

Construction notes – chess set 13th Nov 08

version 1.4 of consolidated notes.

Pawn 1.5” tall (38.1mm)

- Chuck ½” (12.7mm) bar and measure ½” (12.7mm) from faced end
- Set top slide over to 20 °
- Make sure the top slide has enough travel for taper
- Start taper at the ½” (12.7mm) mark and work towards chuck
- Cut taper to a length of ¾” (19.05mm) from ½” (19.05mm) mark
- Use ball turning tool to turn the ball end of the pawn
- Always compare with the master pawn
- Always sharpen tools before starting another pawn

Rook (1.75” tall)

1. Chuck 1” (25.4mm) dia bar with at least 2” (50.8mm) protruding from the chuck.
2. Face off then lightly scribe a mark 1.75”(44.45mm) from the faced end.
3. Now turn the blank to 0.8125” or 20.6375mm
4. ¾”(0.75” or 19.5mm) from the faced end and use the contour tool to depth of the contour (0.7928 or 20.1371mm)
5. Return to the faced end, centre drill then drill out to ½” (12.7mm) using successive drills and 0.250” (6.35mm) deep
6. Use the boring tool to open so 1/8th” (0.125” or 3.175mm) of the outside edge remaining and to a depth of 1/4” (0.250” or 6.35mm)
7. Set the top slide over to 15° and Set tool to be at 90° to axis.
8. Cut taper from the contour towards the turret or faced end
9. Reset top slide over to 3° and square the tool to 90° to axis.
10. From the contour turn the taper back towards the chuck end until you are 7/32nd (0.2185 or 5.5563mm) from the scribed mark at 1.75” (44.45mm) from faced end
11. Move the blank, still in its chuck, to the vertex on the milling machine or rotary table and centre the mill to the rook’s centre
12. Mill 2 slots to a depth of 0.100” or 2.54mm with a 1/8th (0.125” or 3.175mm) slot drill using either the x or y axis (as long as you always use the same axis).

13. Rotate the vertex/rotary table to 60° from your start point.
14. Carry out the next set of slots.
15. Another 60° then cut the last two slots. You should now have six equidistant slots in the rooks head.
16. Take the chuck back to the lathe and polish to finish.
17. Part off to length then polish off the base.
18. Lacquer if wished (bit about my experience)

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Knight 2" or 50.8mm tall

1. Chuck a 1" (25.4mm) dia bar with at least 3" (76.2mm) clear of the chuck
2. Face the end and take a light cleaning cut for a length of a minimum of 2" (50.8mm) and lightly scribe a centre line on the faced end using a tool with the lathe off.
3. This completes the lathe work, which forms the Knight blank as the main work is done on the milling machine.
4. With the blank in the chuck place on vertex parallel to the table
5. Mill down to $5/16^{\text{th}}$ (0.3125 or 7.9375mm) for length of 1.5" (38.1mm) from the faced end or the head.
6. Now turn through 180° and repeat above
7. Set vertex and blank at 45° to cut base shoulder and mill down until you meet the head joint Turn through 180° and repeat the cut to the head joint.
8. This completes the first stage of creating the knight blank. What follows now are the cuts, working with the head now set parallel to the table.

General rotary table notes for the knight chess piece – need dro's

Use angle gauge to ensure blank is parallel to table (photo) and the first section deals with the jaw side of the piece.

- a. Zero the rotary table dial to match 0 when blank is in line to X axis. Now rotate the table clockwise 5° (for the shape of the ear).
- b. Position the cutter's left hand edge to the right of the scribed centre line.
- c. Move the y axis out for 0.0750" (1.905mm) then move x axis to touch the cutter to the edge of the blank. At this position zero the DRO,s if you have them or the dials if not.

- d. Using the x axis mill for a distance of 0.138" (3.5052mm) taking light cuts until through.
- e. Move the table a further 40 ° clockwise. It should now be 45° from the start position.
- f. Mill using the y axis for a distance of 0.460" or 11.684mm (out from column) or cut completely to the edge of the blank.
- g. If you have milled through to the edge reposition the cutter so it cuts from the 0.460" (11.684mm) point on the y axis
- h. Without changing the rotary table settings now use the x axis and mill for a distance of 0.430" or 10.922mm (this is the width of the jaw)
- i. Again without moving the rotary table settings use the y axis into the blank for a distance of 0.200" or 5.08mm
- j. From this position again using the y axis now mill until you reach the outside of the piece.
- k. Reset the rotary table to 0° then 20 ° anticlockwise and the start position of the final cut is located 0.4" or 10.16mm from the inner most position of the lower jaw
- l. From this start position now use the x axis and mill from the neck out to the outside of the knight blank. This completes the first side.

Second phase the back profile of the knight.

- m. Reset the rotary table to the 0 position.
- n. Now turn the rotary table clockwise for 5°
- o. Align the inside edge (nearest pillar) of the cutter with the centre mark.
- p. Move the y axis towards the mill for 0.075" or 1.905mm
- q. From this start position mill on x axis for 0.125" or 3.175mm towards the chuck or base of knight
- r. Now set the rotary table to 45° clockwise from the zero position and place the cutter at the finish position of the last cut.
- s. Use the x axis for a distance of 0.320" or 8.125mm towards the chuck or bottom of the knight.
- t. Reset the rotary table to 0 ° then from this position set it to 15° clockwise from zero and from the previous end position, mill using the x axis to the outside edge.

This completes phase two of the knight. The final cuts are for the eye and mouth.

1. Zero the rotary table
2. Position the centre of the cutter over the centre line of the blank
3. Move the x axis from left to right 0.340" or 8.636mm from the ears.
4. Now move the y axis out 0.085" or 2.159mm
5. Plunge the cutter in to a depth of 0.010" or 0.254mm
6. Reset the rotary table to start position at 0
7. Turn the rotary table 45° clockwise
8. Position the cutter at the centre of the jaw
9. Move the y axis from in for a distance of 0.142" or 3.6068mm and a depth of 0.010" or 0.245mm

This completes the knight all that's left is to polish (k to polishing section) and do the other three!

Before the next pieces can be made a contour tool needs to be ground to a semi circle to a shape you are happy with. (See diagram).

Bishop 2.25" or 57.15mm tall

1. Chuck a piece of 1" (25.4mm) diameter brass or aluminium, face end.
2. Measure back 0.9375" (23.8125mm) and using the contour tool cut in to a depth of 0.100" (2.54mm) for the first cut.
3. From the chuck side of the contour, set the top slide over to 13° and turn the taper until the taper is 15/16th (0.9375" or 23.8125mm) long and the neck diameter is 0.5" dia (12.7mm)
4. Replace cutter with the contour tool and make the contour match the taper already cut.
5. Replace cutter with the ball turning tool set to cut a 1.25" ball. Turn the bishops head to a diameter of 11/16th (0.6875" or 17.4625mm)
6. Keeping the nearly completed bishop in the chuck take it to the vertex and set the angle at 50°
7. Using a 1/16th (1.5875mm) slitting saw cut a slit 0.300" (7.62mm) from the tip of the bishops head to a depth of 0.300" (7.62mm)
8. Take back to the lathe and polish to finish.

Queen 2.45" tall (62.23mm)

1. Using a 3 Jaw chuck (3jc) mount a 1" (25.4mm) dia bar of brass or aluminium with a minimum of 3" long clear of the chuck.
2. Face the end off and take a skimming cut for 2.5" (63.5mm)

3. Centre the contour tool with the faced off end, measure back 0.250" (6.35mm) and then make small cuts until the contour is 0.80" (20.32mm) in diameter.
4. Move the tool towards the chuck by 0.600" (15.24mm. A total of 0.850" or 21.59mm from the faced end)
5. Make small cuts with the contour tool until a finished diameter of 0.840" or 21.336mm.
6. Replace contour tool with a boring bar and set top slide over to 60°
7. Take small cuts until the top of the queen comes to a point I ran mine in reverse to achieve this task)
8. Make a slight cut 0.300" From the centre and make the ring as per photo to a depth of 0.050" (1.27mm)
9. Remove boring tool and replace with cutting tool.
10. Set the top slide over to 5 ° and make the taper cut between the top contour and the middle contour. Continue until the depth matches the two contours.
11. Set the top slide over to 8 ° and make the last taper between the middle contour and the base of the piece.
12. Return top slide to zero °. Use this opportunity to polish the queen.
13. Part off to length of 2.45" (62.23mm)
14. Lacquer to protect the shine.

King 2.5" tall or 63.5mm

1. Chuck a section of 1" (25.4mm) diameter bar and take a light cleaning up cut.
2. Face, centre drill, then drill and tap a 3mm hole (or any equivalent i.e. ME or BA)
3. Use contour tool and centre it at the faced end edge. Measure towards the chuck 0.250" (6.35mm) and form the first contour s just completes its shape and no deeper.
4. Re position the contour tool centre to 1" (25.4mm) from the faced end and using light cuts take the tool in until you have a finished diameter over the contour of 0.8150" (20.701mm)
5. Second .75" from faced end being 1.5 full turns deep
6. Change to ordinary turning tool and set top slide over 10 °. Turn a taper between the two contours.

7. Re position the top slide to 60° and turn between first contour and centre hole forming the topmost taper of the king.
8. Re position the top slide to 6° and cut the main body taper until it blends in with the contour base.
9. Polish the king and then part off to length.
10. Make the cross so the body parts are $1/8^{\text{th}}$ wide (0.125" or 3.175mm) and a thickness of $1/8^{\text{th}}$ (0.125" or 3.175mm)
11. Bottom of the cross is $1/4$ " long and rounded so it can be threaded to match hole (3mm in my case)
12. Polish and screw the cross into the top of the king. I also used a little loctite to ensure it doesn't go missing.

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13th November 2008 1445hrs.

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