How To Make A Singapore Ball

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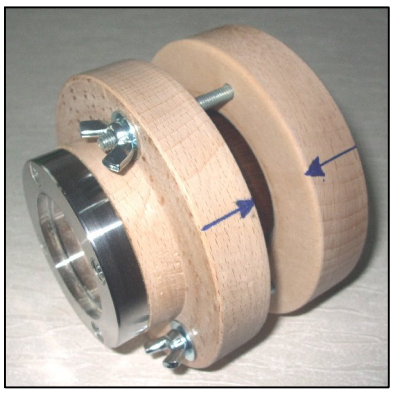
Until May 2009 I had not appreciated that Singapore balls existed, that is, until I watched a very interesting and informative demonstration by Bob Chapman. With that in mind, and having also seen the work of David Springett, my interest grew. I knew I just had to have a go at making one. To try and improve on the methods used by either of those gents would be pointless and futile, so my only reason for penning this narrative is to describe the process that I have found works best for me, and at the same time, if it encourages others to have a go it will have been a useful exercise. For me, the real interest is the technical challenge, and watching the look that spreads over the face of people as they try to figure out how the piece has been made can add a significant level of entertainment.

The Tool Kit: All too often, turners (including myself) tend to avoid this type of project because of the many special tools you need. Having carefully assessed what was really needed to make a ball, the bottom line turned out to be no more than 1) an accurate template to make the ball, 2) a cage to hold the ball whilst drilling, 3) an odd shaped chisel for the hollowing, and 4) a few useful bits and pieces made from scrap.

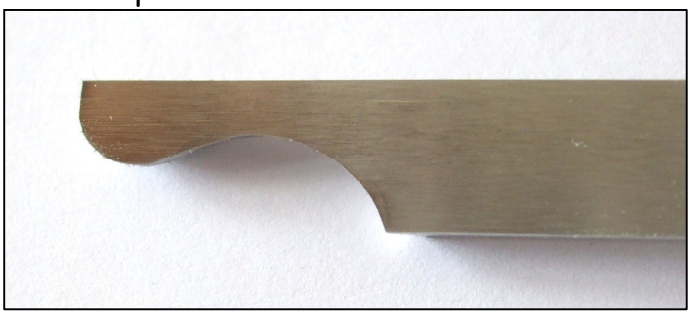
Making The Ball Cutting Template: The first major consideration crops up within seconds of taking the decision to have a go, "What Size Will It Be ?". Try holding different balls in your hand, and judge how comfortable they feel. You need to be able to get your fingers well round, but not all the way. For me, the best size has turned out to be 64mm. Do not try to go too small, it will have serious repercussions later as the job progresses. In recent months I have spent many £'s buying (and making) ball cutting jigs and I have now found the solution that works best for me is a lot simpler and cheaper. I cut a 100mm square of 4mm MDF, screw it to a back plate, mark it with a 64mm diameter circle and then, at VERY high spindle speed, cut the marked hole with something like a point tool. The high speed will give you a clean cut with no surface tear. Remove the square from the back plate, cut it into 3 differing sized sections, and clean up the corners. You now have a selection of perfect templates to help you create a ball. Mark each section with the template diameter and keep all the bits for future use.



Making The Cage: Whilst the ball is being drilled and hollowed it needs to be held firmly inside a cage. This is constructed from 2 pieces of hard, stable timber (I used 40mm Beech). Cut a dovetail spigot on the rear of the back section, or if you can, use a permanently attached face plate ring for your mounting point. The front and rear sections are held together with 3 long 5mm bolts running through both sections. The bolt holes are each drilled 120 degrees apart on a 110mm diameter circle and

the holes on the front face are recessed to remove the bolt heads from "the pink fleshy zone". The overall diameter of the cage is 125mm and the mating faces each have a deep conical section removed to allow balls of a differing size to be clamped within. The front section of the cage is thinner than the rear section. This allows its conical recess to penetrate right through to the outer front face giving you the essential drilling access to the ball.

Making The Chisel: This is the only part of the project that is likely to cost you any money (other than the wood blank to make the ball from). The tool I use is a modified HSS 3/8" square end scraper (Henry Taylor HS101). The first 20mm of the blade has been modified into a 'hockey stick' shape where the bulbous end measures 6mm across and the 'stick' has been wasted in to no more than 4mm. This is very easy to make, and takes only a few minutes on the grinder. Start by marking the material you need to remove and don't be tempted to start grinding until you are happy with the outline. Keep it cool.

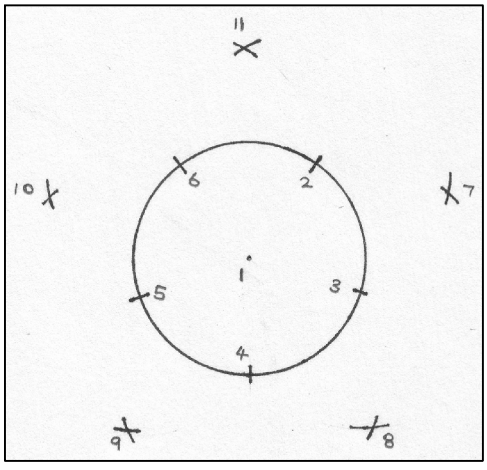


Bits From The Scrap Box: This motley collection of bits will cost you nothing and are 1) A flat topped tool rest for use with the hollowing chisel. 2) A tool rest made from a 50mm square blank, 120mm long. The lower section is turned down to fit the tool rest banjo. 3) A short dowel capable of being held in your chuck, used when sanding and polishing the ball. Taper one end down to about 7mm. 4) A small tapered plug with an arrow drawn on the head. This is used as a simple indicator of which hole in the ball you are making a point for. The plug measures 15mm long, 12mm top diameter, 7mm bottom diameter. 5) A length of thin dowel for measuring hole depths. Round off one end and add a pencil mark 5mm from the end. 6) A length of soft wood for inserting completed points into the ball. Drill one end 5mm diameter to a depth of 20mm and flare out the entrance of the hole a little.

Making The Ball: I decided to make a 64mm diameter ball with Brazilian Tulip. Mount the blank between centres, rough it down to 66mm diameter (2mm over size) and cut a dovetail

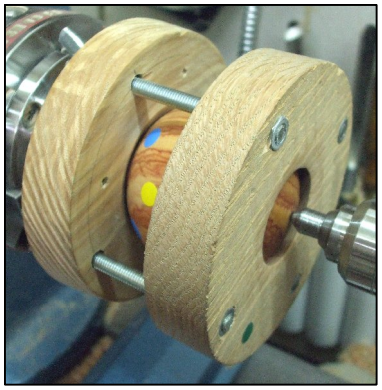
spigot on one end. With the spigot firmly mounted in the chuck, start to make a domed shape on the free end. Keep a regular check on the shape you are cutting using the smallest piece of your MDF template and **do not** be tempted to move on to any other part of the ball until you achieve a **perfect fit**. Gradually work back towards the headstock in steps of about 10mm, aiming for that perfect fit at all times. As soon as is practical, add tail stock support with a live centre (do not use a ring centre). As you approach the blind corner near the spigot you will need to use a cutting template which is elongated and has been thinned down into a hook shape, but other than that, the process remains the same. Keep going until you get down to less than 10mm of wood holding the ball onto the spigot. Sand through the grits to about 400. Complete the parting off process as neat as you can and sand off any remaining bump to leave a good clean ball. Do not be tempted to try and remove the mark left by the live centre. This is a very important reference point and for the remainder of this article, it will always be referred to as **"TOP OF BALL"**. For a Singapore ball to work well, it is most important that it be made with accuracy. Using this cutting method I have found I can make a ball having less than one millimetre error, which is better than any jig I have seen, made, or tried.

Marking Out The Ball: Marking out consists of defining a pattern of 32 equi-distant points on the surface. Take several accurate measurements of the diameter, i.e., top to bottom, side to side, and several points in between, then calculate the average, multiply your answer by **0.526**, and round up the result to the next whole number. This gives you the "**Primary Radius**". Using the layout diagram as a guide, set a compass to the primary radius, and with the point in mark number 1 (**TOP OF BALL**), draw a clear circle, but not so heavy as it will be hard to sand clean. Using the same primary radius, sub-divide the circle into 5 equal parts (points numbered 2 to 6 on the diagram). Working from successive pairs of the points numbered 2 to 6, project the next 5, each being the peak of an equilateral triangle. For example, from points 2 and 3, mark point 7. Having completed that, you should be able to scribe a mark onto the **BOTTOM** of the ball from each of the points numbered 7 through to 11. These 5 rarely meet up correctly, normally leaving you with a small 5 sided pentagon on



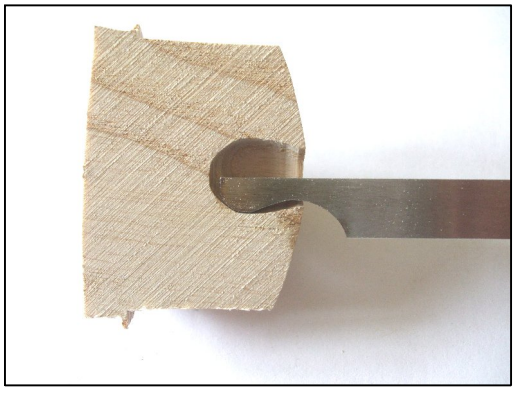
the bottom of the ball. Carefully judge the centre of the pentagon to locate point number 12. This now gives you a defined top and bottom, plus 2 circles of 5 points, all known as the 12 primaries. Make a sharp indentation with an awl at the 12 locations and sand off all your pencil marks. Looking closely at the ball you will soon realise that the 12 points you have marked actually define 20 triangles. The remaining 20 points you need to locate on the surface are at the centre of each triangle. Locate each one by setting the compass to a suitably small radius and scribe 3 marks (1 from each corner of the triangle). Again, make a sharp indentation with an awl at the 20 centres and sand off all pencil marks again. On the fully marked ball I have put a green spot on the top and bottom, a blue spot on the 10 remaining primary points, red spots on the secondary rings round the top and bottom, and yellow spots round the middle. I find this sort of marking is a good aid to keeping track of where you are when you start to drill and hollow the ball.

Drilling The Ball: Trial and error has taught me that if you drill the ball too deep or too wide the holes will merge in the centre. If that happens the ball will not work and if you keep going, you will finish up with a rattle. As a general guide, the drilling depth needs to be close to one quarter of the ball diameter. Also, a 64mm ball can be safely drilled to a depth of 16mm using a 9mm bit.



Altering the drill size or depth will have a marked effect on the final feel of the ball, i.e., drilling shorter and wider will give you a ball with a softer feel, and vice versa. For those who want to experiment with the drilling process, you can calculate the maximum drilling diameter by taking twice the drill depth away from the ball diameter and then multiply the remainder by 0.3142

Using the formula noted above, the maximum drill size for a 64mm ball, drilled to a depth of 16mm, is (64 minus (2 times 16)) multiplied by 0.3142, equals 10.05mm. Thus, a 9mm drill is 1.05mm within the safe drilling limit.

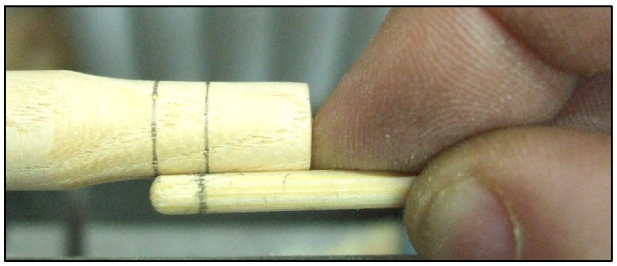


The following process needs to be repeated for **each** of the 32 holes. There is no fixed order you should adopt, but as stated earlier, I do proceed through the grouped colours to allow me to keep track of progress being made. **ALWAYS** drill the top and bottom holes first, then mark the inside of both with a felt tip pen so they can easily be identified later.

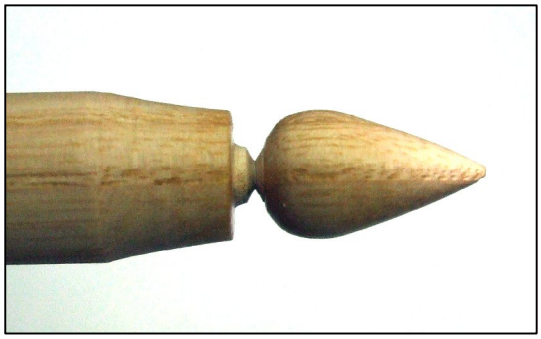
- With the cage held in the chuck and the ball loose in the cage, bring a marked point to the centre of the aperture.
- With a live centre in the tailstock, apply pressure onto the ball at the point to be drilled, thus, firmly locating the ball in the rear half of the cage.
- Tighten the bolts equally, leaving the live centre in place to stop the ball from moving off line.
- Drill a pilot hole with an engineers centre drill.
- With the main drill bit, make **VERY SLOW** entry into the ball and then drill to your maximum depth. I normally work to a permanent black mark on the drill flute.
- Sand the outer surface of the hole with 400 grit paper.
- Using the 'hockey stick' chisel and the flat topped tool rest, hollow out the inner sanctum of the hole a little, making sure you leave the entrance intact and unchanged.

The final picture in this section shows a piece of scrap timber which has been drilled and hollowed, then sliced in half. The image clearly shows the 'hockey stick' tool in a hole with a hollowed interior.

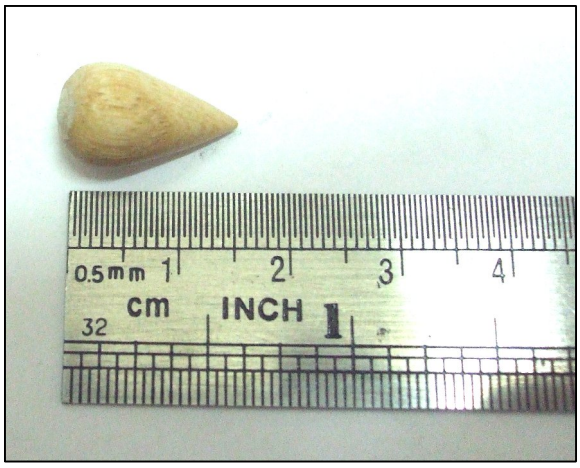
Finishing The Ball: With all 32 holes drilled and hollowed, remove the ball from the cage and admire your work, the worst is now over. Mount the ball between its top and bottom points using the tapered dowel in the chuck and a live centre in the tailstock. Re-sand the whole thing and finish as you feel fit. This piece of Tulipwood was coated in Melamine lacquer and then polished to a high shine. In this picture you can see the 32 coloured dots still stuck to the headstock, each one having been removed prior to the related drilling operation.



Making And Fitting The Tear Drop Points: Not surprisingly, their are 32 of them. I normally use pre-turned dowel for ease (look at **www.plugitdowel.co.uk**) but it is not essential. My only advice here is to use wood which is less dense than the ball but harder than pine. I like to use material having a contrasting colour. Using a similar colour adds to the mystery of how the ball is made, but in some ways, I think it detracts from the final appearance, the choice is yours. In theory, all the holes are of the same depth and diameter, but in practise, they rarely are, so every point you make needs to fit each individual hole. Just like the drilling, repeat the following 32 times.



- Use the small tapered plug with the arrow drawn on the top to indicate which hole you are going to make a tear drop for.
- Turn down a section of dowel to match your drill size (plus 0.5 mm). Use the depth gauge with its pencil mark to measure the depth of the hole.
- Transfer the depth measurement to your turned dowel section and add a second mark, 5mm to the right of the first. These 2 marks represent the point of broadest diameter, and the point at which you will part off (on the waste side).
- Using a small skew, taper from the point of broadest diameter down to the end of the dowel. Part into the waste at the back end of the tear drop.
- While the lathe is still running, put the ball onto the point to leave a burnish mark.
- Reduce the diameter of the tear drop until the burnish mark is almost gone.
- Use the skew to roll over the back end of the tear drop, forming a half bead.
- Sand, finish with friction polish, part off, and sand any pip remaining on the base.
- Insert the tear drop into the ball (round end in, pointed end out).



If you have got it right, the tear drop will click into place with firm finger pressure. If necessary, use the small section of pine with its pre-drilled and flared hole to force the tear drop into the ball. If you have got it wrong, the tear drop will fall into the hole, and when inverted, it will fall out again. If so, do not toss the tear drop into the rubbish, try it in another hole, it may well fit better somewhere else.

Another problem you may encounter is that the hollowing may not be quite enough, and the tear drop will jam in the back of the hole. If so, remove the tear drop with a small chisel, put the ball back in the cage, and hollow out the hole a little more, then make a new tear drop for the hole.

Have fun, and send me some pictures of your efforts. Also, feel free to get in touch if you need any more explanation.

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