per square metre (kg/m<sup>2</sup>) and 6mm plywood max 3 kg/m<sup>2</sup> is available.**

The drawings enclosed with this article are intended as a supplement to the official plans and rules which are available from the IODA. The panels of the sides and bottom are expanded views of the panels. Think of an orange peel laid out flat so that when it is folded up it takes the shape of the orange again.

Although the method that is described here is meant to minimise the use of frames and moulds, it is very important to check measurements and fairness of the hull to ensure that the hull will measure when complete.

The use of a simple mould made from cheap plywood or particle board/chipboard to form the bottom is recommended. The bottom can be screwed, clamped, or weighed down to hold the bottom curve while fitting the sides.

### **A warning:**

The Optimist is tightly controlled by over 60 measurements and the tolerances of the wooden hull are in general plus or minus 5 mm. The tolerances are not meant to allow a builder to exploit the possible shapes available but to allow a competent builder to construct a legal hull.

## ***Materials***

As noted above this guide assumes the use of lightweight plywood. The most widely available type appears to be made using a wood known as Gaboune or Okoume.

The 12mm plywood used for the base is 7 ply and appears to weigh between 16 and 18 kilos per standard sheet of 1220 x 2500mm.

The 6mm plywood used for the sides and transoms is 5 ply (the minimum permitted by the Rules) and appears to weigh between seven and nine kilos per standard sheet of 1220 x 2500mm.

It is important to use only marine grade plywood which lasts longer, is easier to paint and will not delaminate like lesser plywoods. Unfortunately it seems that neither apparent conformity with the British Standard (BS) 1088 nor the U.S. standard PS 1-95 guarantee perfect quality and expert advice is recommended.

For one boat you will require:

### **Plywood**

A cutting guide is shown on the next page.

1 Sheet 1220 x 2500mm 12mm plywood (7 ply) for the bottom, mast-thwart and midship frame.

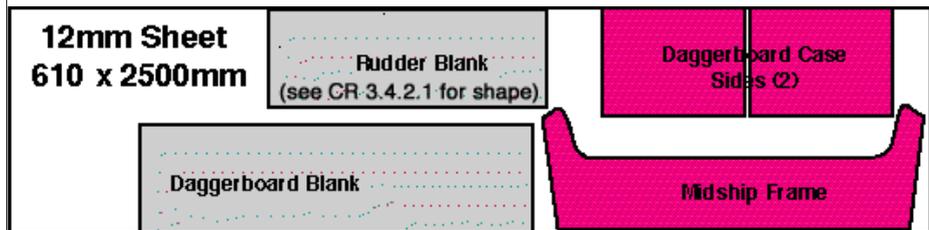
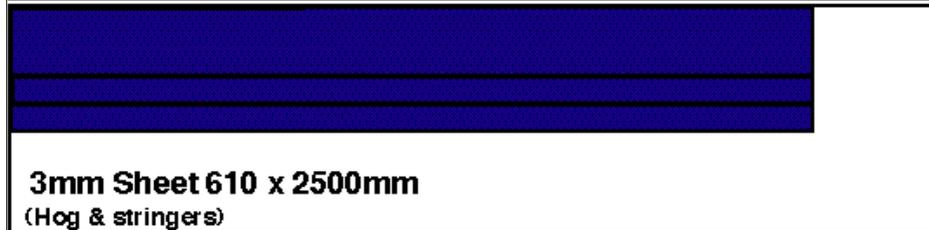
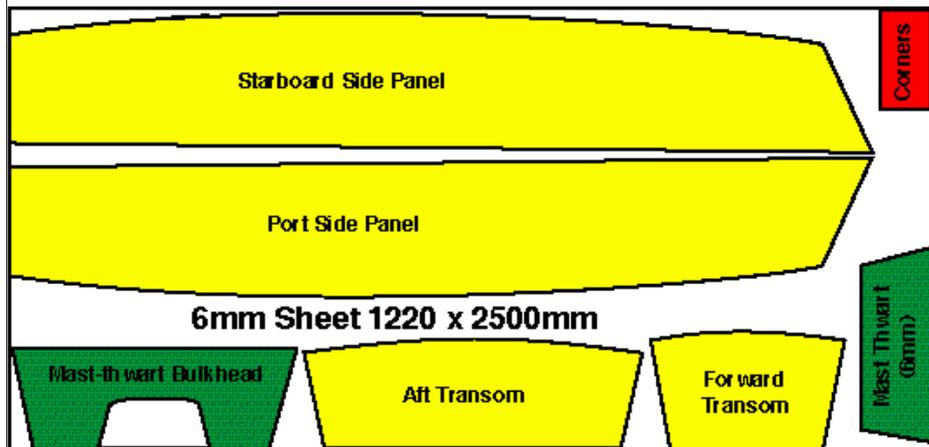
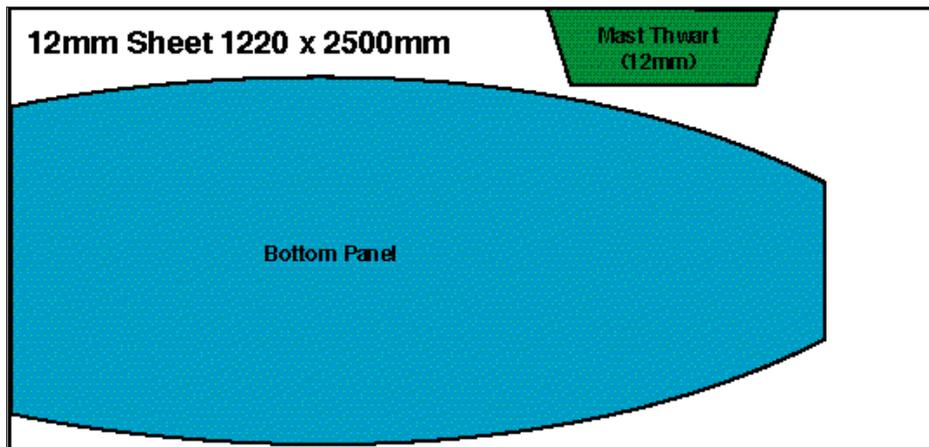
1 Sheet 610 x 2500mm 12mm plywood for the daggerboard case. There will be enough left over for a plywood daggerboard and rudder.

1 Sheet 1220 x 2500mm 6mm plywood (5 ply) for the sides, transoms, mast-thwart bulkhead and corner pieces.

1 sheet 610 x 2500mm 3mm plywood (3 ply) for the hog and stringers.

If possible get an "offcut" of 18mm min. size 200 x 880 for the mast thwart (saves gluing 12mm and 6mm together).

Note: Some saving may be achieved if more than one boat is built together.



## ***Materials (continued)***

### **Inner Gunwales**

6 pieces 2.4m 16mm x 35mm Clear timber for gunwales. Spruce or a light hardwood like mahogany makes for nice light gunwales which are easy to form to shape.

### **Outer Gunwales**

2 pieces 2.40m 20mm x 25mm. Hardwood like mahogany wears better than the softwoods.

### **Framing**

1 piece 16mm x150mm x 2.40m approx for both transoms

### **Daggerboard Case Side members**

2 pieces 27mm x50mm x 400mm

### **Mast step**

1 piece 100mm x 60mm x 180mm

### **Glue**

Approximately three litres marine epoxy glue for laminating parts and coating hull

### **Hardware**

#8 x 3/4" screws. Normal steel since they will all be removed after gluing. The glued joint is stronger than the screws, so why carry around the extra weight.

### **Fittings:**

3 buoyancy bags, mast-step, rudder fittings, padded toestraps, fixing plates.

### **What will they cost?**

The following prices are taken from the internet (search for "marine + plywood") and appear to be average current ex-warehouse retail prices (US\$) from major suppliers:

1 Sheet 1220 x 2500mm 12mm plywood	\$100
1 Sheet 1220 x 2500mm 6mm plywood	\$60
1 Sheet 1220 x 1250mm 12mm plywood	\$50
1 Sheet 1220 x 1250mm 3mm plywood (or 4mm)	\$30
Timber for gunwales etc.	\$50
3 Litres Epoxy	\$90
Fittings*	\$170
<b>TOTAL</b>	<b>\$550</b>

Note: From 2004 the rudder and daggerboard may be max 15mm thick. If 15mm ply is available and funds allow this should be used.

Not bad when you think that the lowest priced GRP Optimist hull will cost at least twice this!

\* Some of these may be available from local chandlers. If not, maybe your nearest GRP builder can help or try Optiparts in Holland who claim to be the "world's largest supplier of accessories for the Optimist dinghy".

### **Tools**

Screwdriver

Metric Tape Measure

Jig Saw - preferably with tilting base

Plane for final fitting of panels & planing gunwales

Electric sander

Drill and #8 bits

Clamps: you need about 10-15 each side when gluing the inner gunwales

Straight edge and flexible batten for drawing curves

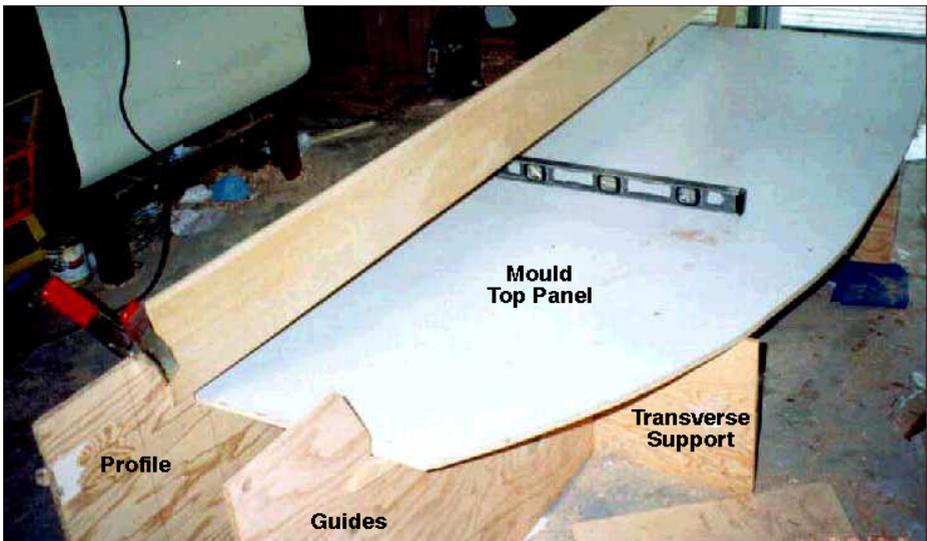
## ***Mould Construction***

A mould is highly recommended to ensure that the boat will measure when complete. A simple bottom mould can be made from two sheets of 20mm particle board (chipboard) for about US\$20 and it is reusable. This bottom mould will define the curve of the bottom of the boat and hold the bottom shape while laminating the bottom and attaching the sides and transoms.

To construct this mould using particle board you will need:

- two "profile guides" running the full length of the boat.  
Take one sheet of the particle board and cut it into two 620 x 2440mm pieces. Using the official plans Sheet 03/10 mark the actual profile of the boat's bottom on one of the sheets. Now scribe a line equal to the thickness of the mould material below this line and cut both sheets the same.
- a mould top panel cut roughly to the shape of the bottom using the dimensions shown in the Expanded Bottom Panel Drawing in Appendix B1 but cut about 25mm narrower than the bottom of the boat.

Glue and screw the top panel onto the two profile guides about 150mm either side of the centre line. Fit a couple of transverse supports so that the bottom mould is quite rigid. If you make them so that they slot over the 2 profile guides you can disassemble the mould for storage.



Double check all of the dimensions on the mould since all boats that are made from it will be exactly the same shape as this mould.

## *Construction*

One of the advantages of using the 12mm bottom construction is that it is thick enough to screw the sides and transoms into. For this reason the bottom panel is cut to fit *inside* the sides and the transoms. Be careful when using the official plans because those plans show the sides *outside* the bottom. Also, since the official plans show the thickness of the bottom as 6mm, you need to add 6mm to the bottom of the bow and stern transoms.

The first step is to cut the transoms out of 6mm plywood (See Plan sheets 05, 09 & 10/10). Use the official plans but remember *add* 6mm to the bottom to allow for the difference in construction described here. The plans show the amount of chamfer required and in both cases the smallest dimension of the transoms are shown.

Mark the centrelines and all lines required. Cut large and plane down later when the framing is glued on. Use the plans to fit the top frames on the transoms. Cut the two temporary moulds (see Appendix A) to be located at the 500mm and 1500mm positions during construction.

Cut the midship frame (Plan sheet 08/10) out of 12mm plywood. In this case make the bottom 6mm shorter in height because the plans show 6mm bottom thickness and the bottom of your boat is 12mm. There is no bevel required on the midship frame.

Cut the daggerboard case (Plan sheet 07/10) out of 12mm ply. Use the alternate method of construction where the entire case extends through the bottom. (It's easier to do and it's stronger.) Note that the height of the case at the aft end is 293mm which, with a 12mm bottom and 3mm hog, gives the Measurement Form height of 308mm.

Cut the sides as shown on the expanded drawing (Appendix B2). Put all lines on as shown, on the inside of the hull to facilitate assembly.

Cut the bottom as shown on the expanded drawing (Appendix B1), but adding about 5mm at the bow (to be trimmed off later). The dimensions have been adjusted to allow the bottom bevel of the sides to be cut at an equal angle of 8 degrees of bevel. This means the angle will be slightly too shallow near the bow but the epoxy glue will easily fill the joint.

Draw the centerline and connect all the lines shown. If you are careful you can cut quite close to the line. Always clean up the saw cut with a sharp plane. The lines will be on the inside of the hull. Take note of the angles of the bottom cut at the bow and remember that the bow and stern transoms are fixed *outside* the ends of the bottom panel but *inside* the side panels.

Cut and fit the doubling pieces (hog and stringers). It is recommended that you use the minimum dimensions stated in CR 3.2.4.2 (it is easy to add weight with epoxy, difficult to reduce it.). Glue them to the bottom panel by using a combination of clamps, weights and screws through the bottom. Use liberal amounts of epoxy since it is very important that they are securely attached to the bottom: they support the securing pads for the toe straps and mainsheet blocks and the mast step.

It is recommended to dry fit (without glue) all the side panels and transoms to ensure that everything fits. Since the sides determine the curvature of the bottom screw the sides securely to the bottom panel.

Slip the transoms into place and plane the angles so that they fit. Epoxy glue is quite tolerant of gaps so perfection in fit up is not necessary. Check that the midship frame fits properly and then stand back at the transom and look down all the centrelines that you drew on the panels. They need to be perfectly lined up indicating that the boat is straight. Once you are certain the boat can be set straight, it's time to do some gluing.

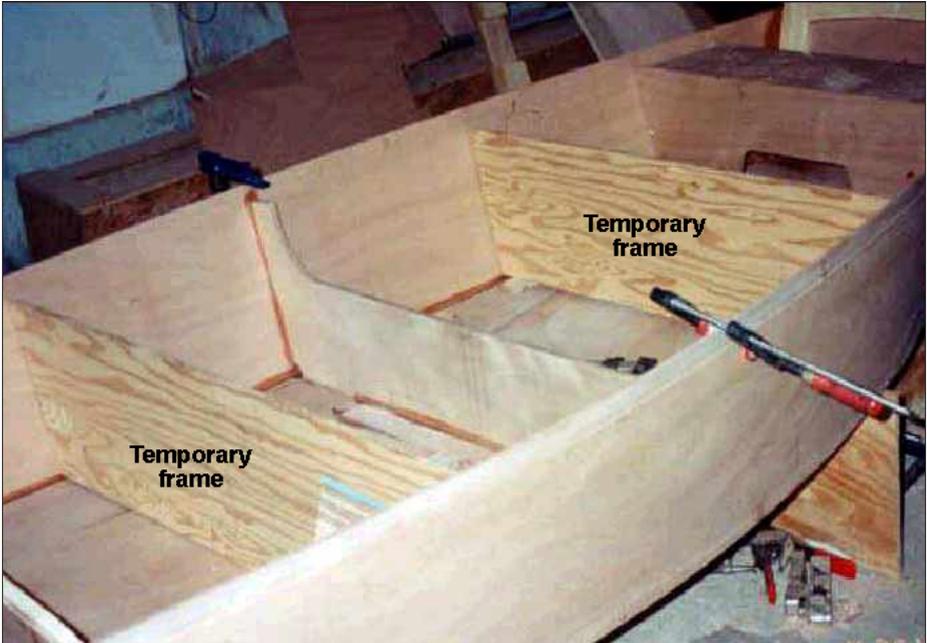
Release about half of the screws from the aft end of the boat to the midship frame on both sides. Glue the joint and put the screws back in to hold while curing. Fit and glue the aft transom. Put the aft temporary mould in position but try not to get any glue on it. Use wax paper if necessary. Release the forward screws back to the midship frame on both sides and glue. Screw the panels and midship frame back together and fit the bow transom.

Fit the forward temporary mould to the panels. Remember to use wax paper so you can remove it later. Once all the glue is cured remove all the screws.

The shell is now complete.

### **Inside Gunwales** See Plan sheet 06/10

The inside gunwales consist of three pieces of wood 16mm x 35mm running the full length of the boat (so not worry if these are a few millimetres short at the ends. They will get covered up by the plywood brackets anyway and, unless you are a craftsman, dealing with all the angles and lengths can either be frustrating (or a challenge depending on your outlook!). Glue and screw (from the outside of the hull) the first strip in position and then you can glue the next two to the first using clamps. The screws can be removed when the glue is dry.



Make certain the two temporary frames are in the correct position or the top-side measurements will not be within the allowed tolerance.

### **Mast Thwart**

Cut the mast thwart bulkhead according to official plan sheet 06/10. Width at top is 800mm: height to the top of the stringers 268mm. Make up an 18mm thick piece for the thwart itself by laminating some 6mm and 12mm ply together (or use an "offcut" of 18mm). The width of the mast thwart itself is 800mm aft and 670mm forward. The thwart needs to fit tightly under the gunwales with generous fillets of glue so that it remains in place.

After the glue has set measure and mark the centre of the mast hole (see Plan Sheet 03/10) and cut this to the appropriate size (see CR 3.2.2.13).

### Corner Pieces

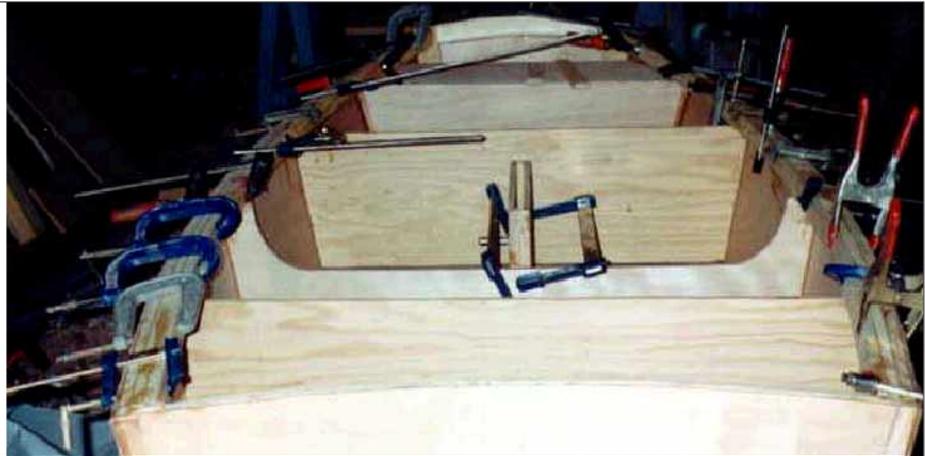
The corner pieces are very important to the strength of the boat. They can be easily fitted by sawing the recess in the inner gunwales with a jigsaw.

Cut and fit the corner brackets and use liberal amounts of epoxy to fill the gap. Wipe off any excess after clamping the corner brackets and plane the excess wood to fit the outer gunwales.



### Outer Gunwales

Using the 20mm x 25mm mahogany fit the outer gunwales by gluing and clamping. The ends can be cut off and shaped after the glue dries.



### Daggerboard Case

Assemble the daggerboard case as shown in Plan sheet 07/10 (remember you are using the *alternative* construction).

Cut a hole in the bottom of the boat and the hog large enough to pass the daggerboard case through.

Now you can mark the shape of the bottom on the extension of the daggerboard case so that you can cut it off flush with the bottom of the boat. Using epoxy glue with a filler carefully glue the case into the boat, screw the case to the midship frame so that it remains square to the bottom of the boat while the epoxy sets. Fit the additional stiffening required by the plans around the base of the case.

## **Buoyancy Bag, Mainsheet Block and Toestrap Securing Pads**

See Plan sheet 01/10

Refer to the official plans for the locations and sizes of the various pads required. These are all measured so be sure that they are correct.

### **Mast Step**

A wedge-shaped block (see Plan sheet 03/10) needs to be fitted under the mast step to level the base for fitting the adjustable mast step. Again you need to refer to the rules and carefully measure this block so the boat passes measurement. It may be useful to attach the mast step fitting to the (varnished) block before gluing it into position.

### **Finish**

The boat is now 100% structurally complete and requires planing of the inner gunwales according to the plans. The sides of the bottom need to be rounded to a 5mm max radius and the whole boat needs to be sanded.

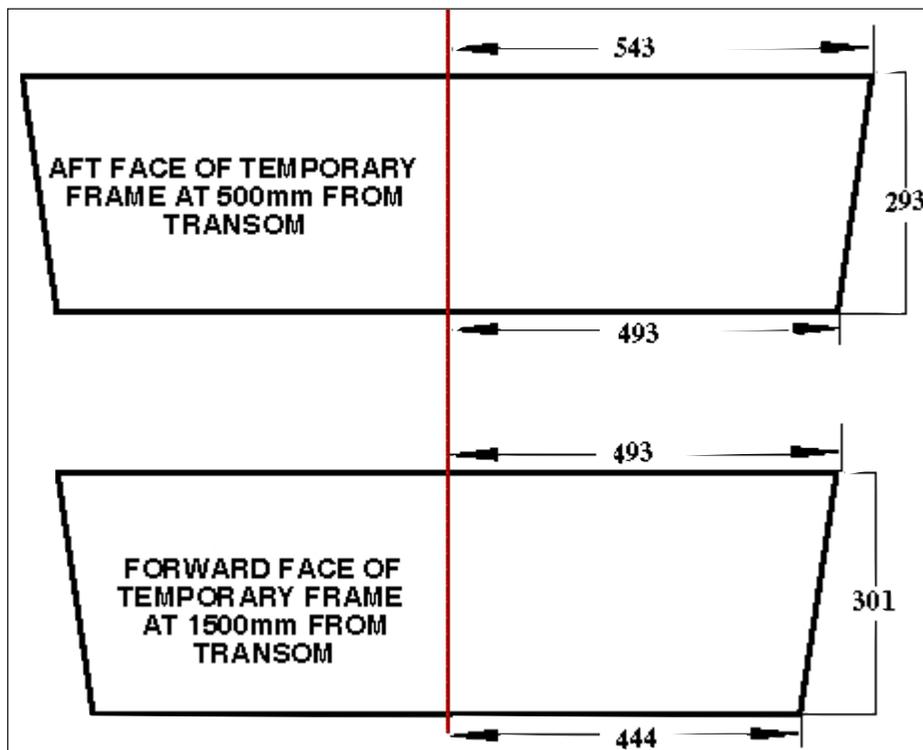
Coat the exterior of the boat and the floor with epoxy but be careful with the amount that is used because epoxy is heavy and you don't want the boat to be overweight. You can balance the boat on its side on a bathroom scale to get a rough check on the weight as you progress. Paint alone will add about 1 kg to the finished boat and the hardware can easily add 2 kg.

The goal is to get the boat just at the minimum weight without using correctors. If you use good quality plywood and are careful with glue you can achieve this weight.

For the exterior hull use a good quality polyurethane paint which is compatible with epoxy and following the manufacturers directions. The interior sides can be varnished and if the boat is kept covered this finish will last several seasons. All the hardware and airbags need to be installed and that will complete the construction of the hull.

### **Foils and spars**

See the Class Rules for specifications. Spar (and sail) plans are available @ US\$20 but are not necessary unless you intend to make your own.



## *Measurement*

Official measurement:

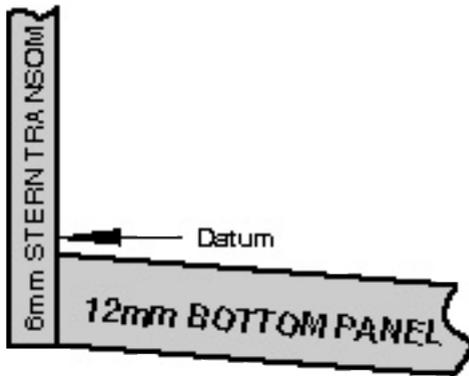
- enables the Optimist to race at any level
- much increases its secondhand value
- enables an official sail number to be issued

Your nearest measurer can be contacted via your National Optimist Association. A list of these is available on the internet at [www.optiworld.org/ioda-members.html](http://www.optiworld.org/ioda-members.html).

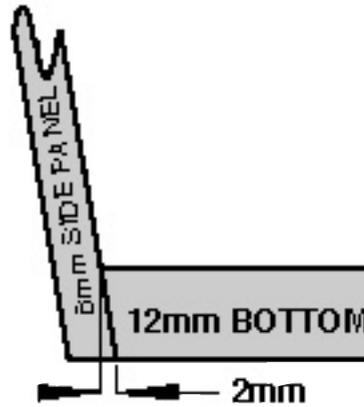
The measurer will issue you with an official Registration Book and an ISAF plaque (sticker) to show that the royalty on the copyright design has been paid.

*Happy Sailing!*

# Expanded Bo

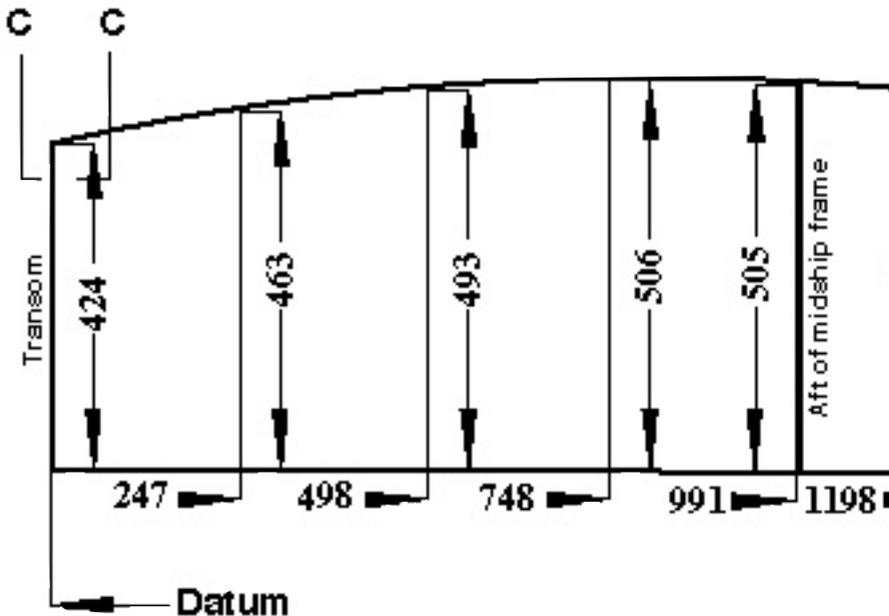


Detail C-C



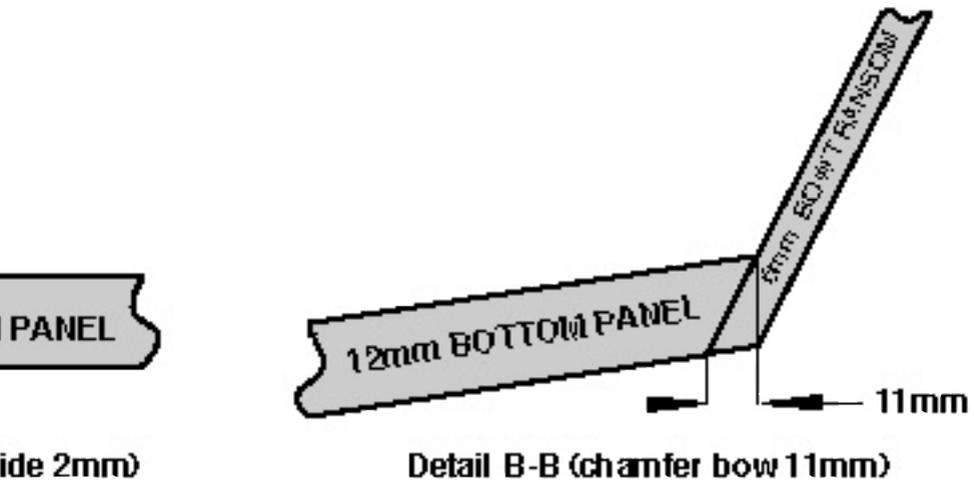
Detail A-A (chamfer s

Note: Dimensions are of the INSIDE of a 12mm bottom panel and allow

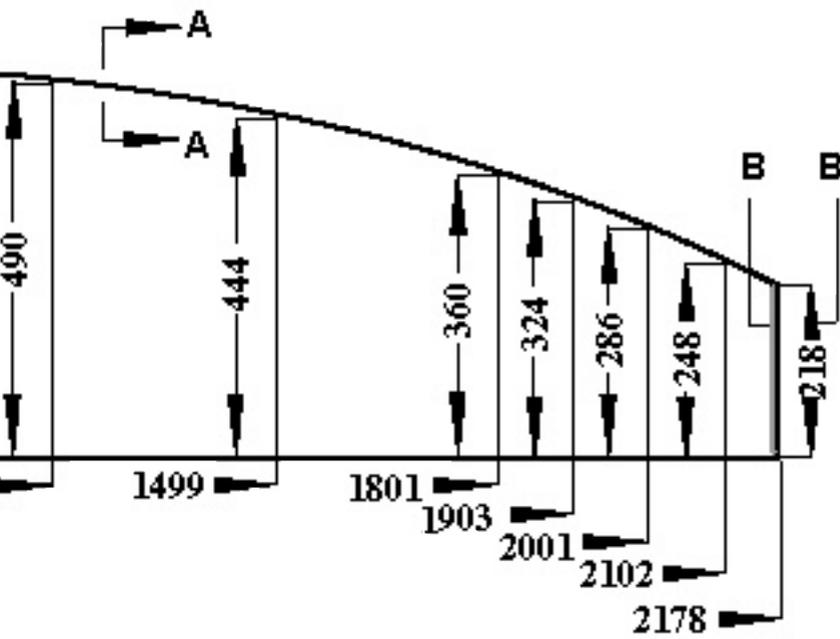


# Bottom Drawing

Appendix B1



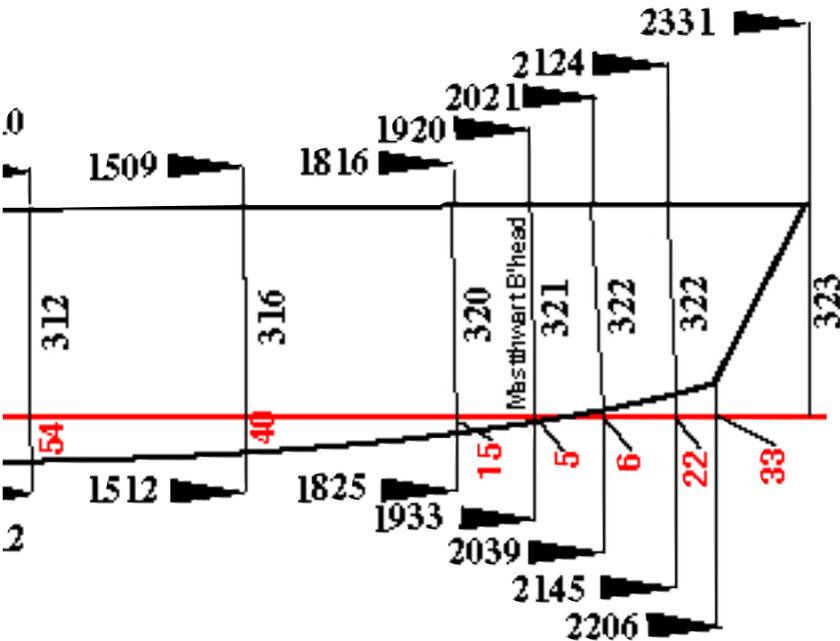
for a 2mm chamfer along the sides and an 11mm chamfer at the bow.





# Panel Drawing

Appendix B2



4. Dimensions shown vertically in **RED** are distances from the Datum Line to the bottom of the side of the hull.
5. Draw all lines shown on the inside of the panels. Cut approximately 2mm outside the lines and plane off excess after assembly.

