

## **Plan & Procedures**

### **Bookshelf Safe**

*Warning: You will not finish this project unless you come in during lunch or after school on days when there are lines for tools or when you are behind schedule.*

*Read each process completely before beginning the process.*

#### **Mill and Glue stock**

1. Cut rough lumber to 25" with the miter saw.
2. Joint one edge of the board.
3. Rip board to 3" on the table saw.
  - a. You should now have a 3" x 25" board. You will need three to make one 25" x 9" board.
4. Dry fit and clamp boards to ensure proper joints.
5. Glue three 3" x 25" boards together and clamp them (alternate end grain patterns to reduce warping)

Each person will need three glued boards that are 25" x 9".

Write your name big and clear on each board and store them in your locker.

#### **Square and Size boards**

You will only need two glued 25" x 9" boards for this step.

Leave your third board in your locker with your name clearly written on it.

1. Plane two 25" x 9" boards to .687"(11/16) (Run both boards through each depth before changing it)
  - a. Set the planer to 15/16" for the first pass.
  - b. Increase the cut by about 1/16" for each new pass until one side is perfectly smooth
  - c. Flip the board over and continue to cut 1/16" each pass until you reach .687" (11/16)
2. Joint one edge of each board if necessary
3. Cut each board to a width of 8-1/2" on the table saw.
4. Send boards through the Wide Belt Sander. Finish thickness should be 5/8". (be sure it is set accurately)
5. Trim a small amount off each board with the miter saw to square up one end.
  - a. Usually you will cut no more than 1/8" unless there are defects you are trying to remove.
  - b. Be mindful of the final length when trimming so you don't remove too much material.
6. Cut boards to length using the Cross Cut sled or miter saw.

You will need two 11-3/4" boards and two 9-3/4" boards.

\*You may want to cut one 11-3/4" and one 9-3/4" length off each board instead of cutting both 11-3/4" pieces from the same board.

Use a stop to accurately and consistently cut the boards to length.

### Box Joints

*Make time to work during lunch or after school to complete this step. Otherwise you will likely be waiting in a line for several hours/days.*

1. Gather your box pieces and get help for this step.
  - a. You should have two 8-1/2" x 9-3/4" boards (top/bottom), and two 8-1/2" x 11-3/4" boards (sides).
2. Start by cutting box joints on both side pieces. Have someone watch you to make sure you do it right.
  - a. *Always* use a sacrificial board to prevent chipping/blowout.
  - b. Make sure to start all cuts on the same edge and end on the same edge.
3. Cut box joints on both the top and bottom pieces.
  - a. You will use a 3/4" tooth from a side board to off-set the box joints on the top and bottom.
  - b. *Always* use a sacrificial board to prevent chipping/blowout.
  - c. Make sure to start all cuts on the same edge and end on the same edge.

### Assemble the Box

1. Dry fit and clamp your box. Do not glue without first dry fitting.
  - a. Fix any mistakes or improper fit before glueing.
2. Use a brush or your finger to spread a light layer of glue on all surfaces that will be in contact when you assemble your box.
  - a. Be sure to check which surfaces need glue prior to applying glue.
  - b. Get help from a friend to quickly apply glue to all four pieces of your box.
3. Assemble your box and add clamps to every joint until there are no more gaps.
  - a. You could need up to 8-9 clamps.
  - b. Get someone to help you assemble if necessary.
4. Use a square or measure diagonals with a measuring tape to check your box for squareness.
5. Take one clamp and clamp diagonal corners together lightly to keep the box square while it dries.
6. Let the box dry for *at least 30 minutes* before removing clamps.

### Make the Back

1. Sand the inside of your box with 100 or 120 grit sandpaper before you attach your back panel.
2. Take the last 25" x 9" board from your locker and plane it to .625 (5/8)".

3. Cut the board in half with the Cross cut sled or miter saw (about 12").
4. Write your name on one of the boards and return it to your locker.
5. Measure the opening of your box where you want the back to fit to the nearest 1/32".
  - a. Everyone will have a slightly different box so you want to be sure you measure your box.
  - b. Don't just take one measurement from the middle. Make several measurements to assure you get the right numbers.
  - c. Write down your measurement on paper or a scrap of wood.
  - d. Have someone double and triple-check your measurements.
6. Joint your board if necessary.
7. Cut your board to width on the table saw.
8. Trim one end of your board on the cross cut sled or miter saw to square it up.
9. Cut your board to length on the cross cut sled or miter saw.
10. Test your back board to see if it fits in your box.
  - a. If it does not fit trim it slightly with the table saw (get help if you are unsure).

#### Install the Back

1. Make sure your back board fits nicely in the box before applying glue.
2. Apply glue to the edges of the back board all around.
3. Place your back board in your box from the back of the box.
4. Clamp the sides and top/bottom of your box to hold the back in place while it dries.
5. If necessary, shoot a few pin nails to hold the back in place while the glue dries.

#### Sand the Box

*Often the difference between a great project and a terrible project is the time and detail spent in sanding and finishing.*

1. Start sanding your box with a heavy grit (80 or 100).
  - a. You need to sand with a heavy grit until all joints and surfaces are flush and even.
2. Some dents can be removed from the surface by placing a wet rag over the dent and then running a hot iron on the rag.
  - a. Steam from the wet rag will get inside the wood, causing it to expand and reverse dents.
3. Once all your joints are flush and large scratches/dents are removed, sand the box with 100 or 120 grit sandpaper to remove heavy sanding scratches.

#### Make the Door

1. Use the remaining 12" x 9" board in your locker to make the door.
2. Measure the opening of your box to the nearest 1/32". Find someone to double-check your measurements.
3. Subtract 1/8" from both measurements (height and width).

- a. This will leave a 1/16" gap around the edges of your door.
  - b. Get a friend to double-check your measurements.
4. Joint your board if necessary.
5. Cut the board to width on the table saw.
6. Trim one end of the board on the Cross cut sled or miter saw.
7. Cut the board to length on the Cross cut sled or miter saw.
8. Check the board to see that it fits in your box with a 1/16" gap all the way around. Trim on the table saw if necessary.

### Laminate (Glue) the Veneer

1. Sand the board lightly with 120 grit sandpaper.
  - a. You are not trying to make it look nice yet. Sanding the door is preparation for lamination.
2. Obtain, or cut Walnut veneers for your door.
  - a. They should be about 1-1/2" wide.
  - b. You need two that are 10-1/2" long and two that are 4" long.
3. Use a brush to apply an even coat of contact cement to every square inch of the veneers.
4. Use a brush to apply an even coat of contact cement to the surface of your door.
  - a. You need to cover everything about 2" in from the edges of your door.
  - b. Don't worry about getting glue in the middle. The CNC router will cut it all away.
5. Let the contact cement dry on both surfaces *before* putting them together. (around 10 minutes)
  - a. You should not see any shiny wet spots and it should only feel slightly tacky.
6. Start by laying one longer veneer along the edge of the door.
  - a. Be careful not to touch the two surfaces together until you have them lined up. They will not come apart nicely.
7. Place the two short veneers down next along the top and bottom edges of the door.
  - a. Do not allow any space between the short pieces and the long veneer you placed first.
8. Place the last longer veneer down against the two shorter veneers.
  - a. Again, do not allow any space between the two shorter pieces and the longer veneer.
  - b. Don't worry if the veneer hangs over or doesn't quite reach the edge of the door. The router will trim everything in about 1/4-1/2".
9. Use a roller to press the veneer down on the door.
  - a. Apply *all* your force to the roller.
  - b. Place the door on the sanding board so that it won't slide on the table while rolling.
  - c. Roll the veneer until you don't hear any more cracking.

### Route the Door

If you applied the veneer correctly you should not have any problems with this step.

1. Place the door in the proper place on the router table and insert the wedges firmly.
  - a. Make sure the door is oriented correctly and that it is flat against the table.
2. Make sure the proper tool is in the router.

3. Zero the router in all three axis. (X,Y,Z)
4. Turn the dust collector on.
5. Select the proper file on the computer.
6. Turn the spindle on.
7. Run the program. Stop the program if errors occur. (Vanir comes off)
8. Continue the program when it asks for a tool change.
9. Turn the spindle off.
10. Remove the door.
11. **Sand the door thoroughly.**
  - a. You may need to use a sanding block to get the mill marks out completely.
  - b. It will take time to make your door look nice. Be meticulous.

### Lock Assembly

1. Lock assembly parts should be cut on the CNC router and the Laser engraver.
2. Watch the Lock Assembly video for instructions.
  - a. There is one step early in the video in which you will need to use two different spacers than those shown in the video. Get help if you are not sure what to do.
  - b. Pay close attention to the video. It is critical that you use the exact pieces in their proper location.
  - c. You should lightly sand the tumblers so that they do not catch when they are not supposed to.

### Rivet Dowels

1. Rivet dowels should be cut to ½". You will need 24 of them.
  - a. There should be a container full of rivet dowels at the door assembly station.
  - b. Two of the holes are reserved for 2 longer dowels that will extend all the way through to hold your lock assembly in place.
  - c. If your lock assembly does not stay firmly mounted you may drill a pilot hole and drive a screw through the lock assembly into the door.
2. Push the dowels into the holes around your door. You may need a tiny bit of glue if they do not fit tightly.
3. The dowels are not all cut exactly the same. Turn your door upside down on the sanding board and rub it around lightly until all the rivet dowels are the same length.
  - a. Be careful not to sand too heavy on one end.

## Hinges

*Do not remove any drills, drill bits, or other tools from the door assembly station. Return tools to their place when you are finished.*

1. The hinges, lever and dial knob should be cut out on the CNC router. A 6" x 18" walnut board will make two sets in the CNC router.
  - a. Get help if these pieces are not already cut for you.
2. Sand all the pieces to get rid of tabs, mill marks and scratches.
3. Use a 2-1/2" dowel as a pin for your hinges.
  - a. You can trim the dowel if you want it to be flush with the hinges.
4. Use the jig at the door assembly station to drill pilot holes in your hinges.
  - a. The pilot hole should be large enough to let the screw threads slide through, but small enough to prevent the head from passing.
5. Countersink the pilot holes with a countersink bit just enough to allow the head of the screw to sit flush with the surface of the hinge.
6. You need your door to sit flush with the front of your box while you attach your hinges.
  - a. Place your box on its back and measure the depth on all four sides.
  - b. Subtract the thickness of your door and write the measurement down.
  - c. Find two to four scraps and cut them to the measurement you wrote down.
  - d. Place the scraps in your box around the sides so that when you place your door on them the surface of your door sits flush with the front of the box.
  - e. There may already be scraps sitting around from previous people.
7. Place the door on the blocks in your box.
8. Center the door so that it has even gaps all the way around.
  - a. Get someone to help you hold it in place if you need to.
9. Place your hinges on your door and box where they will be mounted and drill pilot holes into the door through the pilot holes that are already in your hinges.
  - a. These holes should be **smaller** than the pilot holes in your hinges because you need the screws to grab when they enter the door.
10. Drive the screws through your hinges and into the door with a drill.
  - a. Use the clutch on the drill to prevent stripping out the screw or cracking your hinge. They do not need to be super tight.
11. Hold the door and hinges in place once more while you drill pilot holes through the hinges into the box.
  - a. Once again, these holes should be small enough to allow the screws to grab the box.
12. Drive the screws through your hinges into the box.
  - a. Use the clutch to avoid over-tightening.

### Door Stop

1. Find a piece of scrap to make a door stop.
  - a. The door stop hold the door latched when it is locked.
2. The door stop need to fit between your door and the latch on the lock assembly.
  - a. It should be about  $\frac{1}{2}$ " thick.
3. The length should be the width of the inside of your box (about  $8\frac{1}{2}$ ").
4. The width is not extremely important as long as it is big enough to hold the latch and small enough to fit without interfering.
  - a.  $\frac{3}{4}$ " should be about right for the width.
5. So your door stop should be about  $8\frac{1}{2}$ " x  $\frac{3}{4}$ " x  $\frac{1}{2}$ ".
  - a. Get help if you are unsure about how to safely make a piece this size.
6. The door stop should be attached to the top of the box and set in the thickness of your door.
  - a. If your door is  $\frac{5}{8}$ " thick you will set your door stop  $\frac{5}{8}$ " from the front of the box.
  - b. Make a line with your pencil where the door stop should be.
7. Apply a small film of glue to the door stop and clamp it to the top of the box in the proper place.

### Laser the Dial

1. Dials are cut out 10 at a time on the CNC router with a board that is  $7\frac{1}{2}$ " x 20" x  $\frac{1}{2}$ ".
  - a. There should already be dials cut for you.
2. Sand all the tabs, mill marks, and scratches on the dial before laser engraving.
3. Place the dial in the fixture made for laser engraving dials.
  - a. Make sure the fixture is tight up against the top left corner of the laser table.
4. Select the proper file on the computer.
5. Turn on the dust collector.
6. Turn on the laser.
7. Start the program.
8. Turn off the laser when it is finished.

### Attach the Dial

1. The lock assembly should have a small hole next to the dowel where the dial mounts. Drill a pilot hole through that hole so that a nail fits snugly.
  - a. The nail should not move. You may have to pound it in lightly.
2. Put the dial and the knob together and drill another small pilot hole through the dial and partly through the knob.
  - a. Do not drill all the way through the knob.
  - b. The nail should also fit snugly in this hole.
3. Drill another pilot hole in the dial for a screw that will hold the dial to the lock assembly.
  - a. The screw should be small and should sit underneath the knob where it will not be seen.
4. Screw the dial to the lock assembly.

5. Push the knob on the nail and into the dial.
  - a. If the knob is loose, bend the part of the nail that is sticking out enough to make the knob fit tight on the dial.
6. Do not glue the knob or the dial into place. You will not be able to take them apart later if there are problems. You also will take them apart later to apply finish.

#### Attach the Lever

1. Drill a small pilot hole underneath the lever, where it will not be seen, and into the dowel that it sits on.
  - a. The pilot hole should be as small enough to allow the screw to grab well.
2. Use the countersink bit to countersink the screw head to the surface of the lever.
3. Insert the screw with a screw driver.
  - a. Do not over tighten this screw. It only needs to keep the lever from falling off.

#### Make/Attach the Feet

1. Feet are made from walnut. They should be about 1-½" to 2" on top and taper between 22 and 30 degrees.
  - a. Size is not important.
  - b. There should already be feet made for you.
2. Sand the feet to get rid of mill marks.
3. Measure ¼" in from each side on each corner and make a mark.
4. Apply a small amount of glue on each foot and place it on the marks made ¼" from each corner.
5. Use the pin nailer to shoot a couple pin nails in each foot.
  - a. Be careful not to shoot nails too close to the bottom of the foot or they might poke through the bottom of the box.

#### Handle (optional)

1. You may choose to make a handle that attaches to the two dowels in your door that hold the lock assembly in place.
  - a. There is no specified size or shape.

#### Final Sanding

*Often the difference between a great project and a terrible project is the time and detail spent in sanding and finishing.*

1. Disassemble everything.
2. Sand everything down to 120 grit sandpaper.
  - a. Remove all scratches, burn marks and mill marks.
  - b. Any defects that can be noticed now will be amplified after applying finish.

### Apply Finish

1. Blow and wipe off all dust from sanding.
  - a. Do not use water. Water will cause the grain to raise making a rough surface.
2. Apply lacquer.
3. After each coat is dry (Approximately 15 min) sand everything with 220 grit sandpaper.
  - a. Remove any rough areas, drips or bubbles between coats.
4. Recoat 2 more times. (3 coats total)
5. Do not sand the last coat.
6. Reassemble the safe.

**YOU ARE FINISHED!**

### Tips

#### Squaring up Stock:

7. Joint one edge (usually the better edge because you will cut more off the other edge next)
8. Cut board to width on the table saw with the jointed edge against the fence (this will make edges parallel to each other)
9. Trim one end of board on miter saw or radial arm saw (squares up this end)
10. Cut board to length using miter saw or radial arm saw (squares up last end)

#### Drilling Pilot Holes:

11. Pilot holes should be drilled before driving a screw into any material.
12. The pilot hole of the material being attached should be large enough for the threads to slip through, but small enough that the head cannot enter.
13. The pilot hole in the material that is fastened to should be the size of the screw shaft so that threads will grab without splitting the wood.