**Joe Fleming Woodworks**
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# Suction Fit and Piston Fit, End-Grain Boxes

Airbrushing Wood
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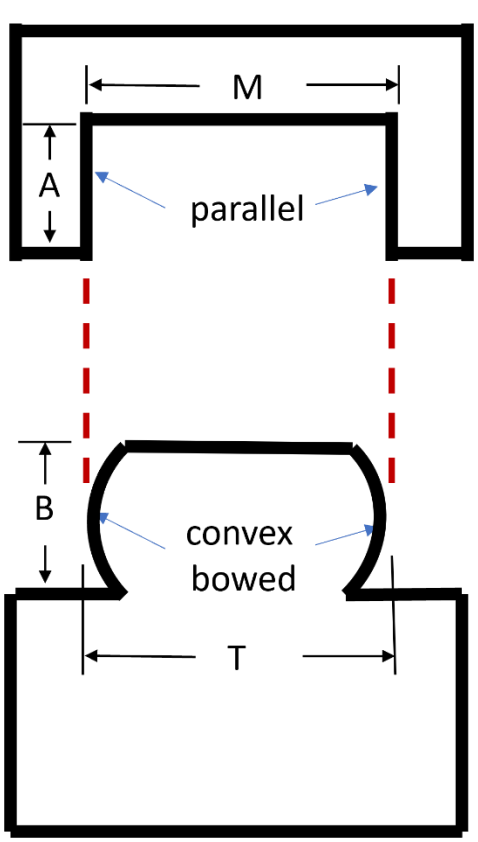
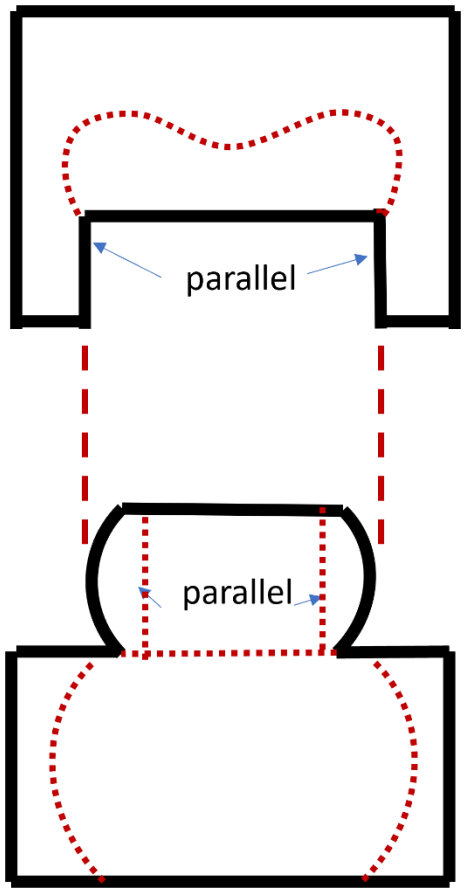
1. **Box Design - Aesthetics**
    a. Grain orientation
    b. Shape
    c. Wall thickness
    d. Inlay

2. **Box Design – Technical**
    a. Lid design
    b. Base design
    c. Mortise and tenon



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3. **Tools and supplies**
    a. Spindle roughing gouge
    b. Spindle gouge
    c. Skew
    d. Beading and parting tool
    e. Parting tool/thin parting tool
    f. Box scrapers
    g. Inside calipers
    h. Rule
    i. Straight edge (pencil)
    j. Chuck
    k. Waste blocks for jam chuck
    l. Sand paper
    m. Finish

4. **Wood Selection**
    a. Grain type
    b. Grain orientation
    c. Defects
    d.
5. **Wood Preparation**
    a. Drying
    b. Roughing out – Starting the box
        i. Mount between centers
        ii. Rough out cylinder or rough shape
        iii. Turn tenon on both ends for rechucking
        iv. Part lid from base (account for future tenon)
        v. Mount lid and rough hollow
        vi. Mount base and rough hollow
        vii. Tape together and label with date and species
        viii. Put away to dry

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6. **Design the box**
   (refer to Raffan's Turning Boxes, Chapter 4, Taunton Press, copyright 1998, 2002)
   a. Study lid and base for approximate dimensions:
      i. Mortise width and depth in lid**: A > B**
         1. Long tenon allows for longer suction effect.
      **ii.** Tenon width and height on base : **M >= T**
      iii. Overall depth of lid. Allow for turning on the outside of the lid including any inlay recesses, finial attachments, shaping.
      iv. Overall depth of base. Allow for turning on the outside of the base including the concave bottom, internal contours, etc.

7. **Make the Lid**
   a. Mount the lid in the chuck by the tenon
   b. Face off bottom of lid to square it. Slight undercut is OK.
   c. Hollow the lid per design. Make the mortise surfaces **DEAD PARALLEL** to the axis of rotation.
   d. Sand inside lid and face, but **DO NOT SAND MORTISE**.
   e. Apply finish of choice to all inside and bottom surfaces of the lid.
   f. Shape outside a bit (optional)
   g. Remove lid from chuck and set aside.

8. **Make the Base**
   a. Mount the base in the chuck by the tenon
   b. Face off top of base lid to square it. Slight undercut is OK.
   c. Cut the tenon to a slightly larger diameter than the lid mortise **T > M**, and cut the tenon about the same height as the mortise.. **A = B**,
   d. Hollow the base per design. Make the inside surface of the tenon **DEAD PARALLEL** to the axis of rotation.
   e. Sand inside base and face.
   f. Lightly sand the inside of the tenon. Avoid if possible..
   g. Apply finish of choice to all inside surfaces of the base.
   h. Using a depth gauge or a pencil, mark the inside depth on the outside of the box.
   i. Mark the expected bottom by adding 3/16" to ¼".

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**9. Fit the lid to the Base**

a. Objective is to make a snug fit
b. Turn the tenon into a cylinder with parallel sides. Use a straight edge scraper like a skew on its side or a beading an parting tool.
c. Chamfer the outer edge of tenon
d. Check the lid.
    i. If it fits over the chamfer, you are close.
    ii. If it does not fit the chamfer, reduce diameter to small diameter of the chamfer.
e. Repeat c and d until chamfer is reached.
f. Make the tenon convex as shown in the diagram. Check the fit of the lid often.
g. Continue to sneak up on a **TIGHT** fit. Use very light scrapes.
h. Press fit the lid, but do not brute force the fit.
i. Once a tight fit is achieved, press the lid on and turn the outside of the box – lid and base.
    i. Turn the bottom corner of the base if the chuck allows access.
    ii. Allow for lid thickness if doing a finial or an inlay.
    iii. Consider turning a detail that highlights the join. The feature will disguise future wood movement. Groove, bead, etc.
j. Once the outside is completed, sand and finish.
k. Remove lid.
l. Very lightly scrape tenon, maintaining the convex surface. Check the fit often.
m. Objective it to reach a suction fit lid.
n. Do not sand the tenon. Apply finish.

**10. Finish the bottom of the Base**

a. Remove base from chuck.
b. Mount a jam chuck blank. Use a softer wood for the jam chuck rather than a really hard wood.
c. Consider tenon inside the box, or a mortise to encompass the tenon.
d. Make a tight fit jam
e. Mount the box. Use tail stock for safety until the end,
f. Turn the bottom.
    i. Consider a concave surface.
    ii. Consider adding groove to show that it is turned.
g. Sand and finish with tailstock in place.
h. Nibble away the remaining tenon until the tailstock must be removed.
**i. DO NOT BREAK OFF THE REMAINING NUB. CUT IT OFF.**
j. Sand an finish. The nub can be sanded off lathe.
k. Sign your box.