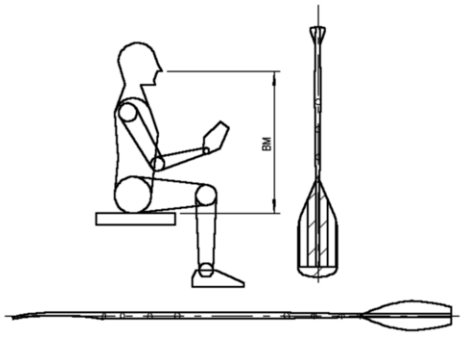
How to build DOUBLE AND SINGLE TOURING PADDLES



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LICENCE

The download of this plan entitles the purchaser to build paddles for their own boat/s.

The right to make paddles to these plans for sale to others is by a further small fee per paddle to be negotiated with the designer. Contact storerm@ozemail.com.au

The purchaser must decide whether the paddle will suit their purposes. I have offered a description of the paddle and its building which is offered in good faith, but it is limited in that it is my opinion only. As there is no control over the materials or workmanship there is no warranty expressed or implied.

PADDLES – Overview

Comments on Paddles

There are two paddles detailed in this pack single bladed and double bladed.

It is usual to carry single bladed paddles on a canoe, but a double bladed paddle can be useful as an auxiliary when paddling by yourself or in calm conditions. There is information on sizing the paddles to the user - this is particularly important on long trips.

Kayaks and one person canoes usually use a double bladed paddle.

Many manufactured paddles are designed to suit the strength of a competitive paddler who trains regularly. As a result the blades are too large and the recreational or distance paddler will tire quickly and have difficulty handling the paddle in waves and wind.

The paddles in this plan have been designed around recreational use and a wide range of weather and sea conditions. They are general purpose, designed for covering distance, not for sprints or tight maneuvering against the clock. A specialist paddle will be better in those cases.

The construction is solid timber for the shaft and two layers of 3mm ply for the blade. This form of blade construction is far stronger and lighter than shaping them from solid timber so it expected that the paddles will stand up to rigorous use. The construction also allows the paddles to be quickly constructed.

The plans are in metric measure. This is by far the most convenient and universal system. Some of my more popular boat plans have materials lists in both systems to simplify ordering, however the building instructions are always in metric.

TIMBER

Timber Selection

It is best to make paddle shafts from straight, kiln dried fine grain timber.

The most appropriate timber to choose in Australia is Oregon (Douglas Fir). Most of the spruce (usually quoted in as the appropriate timber) that we see in this country is poor grade and warps badly when cut or over time. Spruce that is fine grain and dried properly will not warp but is expensive and hard to get.

Paddle shafts need to be light but strong. Fine grain gives strength and resilience. To see if the grain is fine enough, look at the annual rings on the end of the piece. There should be 25 grains per inch.

The timber should be knot free.

Warped timber is heartbreaking in paddles, however a small amount of warping can be eliminated in the shaping process.

Timber weights vary quite a bit. It is more important to have the timber fine grained and knot free, but if you have to choose between two pieces take the less heavy.

Plywood

The plywood for the blades should be 3mm thick. Gaboon marine ply would be recommended for its light weight. Contact me if you have difficulty finding a supplier in the sizes that you need

TIMBER LIST

all dimensions are finished sizes and are in mm unless stated otherwise.

Oregon - Douglas Fir, Spruce, select dry stock. Fine grain, no knots. See notes above.

Part	Size	Length	Number	Species
3mm Gaboon Ply 3ply				
Single Paddle	580 * 235	-	2	
Double Paddle	525 * 180	-	4	
Shaft				
Single Paddle	32 * 32	1500	1	Oregon
Double Paddle	32 * 32	2500	1	Oregon
Handle				
Single Paddle	32 * 36	250	1	Oregon
Double Paddle	none			

EPOXY STUFF

Epoxy	1.5 litres will do two single paddles and a double
Fortifier gluing powder	0.5 kg or less

MISCELLANEOUS MATERIALS

Barrier creme for hands	If you use it religiously the epoxy will come off with soap and water. DO NOT USE SOLVENTS FOR CLEANING SKIN.
Bag of disposable gloves	
Foam rollers	1 - they have a thin layer of foam on the card board roller. If you can get a short roller cage handle (ask your epoxy supplier or included in kit) it means the rollers can be cut in three - a good economy for a little boat like this.

Masking tape 19mm (3/4") wide

Roll of plastic packaging tape 37mm or 50mm wide (1 1/2 or 2").

Sheets sandpaper - alumina paper (white grit) is best.
4 sheets each of 100 grit and 180 grit

Some plastic sheeting would be useful.

Heaps of clean, empty tin cans

Stirring sticks made of scrap timber 200 by 20 by 6mm approx.

TOOLS

Tape Measure - The best type for boatbuilding has Metric on one side and inches with sixteenths marked on other.

Metal straight edge around a metre (3 - 4ft) long.

Combination square.

Jigsaw and/or Japanese back saw. Tenon saw would work okay.

Planes - small block plane or Stanley #4 or similar.

Spokeshave

Chisel - 19mm or 25mm (3/4" and 1")

Sharpening Stone - to keep the Planes and Chisels sharp.

Honing oil - to use on stone. You can make your own by adding a small amount of engine oil to Kerosene (Paraffin) - a couple of tablespoons to a pint.

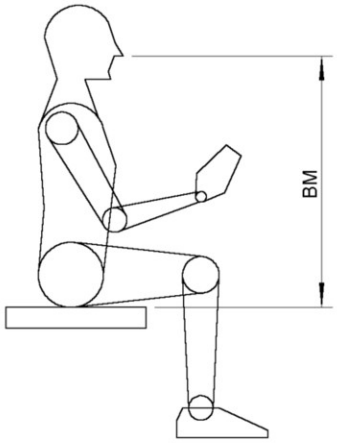
Files - a rasp and with round back.

Sanding Block

Clamps - clamps cam be expensive. I usually get away with a couple of reasonable quality G-cramps or sliding bar clamps with a minimum opening of 100mm (4"). Occasionally it is possible to find cheap sliding bar clamps from Taiwan for around $3, which I collect when I can. The **most useful** and cheap clamps are "spring clamps (sometimes called welders clamps) they sell for around $2 – 5 to 10 would be useful for this and many other projects. Make sure they have a strong springing action.

MAKING PADDLES

Making the Paddle to Fit Yourself



Single Paddle - Sit with a good posture on a hard chair or bench. Measure the distance from the tip of your nose to the bench in millimetres. This is called your "base measurement".

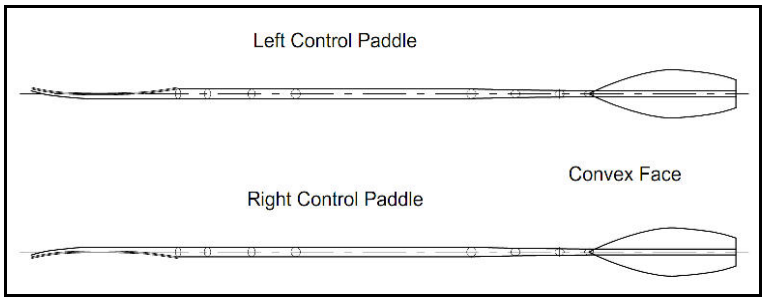
Add 75mm to the base measurement if you are short or average height, and 100mm if you are tall. Now add 486mm to give the length of timber required for the shaft. My base measurement is 750mm, my paddle's shaft is 750+75+486=1311mm. The blade will extend about 72mm past this measurement.

There is a basic width for the single blade paddle blade. It can be decreased by a total of 20mm for children or weaker paddlers or increased by a similar amount for very strong paddlers (if the blade is too large it is possible to reduce the width after trying it out.

Double Paddle - The overall length of the double paddle is 2475mm. This will be appropriate for all but very narrow boats. If your boat is very narrow (less than 635mm) you can deduct 150mm from the paddle length. The tapered part at each end of the loom will have to be shortened by 75mm each side.

Feathering paddles where the blades are at right angles are most efficient and are shown in these drawings. Some Sea Kayakers doing offshore work choose unfeathered paddles as strong wind can get under the blade and tip the kayak over.

Work out whether you want a right or left control paddle - see diagram below. Mark the shaft so the position of the blades are clear.



The paddle with right hand control is much more common. The right hand twists slightly at the wrist to present each blade in turn to the water. The shaft is allowed to rotate freely in the left hand.

There is more strain on the wrist of the control hand. As I have a slight problem in my left wrist I use a right control paddle.

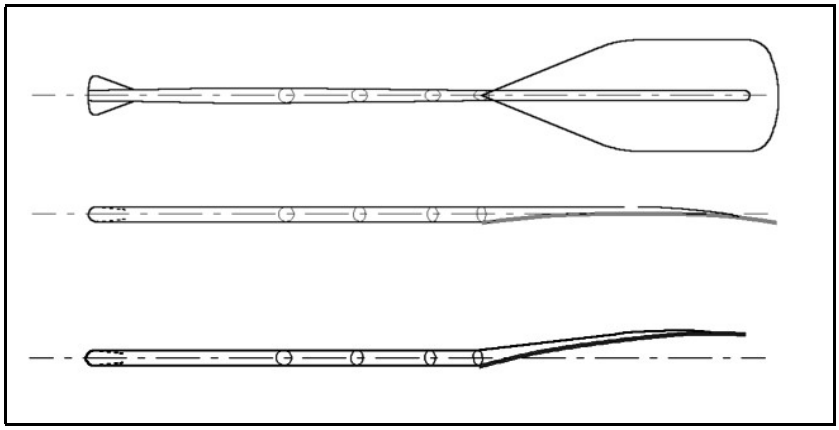
If in doubt make the paddle right control.

Shaping the Shaft

The paddles in these plans are designed to be as simple to build as possible, so specify a shaft made of one piece of timber. It is possible to laminate the shaft, but if the timber is chosen carefully it is not necessary.

Reasons for laminating the shafts can vary from using contrasting timbers for appearance, making a single paddle with a bent shaft, or if suitable timber for a one piece shaft is unavailable or warped. 3 or 7 degrees is quite common for bent shafts, though they can get up to 14 degrees or more. The bending makes them more efficient in a straight line, but less suitable for maneuvering in and when using fancy strokes.

A dimensioned shaft drawing is on the next page



Laminating a shaft

(skip this section if using one piece of timber for the shaft)

The following description is for those who wish build a laminated shaft.

The shaft will have to be laminated out of at least four layers of timber. If you are planning to make a paddle with a very bent shaft, six layers may be more appropriate.

Leave the timber over length for the moment.

Work out how you are going to clamp the timber after gluing. Do a dry run if in doubt.

Lay out the timber in the order of the laminations.

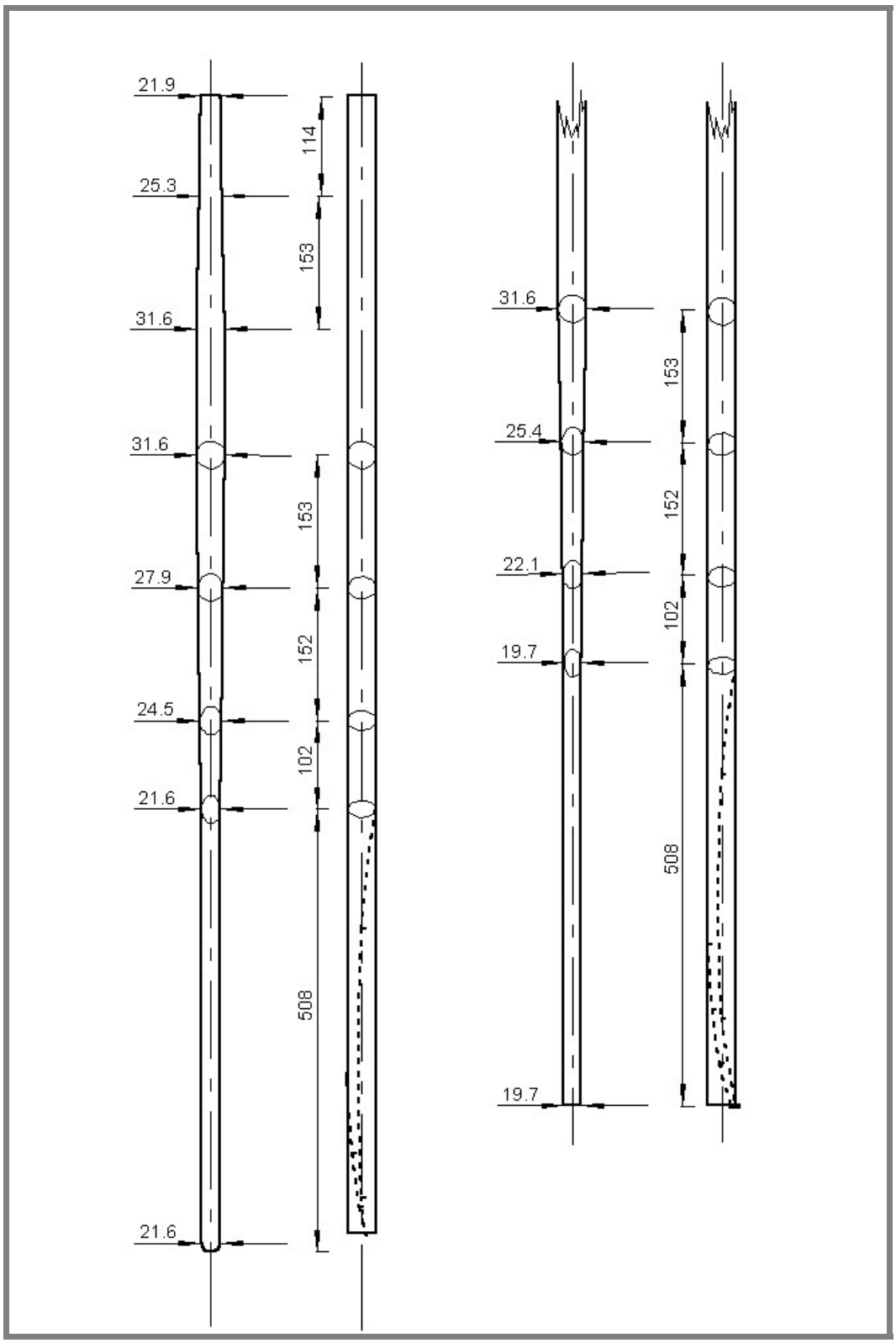
Mix up enough resin and precoat with a thin layer on gluing surfaces. Add gluing powder to epoxy to make a "honey like" consistency, spread on one of each pair of adjacent faces and clamp together. Alternate the clamp handles to face in alternating directions so the weight won't twist the blank.

To ensure the blank glues up straight put it on its side so the glue joint is vertical - sight along the join to ensure it is running straight (unless it is a bent paddle!) If it isn't you may have to loosen some of the clamps to adjust.

When the glue is dry remove the clamps and use a belt or disk sander to remove any glue

runs. Be careful not to lose the square shape of the shaft.

PADDLE SHAFT DIMENSION DRAWING



Marking the Shaft

The taper is marked on two opposite sides of the timber shaft. The other two faces are planed down to those tapers. Follow the method below

Mark and cut the shaft blank to length.

The shaft dimensions are given at different heights in the Shaft Drawing. (If attempting to eliminate some warpage in the material, put the intervals for the most tapered end of the shaft toward the most warped end).

Use the combination square to mark the intervals across the face of the blank.

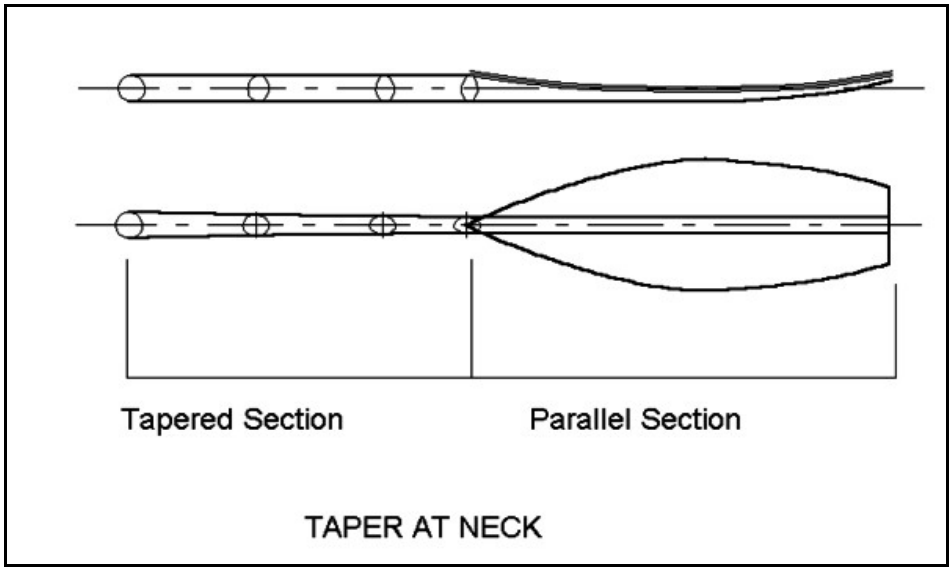
Use the square to transfer the interval lines onto the other three faces.

The front and back faces of the shaft have to marked with the taper as a guide for planing down the sides. The paddle blade positions marked earlier will give identify the front of the shaft. Feathering double bladed paddles will have their ends tapered at 90 degrees to one another.

Work along the shaft measuring and marking the correct width on each interval. (Note - if attempting to eliminate a warp the paddles will have to be marked with a straight centreline using a tensioned string or straightedge.)

The object is to take an equal amount off each side - so if the blank face is 50mm wide and the required width is 46mm, then put a mark 2mm in from each side. You will also need to mark the opposite face with the same measurement.

Where fractions of a mm are given estimate the position that the mark needs to be. A sharp pencil is essential.



TAPER AT NECK

See the diagram above to see how there is a sudden change in shape at the shaft neck, where the blade will attach. The ellipses show the cross section changes at different heights – circular at the left hand side altering to an ellipse.

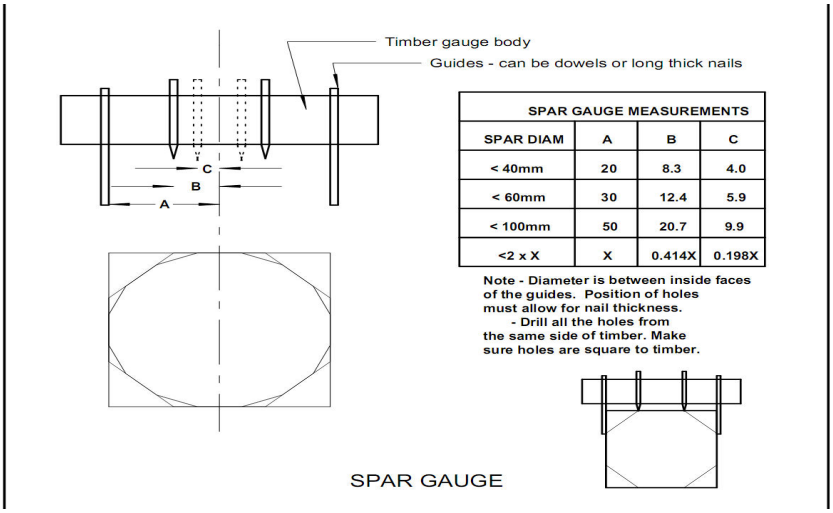
Planing the first two faces

Place the blank at an appropriate height for planing. The marked faces should be to the sides Clamp it down using a scrap of timber under the clamp so the timber is not crushed. Keep the clamp away from the area that you are going to be working. Work on one end of the taper at a time.

Use the longest plane possible AND KEEP IT SHARP. If it gets blunt it will start to split the timber. Glue joins will blunt the plane quickly.

A spokeshave may be necessary for shaping the change of taper at the neck.

Start planing from the areas where most wood has to be removed - if the grain starts lifting try planing in the opposite direction.



Continue planing, check to make sure that you are approaching the taper marks on both sides evenly. DO NOT PLANE THEM OFF.

To produce a smooth taper USE LONG STROKES OF THE PLANE (though strokes will have to stop at the neck). Try and remove the timber evenly - don't concentrate on one spot or you will end up with a hollow. As you get closer adjust the plane for finer and finer cuts. When the first end is done taper the other.

Rounding the Shaft – making and using a spar gauge

The shaft is now tapered but square. A spar gauge is used to mark for planing off the corners to make it eight sided. See figure below

Look at the Spar gauge Drawing. The spar gauge for <40mm is best for paddle making. If you have other slightly larger shafts to do you may wish to scale it up to do all the sizes you need. (note - a spar gauge gets less accurate if it is made too far oversize - don't scale up more than 50% over the given size.

There is an option to use either pencils or sharpened nails to mark the lines. I prefer the nails as you can still see the lines if you happen to plane a little too far. Pencils work fine if sharp.

When the gauge is made, place it over the blank at one end. Twist it so that the guides sit flat on either side of the blank.

Pull the gauge toward you making sure that the guides are kept flat on the timber. There should be two clear lines being marked on the timber. If not you may have to adjust the nails/pencils.

As you proceed toward less tapered areas the gauge will move to a less and less acute angle adjusting the position of the two lines automatically.

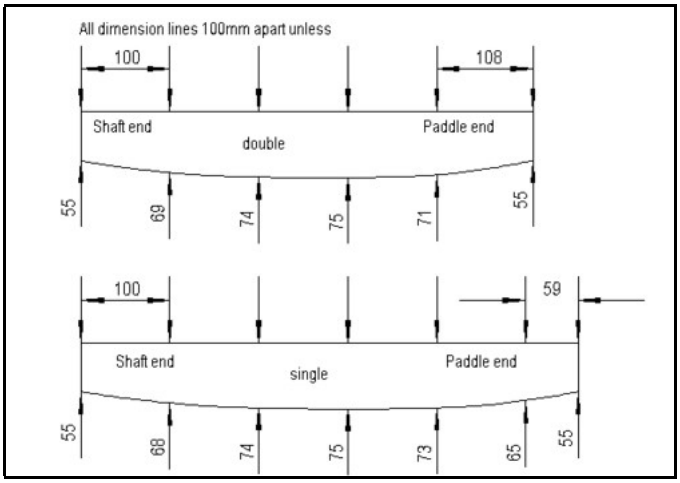
Planing the second two faces

The tapers are marked for the two remaining faces and then they are planed down – remember that the shaft will have different tapers or be untapered for the second two faces. Check the drawings carefully.

Marking the paddle blade scoops

Now the taper is cut the scoop for the blades can be marked.

There are two Scoop Templates - one each for the single paddle and the double paddle. Tape the template down to stiff cardboard or plywood and cut carefully around the outline. Use scrap plywood or timber if you are going to make more than one paddle to make a more permanent template.



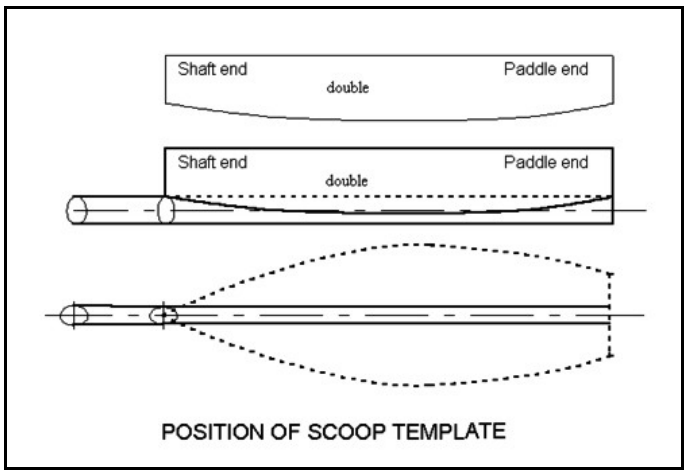
Mark the template so you know which end is the top of the blade.

Mark the scoop on the sides of the loom. The template is positioned as shown above If you want to make several paddles it may be worth taping the template to some scrap ply and cutting it out with a jigsaw to make a permanent template

Cutting the scoops

Use a jigsaw or band saw to cut the scoops on the shafts. Work carefully and check that the blade is following the correct path on BOTH sides of the loom - it may tend to wander.

Use the spokeshave to plane the scoops down to the line.



POSITION OF SCOOP TEMPLATE

Making the blank 8 sided

When the lines are marked on all faces, plane off the corners of the blank.

Carefully plane down to the lines left by the spar gauge.

LEAVE THE BLANK RECTANGULAR FROM THE NECK DOWN AND IN THE HANDLE AREA (single paddles – opposite end of the shaft from the blade scoop) - IT WILL BE SHAPED AFTER THE BLADES ARE LAMINATED IN PLACE.

The shaft needs to be thinned as in the diagram opposite. Note the taper is different for single and double bladed paddles. Keep the curve smooth as you plane it down.

*diagram – see prev para *

When satisfied with the taper use the block plane to continue the eight siding down to the end of the shaft by eye. Be careful not to gouge the blade with the corner of the plane.
Making the blank 16 sided and rounding
In smaller shafts and spars (up to 75mm diameter) the corners are planed off by eye to produce16 sides. This is the case with paddle shafts – the method follows.

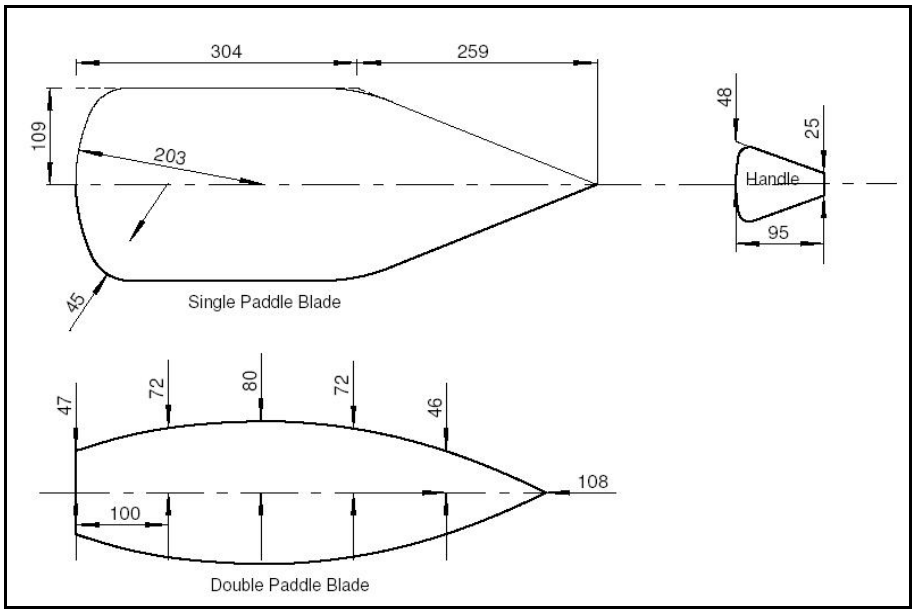
For shafts this size it will be impossible to set up the gauge for 16 siding - the two inner holes will be too close together. In this case it will have to be done by eye.

Use white chalk to mark bands around the shaft about 50 to 70mm apart. This will allow you to see where you have planed.

Plane methodically finishing one corner before moving on to the next - or you will lose track of where you have been. Match the sizes of the planed faces to the unplaned faces by eye.

16 side the handle and shaft at the paddle end as well using the spokeshave.

Cut the ply for the blades



Use the supplied Blade Templates to mark the shapes on 3mm ply. There are two pieces (laminations) needed per blade.

Cut and sand one lamination per blade accurately to shape. The other can be cut 5mm oversize for the moment.

Clamp the accurate shape in place. Adjust until it is perfectly square. Mark the position by marking the loom shape on the blade by running a pencil around it. If there are lumps and bumps stopping the ply from matching the scoop shape neatly remove them with the spokeshave.

Gluing the blades on the shaft – the dry run – NO GLUE YET.

When a clamping procedure is a little complicated I always do a dry run – clamp everything together without the glue. This makes sure you have your method right, rather than finding you don't and have the glue rapidly hardening or just creating a big mess as you try to get everything right.

Do a dry run to make sure that both laminations can be clamped in position with the available clamps. Clamp the two blade laminations together with two clamps on edges, then bend the laminations in place on the shaft by clamping them in place. Put additional spring clamps around the perimeter of the blades to hold the two blade laminations together. There should be minimal gaps without excessive clamp pressure.

Remove clamps.

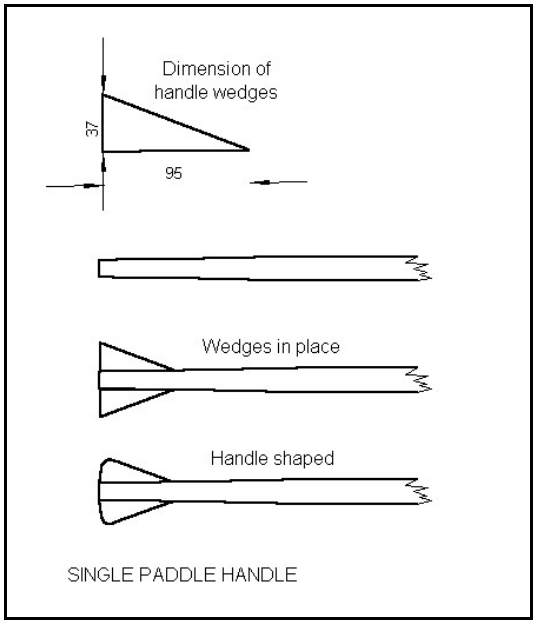
Gluing the blades on the shaft – the real thing!!!

Brush resin/hardener mix onto the scoop area of the shaft. This is necessary because the oblique ends of the scoops have exposed end grain. End grain is highly absorbent and may suck all the epoxy away from the joint area.

Add the high strength gluing powder to the tin of epoxy.

Apply epoxy/powder mix to the mating surface of the paddle blades and the scoop area of the shaft and reclamp in the correct position.

Wait half an hour then tidy up any glue oozing out from the joins.



SINGLE PADDLE HANDLE

Fitting the handles to the single blade paddle

Cut the handle triangles as shown and mark their position on the shaft.

Work out how to clamp the handle triangles in place on the shaft. It can be useful to tap a fine nail (must be fine or the hole will show when the paddle is finished) partially into the shaft to stop the triangles from slipping. in place so that

Apply glue to the handle triangles and clamp back in place.

Shaping the handles

Use a power sander, rasp or coarse sandpaper on a block to sand the handle triangle faces down flush with the shaft.

Use the Handle Template to mark the finished handle outline on the paddle. Trim it to that shape using a jigsaw (make sure the saw cut is vertical and not cutting too far in on the underside).

Use the spoxeshave to continue the eight siding of the shaft up the sides and across the top of the handle by eye. See Diagram opposite.

Grasp the handle - see if it is starting to feel comfortable to grip. Continue to rough out the handle.

Rounding the Shaft and handle

Now to round the shaft.

It is best to use a sanding belt - these are very durable - get them as long as possible - cut them near the manufacture join. Alternatively use a length of sandpaper sold off the roll at Hardware stores. You will need 100 to 120 grit coarse belts for coarse shaping and a 180 grit medium for final rounding.

Using the coarse belt, wrap it 180 degrees around the shaft. Angle the paper so it is around 45 degrees from the perpendicular.

Shape the shaft only at this stage. Sand until the ridges are around 90 percent gone. Then move down to the finer paper. Continue sanding until there is only slight evidence of the flats.

Use the same method to shape the handle.

The shaft at the blade end can have its corners planed off once more with a VERY finely set plane, then be sanded with coarse then fine sandpaper on a block to get rid of the ridges. To prevent gouging the back of the blade it can be masked off with multiple layers of masking tape.

Hand sand to get rid of sanding marks from rounding the shaft.

The final stage is to get rid of the sanding marks that are running helically around the shaft and handle. To do this, sand along the grain with handheld sandpaper (approx 220 grit) until the scratches are gone.

The shafts are now shaped.

Trim the blades to their final shape and sand a slight radius on the corners of the blade.

Final Epoxy coating

Read the appendices about “wet on wet application of epoxy” and dewaxing epoxy before continuing. Follow your epoxy manufacturer's directions

Epoxy manufacturers usually recommend 3 coats over wood.

When epoxy has cured, dewax (see appendices first) and then varnish (make sure varnish has UV filters - spar varnish) - follow directions on can.

Almost finished!

Finally when all the epoxy has cured sand the surface lightly to remove the shine. The boat is now ready for painting or varnishing.

Painting and Varnishing

There are two basic types of paints and varnishes.

1.Two pot - which is very hard and durable, but can be hard to get a good finish with a brush and to touch up. You have to be careful of the fumes. No primer or undercoat is required.

2.Conventional varnishes - thin with turps, are easier to put on, but may remain soft for some time. The conventional varnishes often have a better gloss and I think they are much more pleasant to use (feel nice/smell nice).

Use varnish and paints according to manufacturer's directions. A professional finish is 90 percent dependant on getting the surface smooth between each coat.

If varnish is continually exposed to sun it will need a light sand and two or three new coat every year (less in Northern Australia).

Two pot varnish will go for a couple of years under the same conditions.

Keeping the boat and paddles out of the sun will reduce need for maintenance many fold.

APPENDICES

Cordless Battery Drill with Clutch.

A marriage made in heaven. The drill can be battery (most convenient) or mains powered. It is best if it has a variable clutch. If you have a drill without a clutch, you can often buy a new chuck with inbuilt clutch.

The screws are self tapping and match a Phillip's head bit in the drill. Just hold two pieces of wood together with one hand and drive screw in with drill in other. Fast - and the screws can be re-used.

If you want to minimize the indentation where the screw head meets the ply, use a plywood pad already placed on screw. If gluing, the pad should have some plastic packaging tape wrapped around it to stop accidental bonding to the workpiece.
I mass produce the pads by cutting a strip of ply (usually 6mm, 1/4" thick) about 19mm wide (3/4"), covering one side with packaging tape, then cutting it into 19mm (3/4") squares

Wet-on-Wet Coating and Dewaxing Cured Epoxy.

Great improvements have been made to Bote Cote brand epoxy in regards to this problem. It is very unlikely to occur at all. All the preparation you need for the next process is to sand the hardened epoxy surface. The wet-on-wet application method is still the best as you don't have to sand between the coats.

However other brands of epoxy may suffer from wax.

As epoxy cures some of the unreacted components migrate to the surface, leaving a waxy residue.

This can reduce the adhesion of following coats, whether epoxy or paint and make them go "fish-eyed" (the surface finishes pitted).

This is why I always use a "wet-on-wet" epoxy application method (see "epoxy coating" above). If the surface is allowed to cure it will have to be dewaxed (not Bote-Cote) and sanded (Bote Cote too).

Dewaxing - When the two to three coats have cured I always de-wax the surface using a plastic domestic scourer (Scotchbrite) and water with some cloudy ammonia added. Scrub very thoroughly.

You can then sand the surface to key it for further painting, epoxying or gluing.

Filleting and Gluing using “Snap Lock” Plastic Bags

Most supermarkets have varieties of “snap lock” bags. They have a seal across the opening of the bag that can be pressed together with fingerpressure. They make it a lot

easier to keep epoxy glue away from areas on the boat where you don't want to put it. And also areas on yourself where you don't want to put it!

Make up some epoxy, thicken it to the consistency of peanut butter. Put a "snap lock" Glad plastic bag into a tin and fold the top of bag over lip of tin (like a garbage bag in a garbage bin - trashcan). Scrape epoxy into the bag.

Take bag out of tin, seal opening and cut one corner out of bag to make a hole a few mm (approx 1/4") across - size will need to vary with consistency of mix.

By gently squeezing the bag a bead of epoxy will ooze out of hole in controlled way from the hole.

Pipe a bead of epoxy down the right angle between the bhd and the sides, across the chinelog and bottom. The bead should be about 12mm across the back.

Use a filleting stick of a radius three times the lesser ply thickness to smooth down the fillet. Practice getting it smooth and even.

Remove excess from either side of fillet with a stirring stick that has been sharpened to a chisel point. It is possible to lay masking tape down either side of the join in the first place so that the excess can be removed with the tape.

Giving Yourself Time

If doing large areas the epoxy will go off too quickly if left in the mixing tin. You will have much more working time if you pour most of it out over the surface first and roughly spread with a squeegee, before going back with a roller to spread properly.

This allows the heat of the epoxy reaction to escape into the air. If the epoxy is mixed and left inside a tin it will overheat and harden in 15 minutes. If you get it out onto the surface reasonably quickly you will have half an hour to play with.

When it is spread hold roller so it cannot rotate and pull gently along surface of epoxy. It slicks the surface smooth and pop any air bubbles.

When first coat has become quite tacky, roll on second coat. Slick the surface.

When second coat is tacky roll on third (if required) and slick it down.

IMPORTANT - Remove masking tape when third coat is still tacky. You don't want to glue it down - forever.

If you have problems getting a good finish speak to your epoxy dealer.

Building strong lightweight boats and items - a note on the use of epoxy

Epoxy is expensive stuff, so when there is a bit left over from a process there is a temptation to use it somewhere.

Don't do it! The boat has been carefully designed to be strong enough already - all you

will do is add weight and ruin the boat. Where you can use it for a legitimate step, do so - but think about it first.

Another time it is best to throw out epoxy is if it is starting to go off in the bag or tin. If it is starting to get too hot to comfortably hold it is going to be hard very shortly - you are unlikely to have enough time to put it into place.

Furthermore, hot epoxy fillets slump badly, hot coatings wax and get fish-eye pitting, and hot glue joins end up with lumps that stop clamping. Make up a smaller mix next time and get it out on the surface earlier – straight after careful mixing in the tin or bag.