

Single Action Hinge

## Wooden Hinge Plans

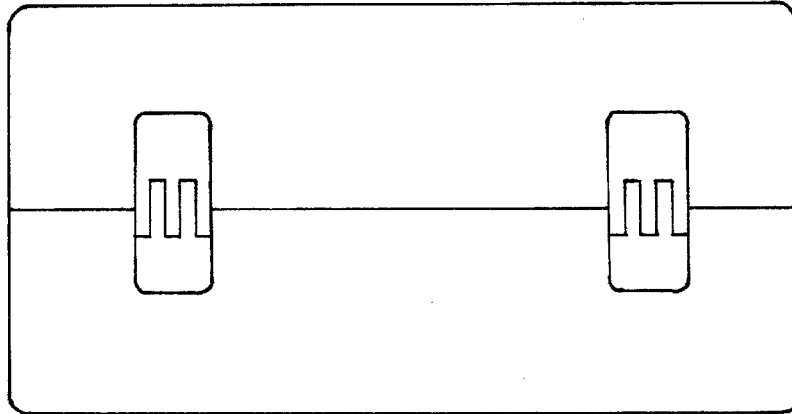
by

Roger Gifkins



Double Action Hinge

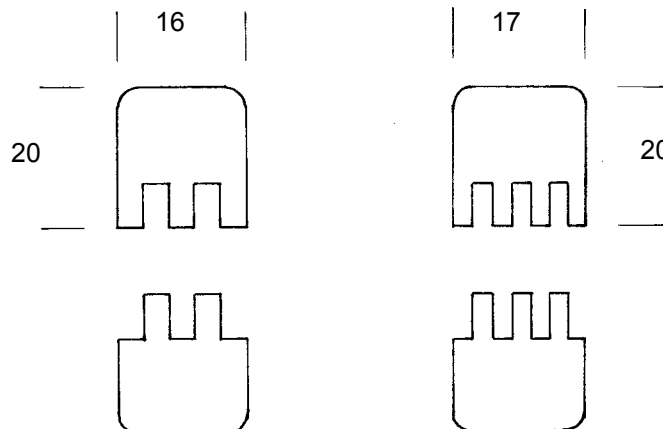
# Single Action Hinge



Over the past 7 years I have produced two types of wooden hinges, a single action hinge (that is in effect a finger joint with a pin through it) and a double action hinge which has two pins. The advantages of the double action hinge are that it will open out 180°, and you can set it in flush with the back of the box. With the single action hinge, it will only open just past 90°, and it can only be rebated into the box to half its thickness, but it is much simpler to make than the double. These plans will describe making and fitting the single action hinge in detail, and I will write plans for the double action hinge at a later date. These hinges are best made as a small batch with pieces put aside for future use, rather than setting up to make just one pair. For work at this scale you need will need a small solid carbide spiral cutter (3.2 mm diameter) and a 2 mm spur point drill. These items are available from Gifkins Dovetail. You also need dial or digital callipers, a ruler is not accurate enough.

## Hinge Sizes

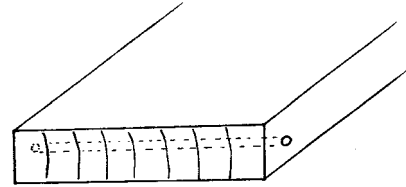
I will describe the hinge for small work, such that I have made for a box 120 mm x 120 mm x 60 mm. I have used this same size on a box 300 mm x 250 mm x 150 mm. There is no reason why the hinge could not be scaled up or down to suit other sized boxes. The actual dimensions will depend on the size of the cutter you use for the finger joints, as the width of the hinge will be an odd whole number multiple of the cutter diameter: eg for a 3.2 mm cutter you might use stock 16 mm wide (3.2 x 5), or for a 2.4 mm cutter use stock 17 mm wide (2.4 x 7). I will use a 3.2 mm cutter and 16 mm stock in the following description.



## Selecting & Preparing Stock

As with all small work, the more accurately you prepare your stock, the better the end results will be. Ideally we want a timber that will not split easily. It is worth experimenting to see how your wood behaves, as most woods split more readily along the rings than across the rings. As we will be drilling holes from one side to the other, the timber will be less inclined to split in line with the hole if we use quarter sawn timber.

Timbers I have used successfully for these hinges include: Ebony, Hornbeam, Satin Box, Jarrah and Rosewood. I have used softer timbers like Red Cedar and Mahogany successfully, but they may not wear as well as the harder timbers. Thickness your wood to 6 mm, trying to get as clean a finish as possible on both sides. The thickness needs to be uniform, so it is best not to use the end 50 mm or so from either end of the board.



**TIP:** For thickening stock less than about 13 mm, I find I get better results if I use an accurately thickened board under the workpiece, so that the two pieces are fed through together. A piece of 18 mm pine that is longer and wider than the workpiece is ideal. Don't forget to add 18 mm to the thickness you want when setting the thicknesser! Keep this backing board for future use. You don't need cleats on the bottom board to hold the workpiece – they will feed through together OK just stacked on top of one-another.

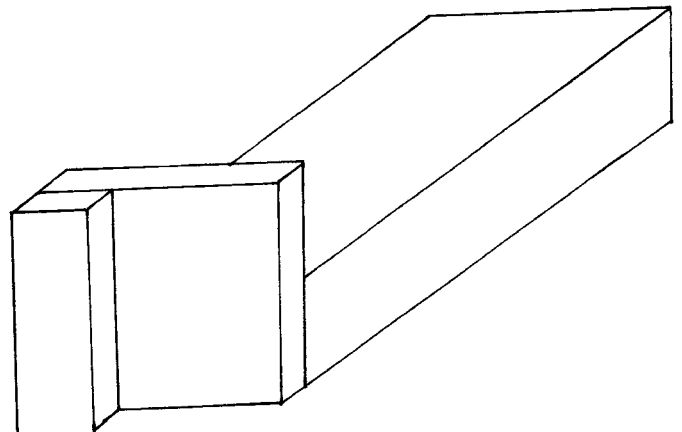
Once thickened, joint one edge flat and square and then cut a strip at 16 mm width or just a bit over. It can be cleaned up to width later. **NOTE:** When workpieces are this small, it is much safer to cut to width on a bandsaw (with a fine blade, say 6 or 8 TPI) than on the table saw. Dock your stock to lengths of about 150 mm or 200 mm, ready for finger jointing, making sure the ends are cut accurately square.

NOTE: The drop saw is ideal for cutting small pieces accurately. See fence ideas for the drop saw at [www.gifkins.com.au](http://www.gifkins.com.au)

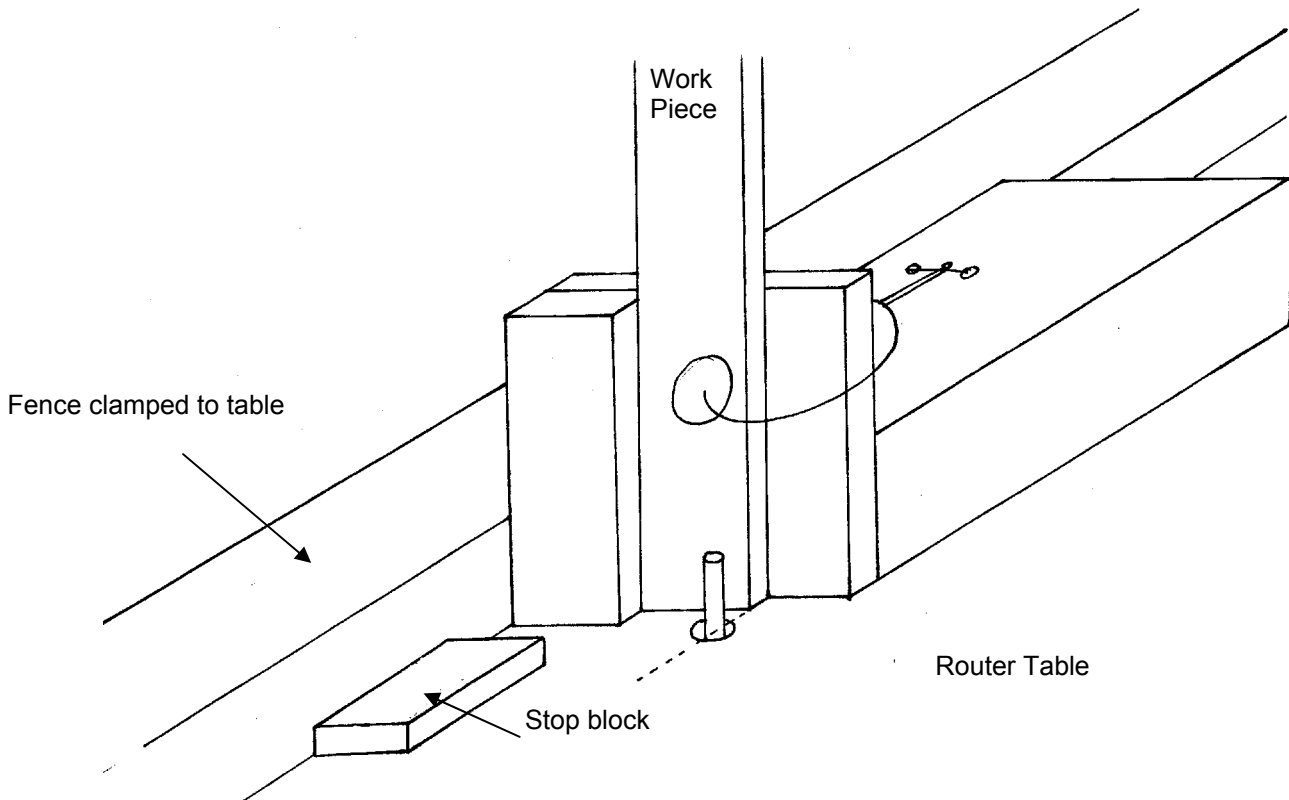
## Jig for Slotting

Whilst you could use an incra jig for slotting, I find I get better results with a fixed fence on the router table and a set of shims that are thickened to twice the diameter of the cutter. These need to be prepared very accurately, but once done they can be used time and again. You will need to cut trial finger joints when thickening these shims, so it is best to make up the jig for the finger joints before thickening the shim. The dimensions given for this jig are only a guide, and do not need to be followed accurately. I use a block of 100 mm x 50 mm hardwood, jointed flat and square before thickening. Cut one end flat and square, and glue and screw a piece of 12 mm craftwood to the end as shown. A strip of 12 mm craftwood is then glued and screwed to the edge such that it is accurately vertical. Make sure any screws are safely above the cutter.

To use the jig, the workpiece is clamped in place as shown, and a straight fence is clamped to the table. Set the height of the 3.2 mm cutter slightly higher than the thickness of your timber, say 6.25 mm for 6 mm stock. Position the fence to get the layout of the joint that you want, so that the outside of the cutter is in line with the outside of the workpiece. With the router going, run over the cutter, cutting through the workpiece and into the craftwood. A stop block clamped to the table so you don't go too far is worthwhile. Instead of sliding the jig



back off the cutter, I prefer to lift the front of the jig off the cutter (with the cutter still running) and then move the jig back away from the cutter. This way there is no risk that the cutter will widen the slot as you slide the jig back. We would then insert one shim (which we haven't made yet!) between the jig and the fence and repeat the cutting, then a second shim etc.

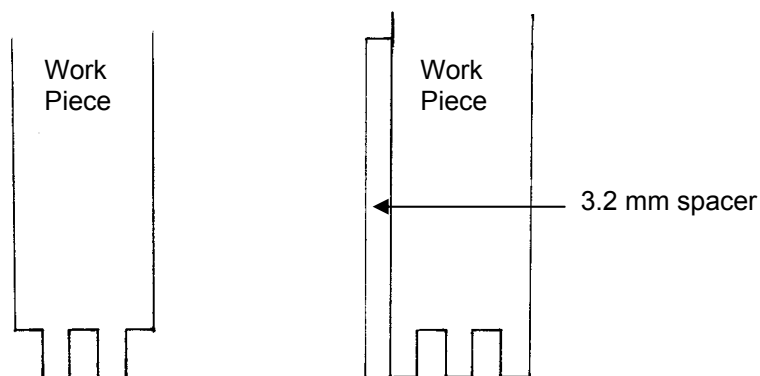


## Shims

We can now get back to the shims. Thickness some strips of hardwood for the shims (running through the thicknesser on a backing board) to a little thicker than twice your cutter diameter, say 6.6 mm, and keep this setting on the thicknesser. Cut two trial sets of finger joints and test for fit (they should be too tight). Now, using the same setting on the thicknesser, run the shims through again with a sheet of paper between the shim and the backing board. This will decrease the shim by the thickness of the paper. This method gives you very fine control over the final thickness. **NOTE:** Standard photocopy paper (80 gsm) is 0.1 mm thick. Keep decreasing the thickness (adding sheets of paper) till the finger joints fit together easily but without any free play.

**NOTE:** When using the jig, it is vital to keep the router table as clean as possible, as any dust on the shims or between the fence and the jig will destroy the fit.

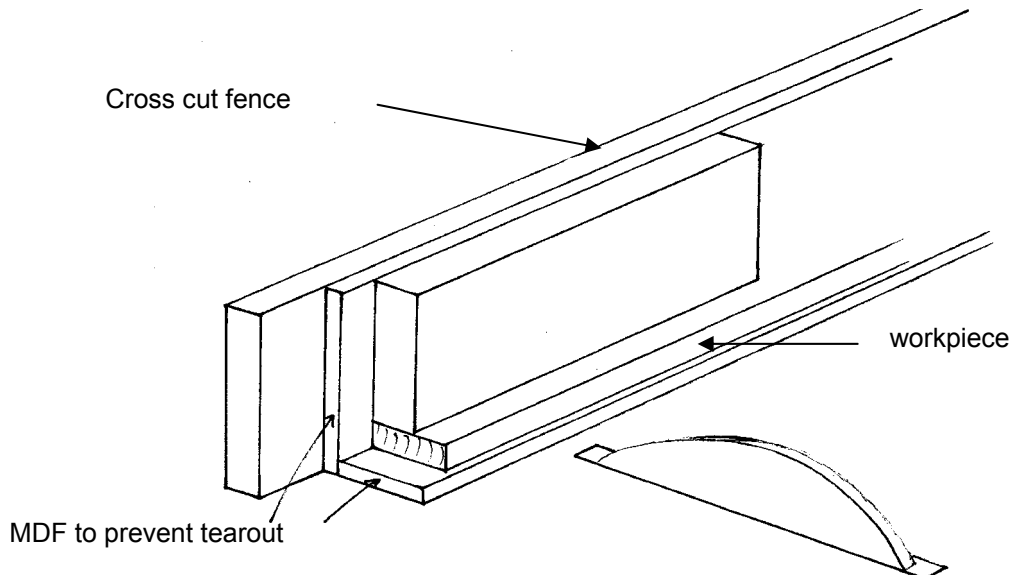
Once the jig is working the way you want, machine finger joints on one end of each workpiece. We then turn the workpiece end for end, but before we clamp it in place, insert a 3.2 mm spacer between the work and the jig to move the workpiece 3.2 mm further away from the fence side of the jig.



This spacer will offset the second set of finger joints by the finger width, to give us two pieces that will go together with their edges flush.

If making lots of hinges, dock both ends off accurately at 20 mm and machine fingers again on the shorter strips. Continue till you have enough, remembering that some pieces will be rejected in the drilling process, so have plenty of spares.

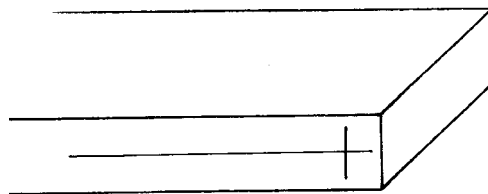
**NOTE:** When docking to length, we want the cleanest cut possible, so I use offcuts of MDF underneath and behind the wood to prevent tearout on the table saw. Seeing that we are dealing with such a small workpiece, I also use a hold-down block above the workpiece to keep my fingers well away from the saw:



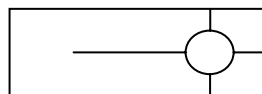
With small workpieces I prefer to run the work onto the saw, and then stop the saw before I pull the work back off the blade. This is not only safer but also results in cleaner cutting.

## Drilling

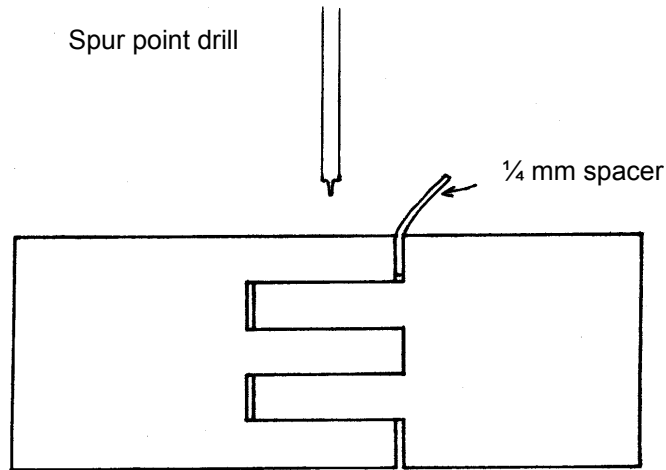
For this we need a 2 mm spur point drill, as an ordinary twist drill will run off line and tend to follow the grain. It is possible to grind your own spur points, but at 2 mm diameter this is difficult to do accurately. Set a marking gauge to the centre of the wood (3 mm) and scribe a line from both sides. Readjust the gauge if these lines do not overlap. Once set to the centre of the wood, scribe a line along a trial piece and also across the end as shown. See page 8 for alternative hole position.



Using a fence and stop block on the drill press, drill a trial hole and check that it is central to the scribe marks both top and bottom:



Positioning of the hole is critical for the hinge to work well, so the drilling should be done as slowly as possible. Whilst it is possible to drill the two halves of the hinge together, I have found that the drill is more likely to run off. Try it both ways and see which works best for you. If drilling the two halves together, it is necessary to use a 0.25 mm spacer (paper or cardboard) to stop the fingers going right home:



Remember that we allowed 0.25 extra depth when cutting the fingers. This extra depth allows the hinge to swing freely without the ends of the fingers catching on the bottom of the corresponding slot.

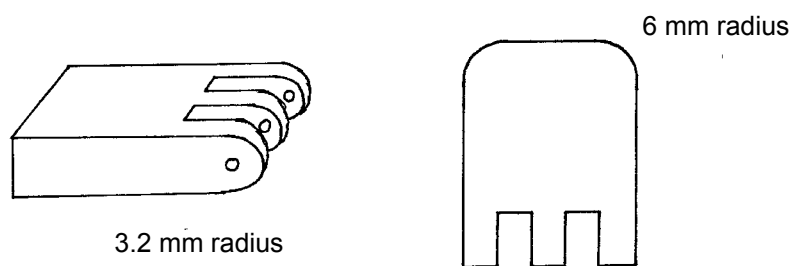
## Hinge Pins

Whilst you could use brass, stainless steel or sterling silver for the pins, I feel that having gone to the trouble of making a wooden hinge, it should be all wood! I use bamboo for the pins, as it has long fibres and is less likely to break than solid timber. Remember we are working at 2 mm diameter here!

I buy bamboo skewers from the supermarket which are about 3 mm diameter (look for ones that appear solid with no loose fibres). To bring them down to 2 mm I hold a 50 mm length in the drill press and plunge it through a 2 mm hole in a piece of mild steel, with the bamboo spinning. This shaves the outside off, leaving a perfectly round 2 mm bamboo pin. Some bamboo twists as it goes through the hole. If this happens, try a different brand of skewers!

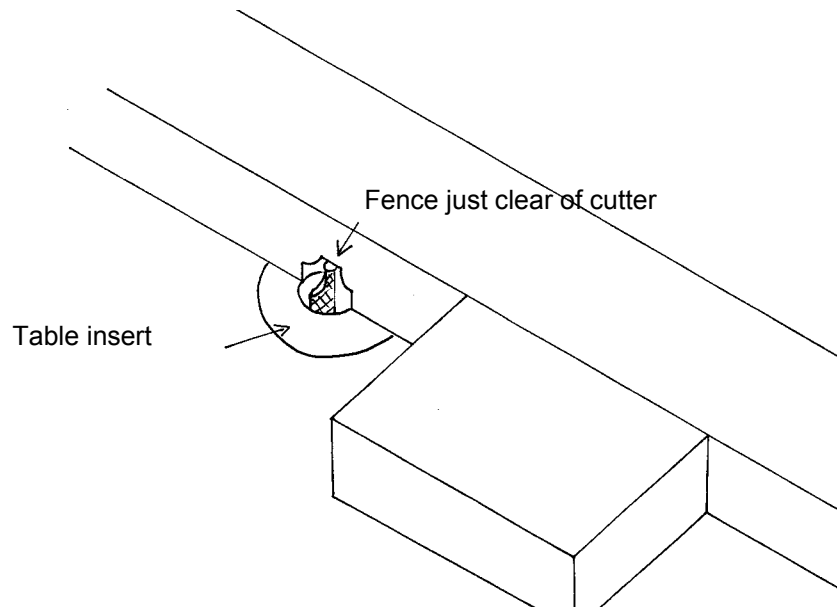
NOTE: To get exactly the fit I want for the pin (firm without being tight), I use a 2.1 mm hole in the steel and then hand sand the pin to give the required fit. You can get fractional sized drill bits from Engineering Suppliers. Before assembling the hinge it is necessary to round over the hinge fingers and the outside corners of the block:

## Round overs



We need to round over the ends of the fingers (both sides) and also the outside corners of the hinge pieces.

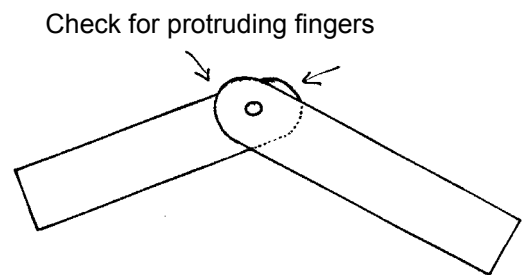
The radius of the cutter for the fingers should be  $\frac{1}{2}$  the thickness of your stock, or a bit more. In this case a 3.2 mm radius would be fine. For the top corners of the block, the round over should match the cutter you plan to use for the hinge rebate. In this case I would use a 12 mm diameter straight cutter for rebate, so I would use a 6 mm radius cutter for the round over. This round over needs to be done carefully as we want the hinge to be a good fit when rebated into the box. Use a square push blocks and a good fence for these Round overs, and do trial cuts to set things just right:



**NOTE:** In the drawing above I have used a table insert to give support right up to the cutter, and the fence is only cut away just enough for the cutter to spin freely. With such a small workpiece it needs to be fully supported as it goes past the cutter.

## Assembly

You can now assemble a hinge and test its movement. With the fingers cut 0.25 mm longer than the thickness, the hinge should open out just over 90°. If you want it to open further, you could allow more depth to the fingers when machining them. If the bamboo is a tight fit, sand it lightly till it is free to slide in and out easily. If the outside edges of the two halves do not align flush, clean this up now on a shooting board before we make the following jig. It is vital that the fingers do not protrude on the inside face of the hinge as the hinge opens, as this would prevent the hinge from opening when it is glued in place. If they do protrude, hold one end of the hinge flat on a sheet of sandpaper and swing the other end back and forth till the fingers are flush. Repeat this process for the other end.



## Jig for Hinge Rebate

The jig I use for the hinge rebate is a remarkably useful device and is a jig that I make again and again for all sorts of hollowing out operations. It is quick to make, so I make up a new one for each different job, and keep them aside for future use. To make the jig we need some 12 mm MDF and some 25 mm chipboard screws.

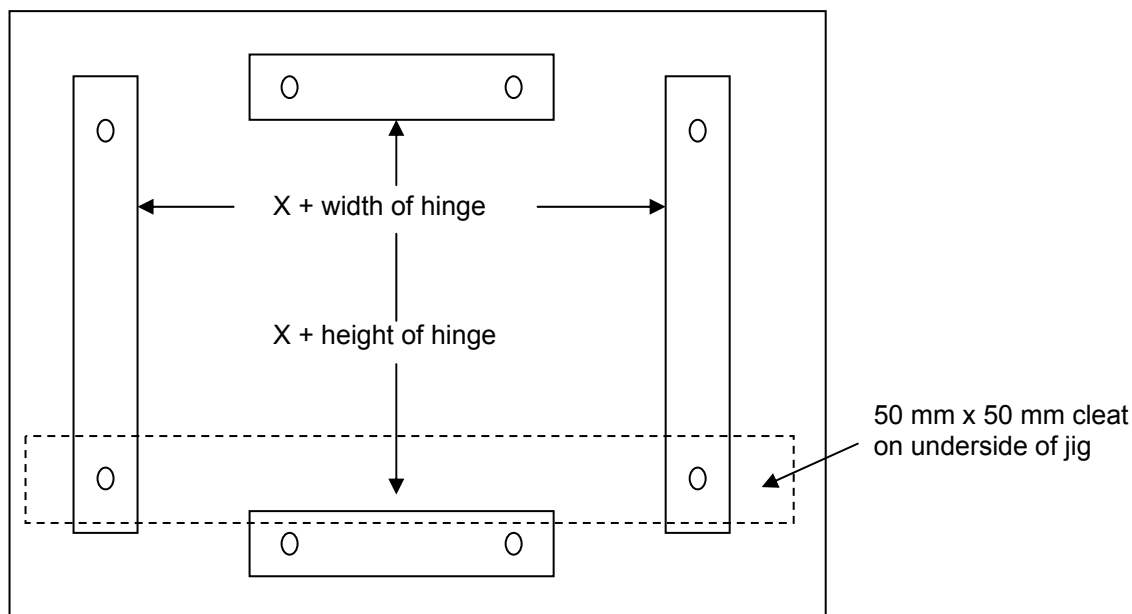
**NOTE:** For this jig to work you need a plunge router with a round base.

Measure the outside diameter of your router base accurately (for Makita 3600 this is 160 mm). Subtract the diameter of the cutter to be used for the hinge rebate (12 mm, as noted above in the round over section), to give us the figure "X". That is:

$$X = \text{Diameter of router base} - \text{diameter of cutter}$$

Start with a square piece of MDF about 200 mm bigger than the router base. To this we screw down 50 mm strips of MDF as shown below (pre-drill the strips at 4.5 mm, there is no need to pre-drill the backing board if using chipboard screws).

**TIP:** Screw the left hand strip in place. With a steel rule and a knife, measure from this strip and put a knife mark at ( $X + \text{width of hinge}$ ). Do this top and bottom, so we have two knife marks to line up the right hand strip on. With the RH strip pre-drilled, clamp it in place along these knife marks and then screw in place. With this method we can get the strips accurately parallel and accurately spaced. It is better to err on the side of too close together, as then we can adjust the jig to size by planing the inside edges of the strips on a shooting board. Repeat the process for the top and bottom strips, making sure that the third strip is at  $90^\circ$  to the first two.

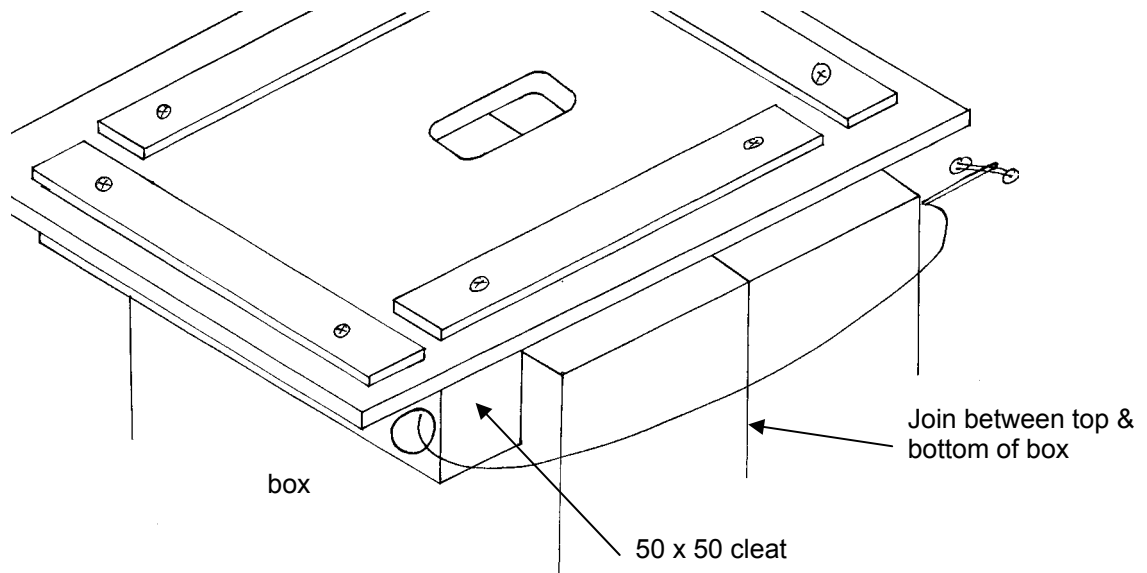


Clamp the jig over the edge of your workbench, or support the jig over some waste material, so that when we plunge the router through the middle we do not plunge into the bench. With the 12 mm cutter in the router, run around the inside edge of the strips in a clockwise direction, cutting a hole in the board the same size as the hinge. Do this in two passes, only going half way through the first time. It is good to have dust extraction on your router for this jig. Try the hinge in the hole and adjust the position of the strips if necessary. We want the hinge to be a firm fit in both the height and the width. If the hole is too big, it is easier to shim the inside edges of the strips than to move the strips in.

## Cutting Hinge Rebate

To locate the jig on the box, we will screw a 50 mm x 50 mm cleat to the underside of the jig, so that when the bottom of the box is against the cleat, the join between the bottom of the box and the top of the box runs across the exact centre of the hinge hole in the jig. It is important to do this accurately! This cleat is screwed down from above, making sure the screws are countersunk below the surface of the jig. Mark out the hinge positions on the back of the box, so that we can use these marks to position the jig.

To use the jig, hold the box in the vice with the hinge side up, and place the jig on top, with the cleat against the bottom of the box. Position the hole in the jig over one hinge position mark, and clamp the jig to the box as shown:



With the router sitting on the jig and NOT turned on, lower the cutter till it just touches the box, and lock the depth in this position. Now set the depth gauge on the router to 3 mm below this point (half the thickness of the hinge lower). Unlock the router to bring the cutter up clear of the box. We are now ready to route the hinge rebate, once again going clockwise around the inside of the jig. Move the jig to the other side of the box and repeat for the second hinge rebate.

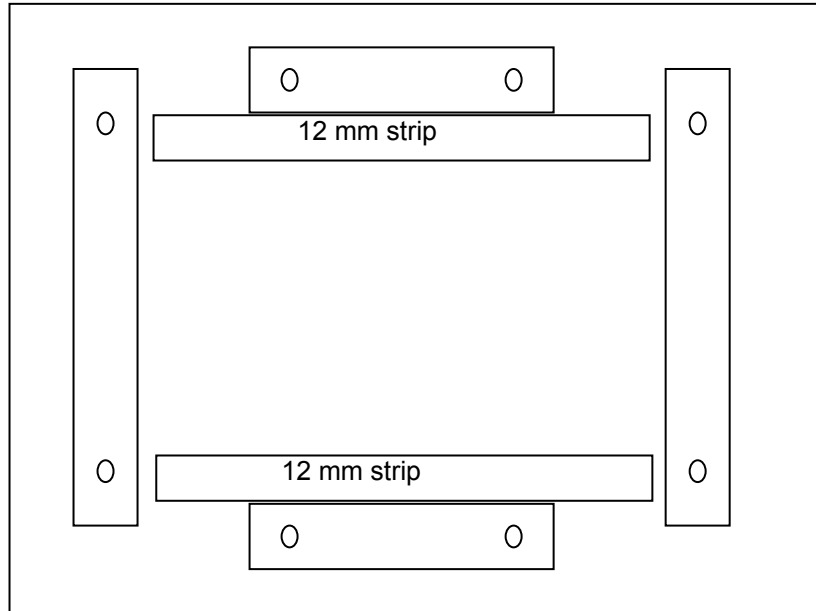
**TIP:** If you place a sheet of paper between the box halves before you clamp it in the vice, this will make the finished hinge rebate slightly lower than the height of the hinge. This way the box will still close fully at the front, but the back edges will be clear by 0.1 mm, which avoids any issues with the edges binding on one another.

## Fitting Hinges

All that is now left to do is to fix the hinges in place. It would be possible to screw the hinges in place from inside the box, which would give you the option of taking the box apart again if adjustment is necessary. However I prefer to glue the hinges in place, once again making everything of wood rather than introducing metal. You do have to get everything just right first time, as there is very little adjustment you can make once the hinges are glued in. It is important that you don't get any glue on the finger part of the hinge, or it would glue the hinge shut, so only apply a light smear of glue to the top and bottom areas of the hinge rebate. I use white PVA and clamp the hinges in place while the glue dries. You need to brace the inside of the box in line with the hinge if clamping the hinge for gluing. Make sure you will still be able to open the glued up the box with the bracing in place, as some bracing will prevent the lid from swinging open!

## Alternative position for holes

It is possible to make the hinge stronger by cutting longer fingers (say 8 mm long in 6 mm stock). We would then position the holes 4 mm in from the end of the fingers, so the hole is still located in half way back on the fingers. This means that when the hinge opens, the fingers protrude 1 mm past the back of the hinge. When it comes to the round over, only do this on the front (outside) of the hinge, leaving the back surface square. When we cut the rebate in the box, we will cut it as described above, then we will increase the depth of the centre section of the rebate to accommodate the protruding fingers. To do this, cut two strips of MDF that are 12 mm wide (i.e.: 20 mm hinge block less 8 mm fingers) and about "X + Width of hinge" wide, and use these to block off the jig, top and bottom, as shown:



With these strips in place on the jig, increase the depth setting by just over 1 mm and route the centre portion of the hinge rebate deeper. It is then necessary to clean up the corners for this deeper section with a chisel so we have square corners, rather than round from the cutter. This version of the hinge can now be finished off and fitted in the same manner as described above.

## Double Action Hinge



These plans describe my “Double Action Hinge” which has 2 hinge pins, allowing the lid of a box to open out to 180°. It is ideal where the box is split in half in the middle, so that the lid opens flat on the table. This way the lid doesn’t need any supports or stays to hold it in the open position.

Whilst the hinge is somewhat complicated to make and needs to be made very accurately, once you have mastered the techniques, the components can be made up as a batch in advance. This way, fitting the hinges and finishing a box is very quick and simple.

These plans should be seen as a continuation of my “Single Action Wooden Hinge” plans, and I will assume that you are familiar with the techniques and jigs I described for making them. I will refer back to these earlier plans from time to time.

With the Single Action hinge, the spacing between the fingers needs to be exactly the same as the width of the fingers (i.e. a finger joint). However the Double Action hinge consists of 2 identical parts, and the spacing between the fingers is not important. This makes the fingers much easier to set up for, as we don’t need the accurately thickened shims as described on page 3. If you have already made the Single Action hinge, you may as well use the same shims, as their spacing also looks good for the Double hinge. If not, the shims can be whatever thickness you want. The only important point is that they should all be cut from the same board, to ensure they are all exactly the same thickness as one-another. The size of these hinges can be adjusted to suit the size of your project, however I will give sizes of the large and small ones that I have made:

For A4 document Box (see photo above) - 50 x 29 x 8 mm with 3.2 mm slots

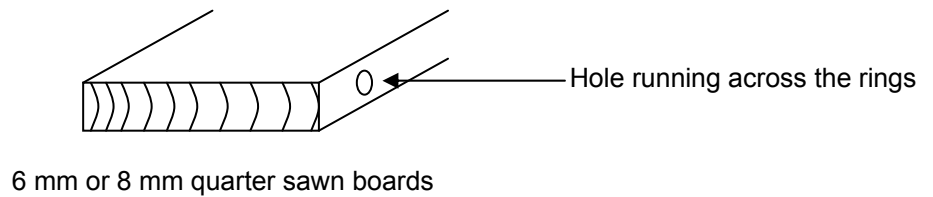
For smaller box – 40 x 17 x 6 mm with 2.4 mm slots or 40 x 23 x 6 with 3.2 mm slots



The width of the hinge should be calculated to give equal width fingers on both sides of the pieces, as shown in the photo above. This means there will always be one more finger than there are slots.

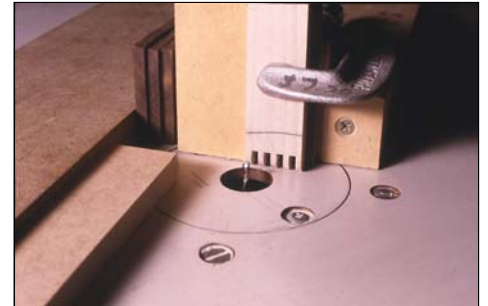
## Timber selection

As a starting point, the timber used should be tough and not prone to splitting, but with that said I have made them out of Red Cedar and Huon Pine, as well as Rosewood, Ebony, Hornbeam and Satin Box. My favourites are Hornbeam and Satin Box as I like the contrast in colour when making the box out of a dark timber. Keep in mind that the timber should be long enough to run through the thickener, in my case at least 250 mm long. The direction the rings are running is vital, especially in the small interconnecting wafers. Most timbers will split much more readily along the rings than across the rings, which is handy to know when splitting firewood with an axe! This being the case, we want to drill the holes across the rings rather than parallel to the rings. This means that we can prepare all our timber as quarter sawn boards 6 mm (or 8 mm) thick. We will then cut some of this into narrow strips for the interconnecting leaves. These narrow strips will then be back sawn, but the holes will be across the rings as required.



## Cutting the fingers

This is exactly the same process as before (see Jig for Slotting on pages 2 - 3), except that this time we don't offset the second half with the 3.2 mm spacer as described on page 3. All the pieces we cut are identical. The height of the cutter should be set to the thickness of the timber we are slotting, or just a fraction more. Once again we would slot both ends of a board, then cut both ends off to length (at 20 mm for the small hinge or 25 mm for the big one) and repeat this process till you have enough pieces (including some spares). You may get a cleaner finish if you do the round over across the outside of the fingers before you slot the fingers (see below).



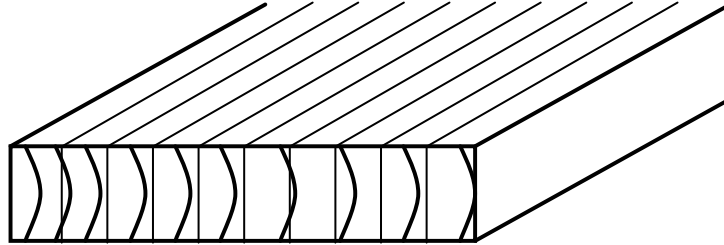
## Round overs

For the double hinge we only need to round over the outside end of the fingers, whereas with the single hinge we rounded over both the inside and outside. Use the same procedure as before (page 5), using a 3.2 mm radius round over bit for 6 mm timber or a 4.8 mm bit for 8 mm timber. The corners at the opposite end to the fingers should be rounded over to match the radius of the cutter you will use for cutting the hinge rebates.



## Interconnecting Leaves

For the leaves, start with a quarter sawn board the same thickness as the hinge finger blocks and long enough to be able to run through the thicknesser. I have always used the same timber for the leaves and the finger blocks, but using contrasting timber could give an interesting appearance. We want to slice this into thin strips, a little thicker than the gap between the fingers. If using a 3.2 mm cutter for the fingers, cut the strips at about 3.5 mm thick. A shooting board is useful here, so you can shoot both edges flat and square before cutting a 3.5 mm slice off each edge on the bandsaw. Keep repeating this process till you have a bundle of strips 6 or 8 x 3.5 x at least 250 mm.



Cut quarter sawn board into 3.5 mm strips

## Thickening Leaves

To thicken the strips, use the same method as for the spacer shims in the Single Action Hinge plans on the bottom of page 3. Set the thicknesser a bit more than 3.2 mm and use paper shims between the strips and the backing board to bring them down to 3.2 mm. We want the strips to be a tight fit in the finger stops, so it is important to cut the fingers before thickening the strips. Ideally the strips should be so tight that they are difficult to get in by hand. We will loosen them later!

## Cutting Leaves to length

Once thickened, we wrap the strips up in a bundle with packaging tape or Sellotape, covering all 4 sides over the full length. This way, when we cut the leaves to length, we have little bundles of leaves still taped together, making them easier to handle than the individual leaves. We can now cut the leaves to length, on the saw bench (as on page 4) or the drop saw. The length should be twice the depth of the slots between the fingers, or just a fraction less. Keep the bundles wrapped up for the next operation.



## Rounding over leaves

For rounding over the ends of the leaves, we need a round over bit whose radius is half the thickness of the hinge, or just a bit more. 4.8 mm radius is good for 8 mm thick hinges, and 3.2 mm is good for 6 mm. Seeing our little packets are so small, extra care needs to be taken with this operation. You need a fence for the router table that is only cut away exactly where the cutter is, with no gap between the fence and the cutter. You also need full support on the table surface right up to the cutter, again with no gap between the table and the cutter. For this you need a table inserts or a false top on your router table. For the fence, use the swinging fence idea in my router table plans ([www.gifkins.com.au](http://www.gifkins.com.au)). It is best to remove the bearing, cut a small slot for the bearing spigot across the fence and then swing the fence over the cutter. Whilst there is some work involved in setting up for this cut, it is important to take the time to set up properly. You will need to do trial cuts on some offcuts (the same thickness!) to get the height of the cutter and the position of the fence just right. We can then use a push block behind the bundle and another push block to hold the bundle down, and run over all 4 corners of each bundle.

## Assembling Hinges

For the hinge to work smoothly it is vital that the leaves are tighter in one end of the hinge than the other. It doesn't matter which way around, so long as both hinges are the same way around when we glue them in place. If you

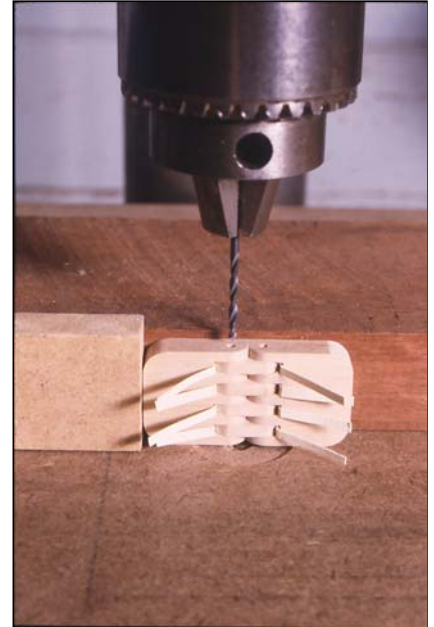
make the hinges equally loose at both ends, the action of the hinge when opening the box is clumsy, and the lid flops sideways as it opens.

After rounding over the little packets of leaves, take them apart and hand sand to bring them down in thickness. We want one end a tight fit and the other a loose fit. Start by sanding till a firm fit on both ends, then selectively sand one end to bring it down to a loose fit. This can be done with the sandpaper flat on the bench, and dragging the leaf across the paper pressing on one end only. Use 320 or 400 grit paper and keep trying the fit often, as we don't want it too loose.

## Drilling

Set a marking gauge to half the thickness of the hinge and scribe a line top, bottom and across the end, as for the Single Action Hinge. Set up the drill press with a good solid fence that is square to the table. Use a stop block and adjust the position of the fence and stop block till the spur point drill sits exactly on the cross lines.

It is best to drill the hinge blocks first without the leaves in place, and then re-drill with the leaves. When re-drilling with the leaves, make sure all the leaves are around the right way (all tight at the same end). Use 0.25 mm spacers of cardboard (eg. business card) at both ends to position the leaves centrally. Ideally with the cardboard spacers in place, the two hinge blocks should not quite touch one another. It is important to retain the layout of the pieces, so mark the outside face with a pencil. These marks can be sanded off later.



## Bamboo Pins

As for the Single Action hinge, I use bamboo for the hinge pins, using exactly the same method as described on page 5.

Once you have the pins made, check the action, making sure the leaves don't protrude as the hinge opens. See page 6 for details.

## Rebates in Box

To cut rebates in the back of the box we use the same jig as described on pages 6 – 8, although you will have to make up a new jig to match the size of your new hinges. The only difference when cutting the rebates is that we can set the hinge into the box to its full thickness, so the finished hinge is flush with the back surface of the box. It doesn't hurt if the rebate is very slightly smaller than the finished hinge, it is then easy to sand or trim the hinge down to give a good tight fit. You may need to round the back edges of the box slightly so they don't catch as the box is opened. With these hinges a mitred lining in the bottom half of the box that sits a few mm higher than the sides works well to locate the lid accurately as the lid closes.



## Fitting Hinges

Trial fit the hinges into the rebates, and adjust the hinge size and corner round overs to get a good tight fit. Once you are happy with the fit you can glue them in place, clamping lightly to make sure they are seated to the bottom of the rebate. When gluing the hinges in place, take care not to get any glue the interconnecting leaves. With a project this complicated, don't expect to get it right the first time. Try making some and fitting them, and, most importantly, look at what is happening as you work. This way you can make adjustments to the techniques to get the results you want.



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