

IC Pads - Manhattan Style

Make mounts for even tiny SMT components with this precision jig

Introduction

Manhattan Construction, especially as practiced by Grandmasters like Chuck Adams, K7QO [1], and Jim Kortge, K8IQY [2], is a reliable and convenient method of circuit construction.

Many circuits QRPer's are building these days employ integrated circuit devices. Preparing mounting pads for the closely spaced connections of these devices can be tedious. A fair amount of precision is needed if the device leads and mounting pads are to align properly.

Complicating the problem is the desire to employ smaller devices, such as surface mount components. While the leads of the common IC are spaced 0.1 inch, surface mount leads may be spaced 0.05 inch, or even 0.0256 inch.

Chuck Adams has described on his web page [1] a handy jig, based on the carpenter's miter box that allows 0.1 inch spaced IC pads to be produced quickly and precisely. This article expands on Chuck's design, presenting a device that allows cutting even closer spaced pads.

Theory of Operation

While "theory" of a miter box may sound pretentious, a brief comment is in order. This jig uses a threaded rod to advance a carrier into the cutting area. Thread pitch determines the distance the threaded rod will advance as a result of each full rotation of the rod. The 1/4-20 rod used here has 20 threads per inch (TPI), advancing 1/20 inch for each rotation.

Notice that 1/20 inch is 0.05 inch. So two rotations advance the rod 0.1 inch, the right spacing for the common IC devices. One turn is a 0.05 inch advance, correct spacing for SOIC surface mount IC's. And a half turn "fudged" just a smidgen advances 0.0256 inch, the spacing of tiny devices like the AD9850 DDS and other similar chips.

Materials

With the exception of the printed circuit board (PCB) stock and the knob, all of the other materials and tools needed should be found at hardware stores, home centers, or craft/hobby stores. The total cost should not exceed ten dollars (US).

The pine board is sold at home centers such as Home Depot or Lowes as "hobby boards" or "craft boards," usually available in oak, poplar, or pine. Pine is perfectly adequate here, and the cost is under a dollar. Remember that the actual dimension of a 3" board is really about 2 1/2 inches. You could use any scrap wood, but hobby boards are convenient because they have straight, square edges and are sanded smooth on both faces.

Construction

Refer to Figure 1 and cut the 18 inch board into three 6 inch sections. Be as neat as you can, but these cuts need not be particularly straight, or even square. If no other tools are available, make the cuts with the miniature hacksaw. Set one piece aside. It can be the base of a second jig later.

Make two rip cuts, dividing one of the 6 inch pieces into three parts. Make the cuts 3/4" in from each factory edge. Once again, don't fret if you have to use hand tools and the cuts are not perfectly straight. Save the two outer pieces, the ones that have a square factory edge, and set the middle piece aside.

- miniature hacksaw, with 6" blade
- hobby saw, example:
 - Excel # 30450, 42 teeth/in, or
 - Excel # 30490, 54 teeth/in
- 1 piece, 3/8" x 3" x 18" pine
- 1 - 1/4-20 x 5" threaded rod, or
1/4-20 5" carriage bolt
- 1 plastic knob, for 1/4" shaft
- 2 - 1/4-20 **BRASS** hex nuts
- 2 - #4 x 1/4" flat head wood screws
- 2 - #4 x 1/4" round head wood screws
- PCB stock, 1/16" x 1" wide, about 7" long, or one 5" and one 2" strip
- carpenter's wood glue and clamps

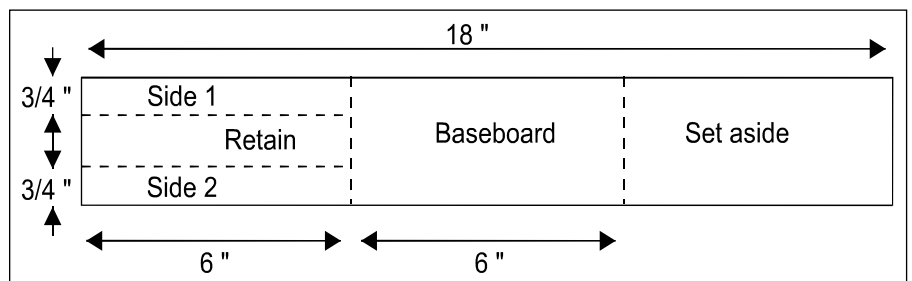


Figure 1. Wood cutting dimensions.

Save the two outer pieces, the ones that have a square factory edge, and set the middle piece aside.

Glue a 3/4" strip to the baseboard, positioning it flush with the outer edge of the base, as shown in Figure 2. **Be sure that the factory edge faces inward.** Clamp it in place while glue cures.

While waiting on the glue, prepare a piece of PC board material 1" wide and about 5" long. The length is not critical, and even the width need only be approximate. But it is important that the long sides of this PCB strip be as parallel as possible. Cut them carefully and touch up the edges, holding them vertically and running them over some fine sandpaper placed on a smooth, flat surface.

Examine Figure 3 and, using the 5" PCB strip as a guide, position the other 3/4" wood strip on the base board, **factory edge facing inward.** Before any glue is applied, clamp it in place and verify that the PCB strip can slide smoothly between the two wood strips. A slightly snug fit is fine, sanding can fix that, but it should not wobble from side to side as it slides.

Once you're sure that the PCB fits and slides smoothly end to end, apply glue and clamp the wood strip in place. Recheck the fit while the glue is workable and you can still reposition the strip if necessary. Set this assembly aside and allow it to dry completely. Leave the PCB strip in place while the glue cures, but be sure so much excess glue hasn't oozed out that it glues the PCB in place!

Now prepare the lead screw assembly. Cut a piece of PCB stock about 1 1/2" to 2" long, and just wide enough to fit between the wood strips on the base. You will be soldering the brass hex nuts to the surface of this PCB strip. A fairly robust soldering tool is called for, such as a 150 watt soldering gun.

Thread the hex nuts onto the threaded rod and dry fit the assembly as shown in Figure 4. Arrange the nuts so they are about 3/16" from the end of the PCB strip. This leaves room for a good fillet of solder all around the nuts. Notice the scraps of PCB stock used as shims to space the nuts from the wood strips and keep them parallel to the sides.

Make sure the copper cladding on the PCB and the bottom surface of the brass nuts are clean. If available, apply a little rosin paste flux before positioning the nuts. Clamp the assembly in place and apply the tip of the solder gun to the top of the nut. Heat the nut until solder applied between it and the PC board begins to flow. Be sure the parts don't move while the solder cools.

Position the lead screw assembly with edge of the PC board even with one end of the baseboard. Drill two holes through the PC board and into the base board with a 1/16" drill to form pilot holes. Then enlarge the holes, **in the PC board only**, to 1/8" to clear the #4 wood screws. Fasten the assembly in place with two #4 round-head wood screws. Attach the knob to the free end of the threaded rod.

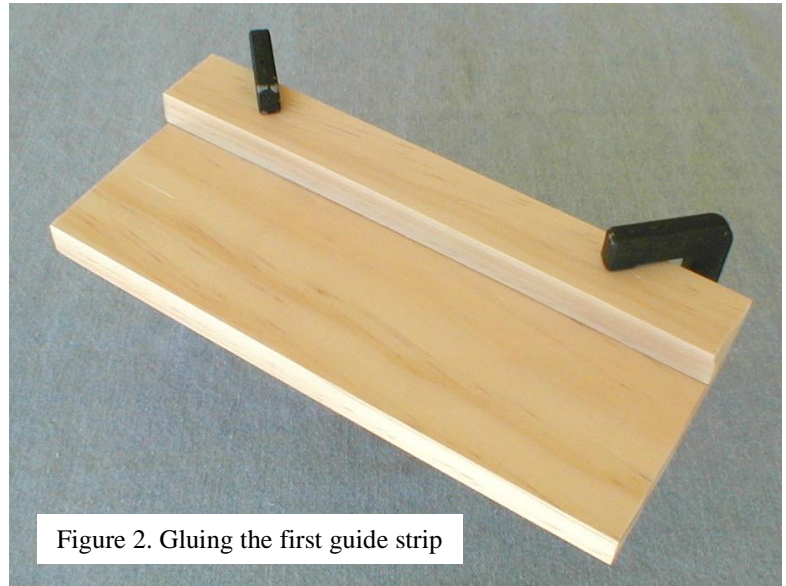


Figure 2. Gluing the first guide strip

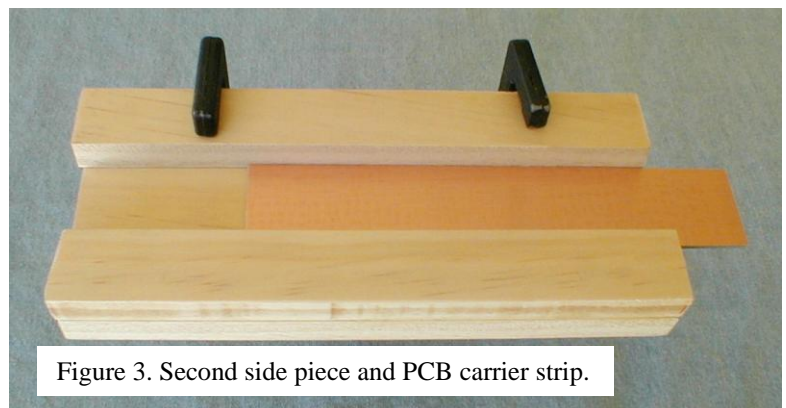


Figure 3. Second side piece and PCB carrier strip.

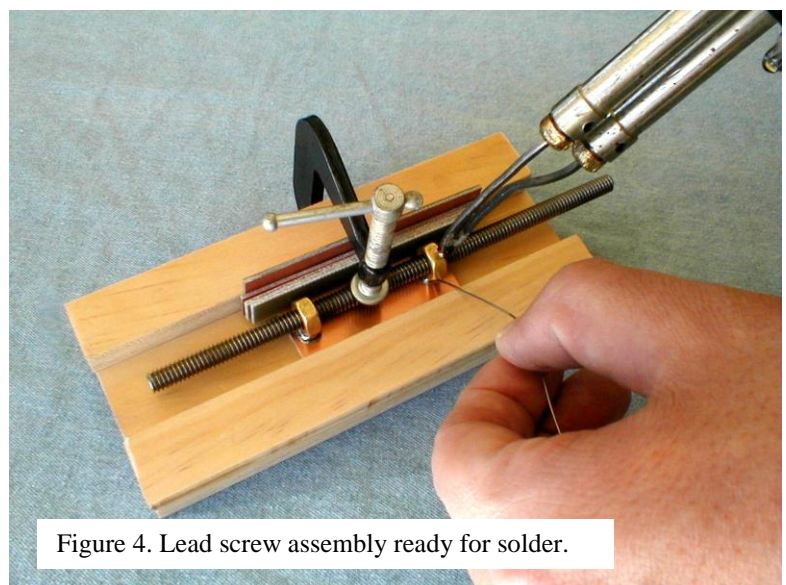


Figure 4. Lead screw assembly ready for solder.

Refer to Figure 5 as you prepare the carrier. Cut the wood stop block from the stock that was left over when you ripped the two side pieces of the miter box. Fasten the block to the 5" PC board strip using a pair of #4 flat-head screws. Again, drill 1/16" pilot holes and enlarge to 1/8" for clearance. The screws must be countersunk so that the bottom of the carrier will slide smoothly through the miter box. If you don't have a real countersinking bit, a 1/4" drill bit can do the job.

Two guide kerfs should be cut into the miter box. One is cut using the mini hacksaw and the other using the hobby saw. These kerfs should be about 1/2" to 3/4" apart and not nearer than 1/2" to the end of the miter box. Make the hacksaw kerf closest to the end of the miter box. It is important that the kerfs are cut square to the inner surfaces of the miter box side pieces, and perpendicular to the baseboard. Use a guide block as shown in Figure 6. to maintain the saw blade square and plumb. The kerfs should not penetrate all the way to the baseboard. Place a scrap of PC board material in the miterbox and stop before a kerf reaches the scrap.

Operation

Righthanders will find it easier to orient the miter box with the lead screw to the left. The piece to be cut can be held in position with the left hand while the right hand makes the cut by *drawing the saw back towards the operator*. If desired a small push block can be fashioned to permit better control of the workpiece. If the entire surface of a blank pad strip is tinned with solder *before* the cuts are made the tinned pads will be very uniform.

Use the hacksaw kerf with the mini hacksaw to make cuts for pads that are to be spaced 0.1". Use the hobby saw in its kerf for more closely spaced pads. After each cut advance the screw two turns for 0.1" spacing, one turn for 0.05", and just slightly more than a half turn for 0.0256" spacing (actually a half turn plus 9 degrees more).

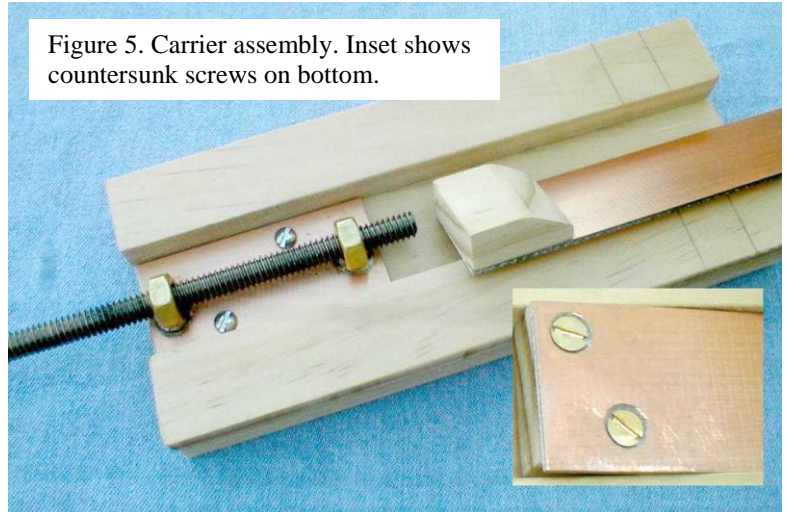


Figure 5. Carrier assembly. Inset shows countersunk screws on bottom.

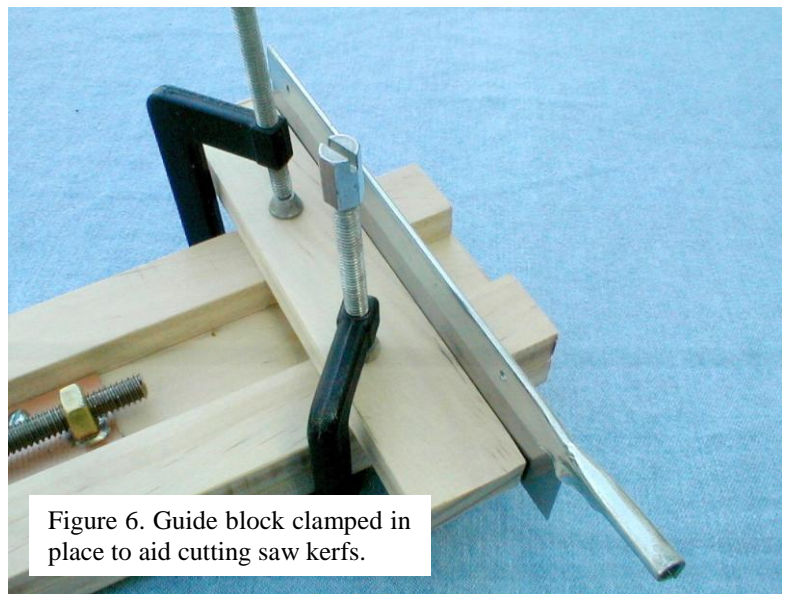


Figure 6. Guide block clamped in place to aid cutting saw kerfs.

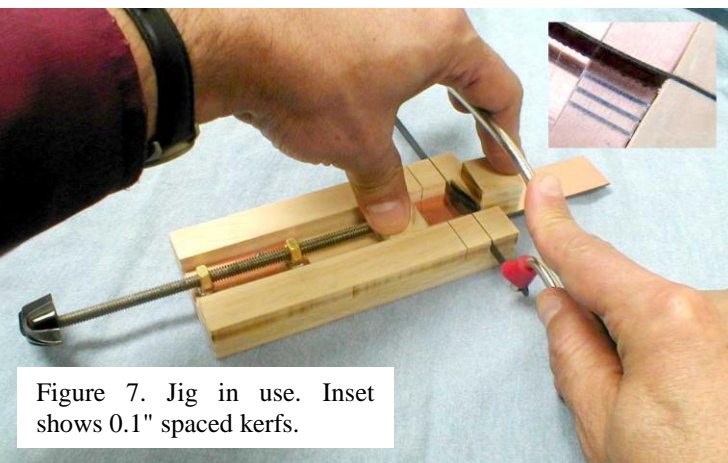


Figure 7. Jig in use. Inset shows 0.1" spaced kerfs.

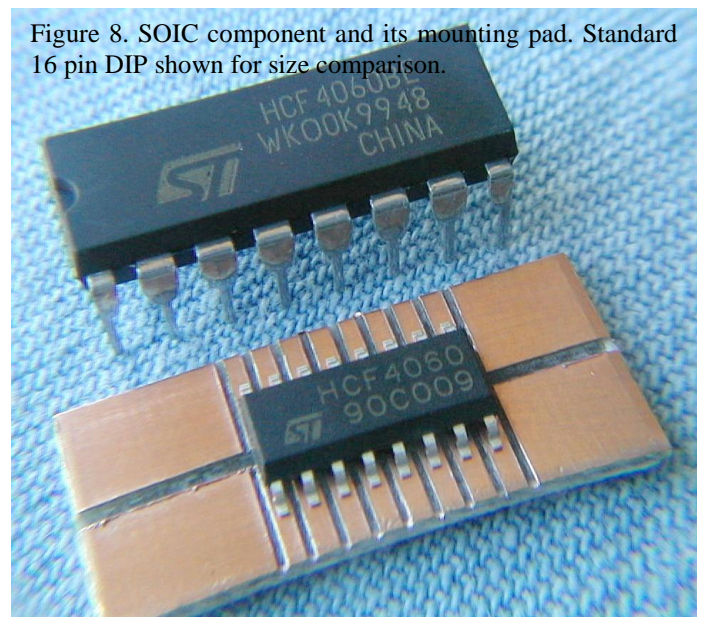


Figure 8. SOIC component and its mounting pad. Standard 16 pin DIP shown for size comparison.

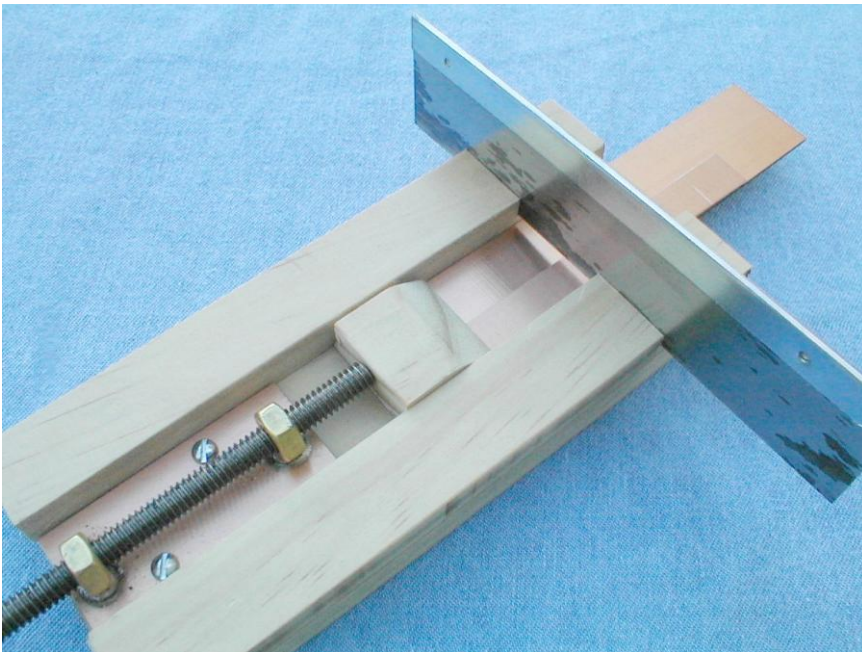
References

[1]Chuck Adams's web pages: <http://www.k7qo.net/index.html>

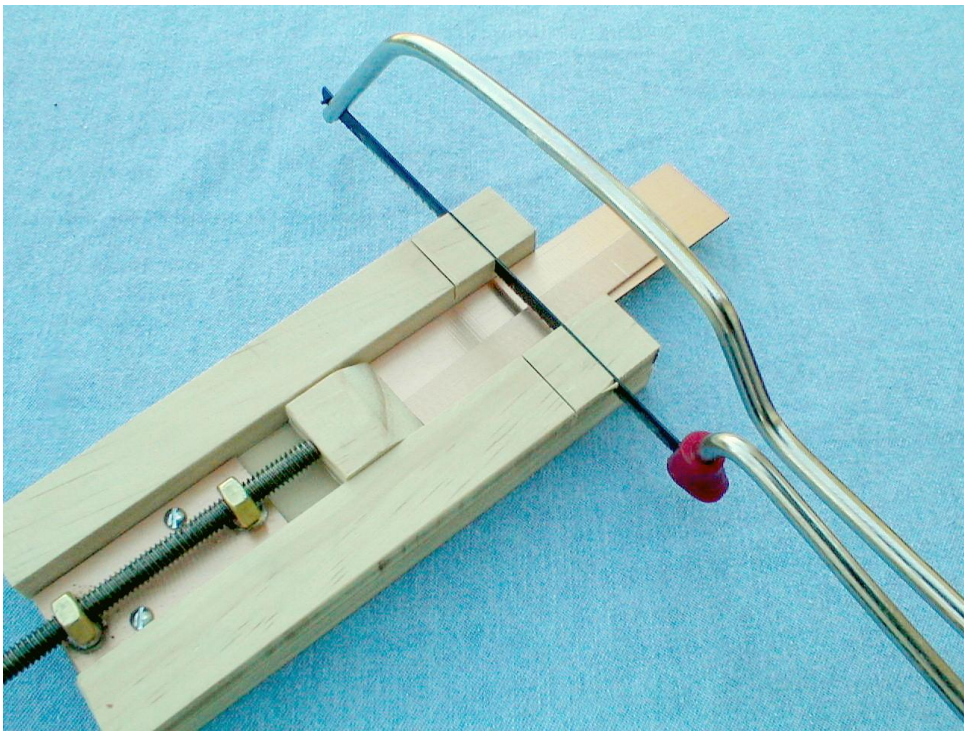
[2]Jim Kortge's web pages: <http://www.k8iqy.com/>



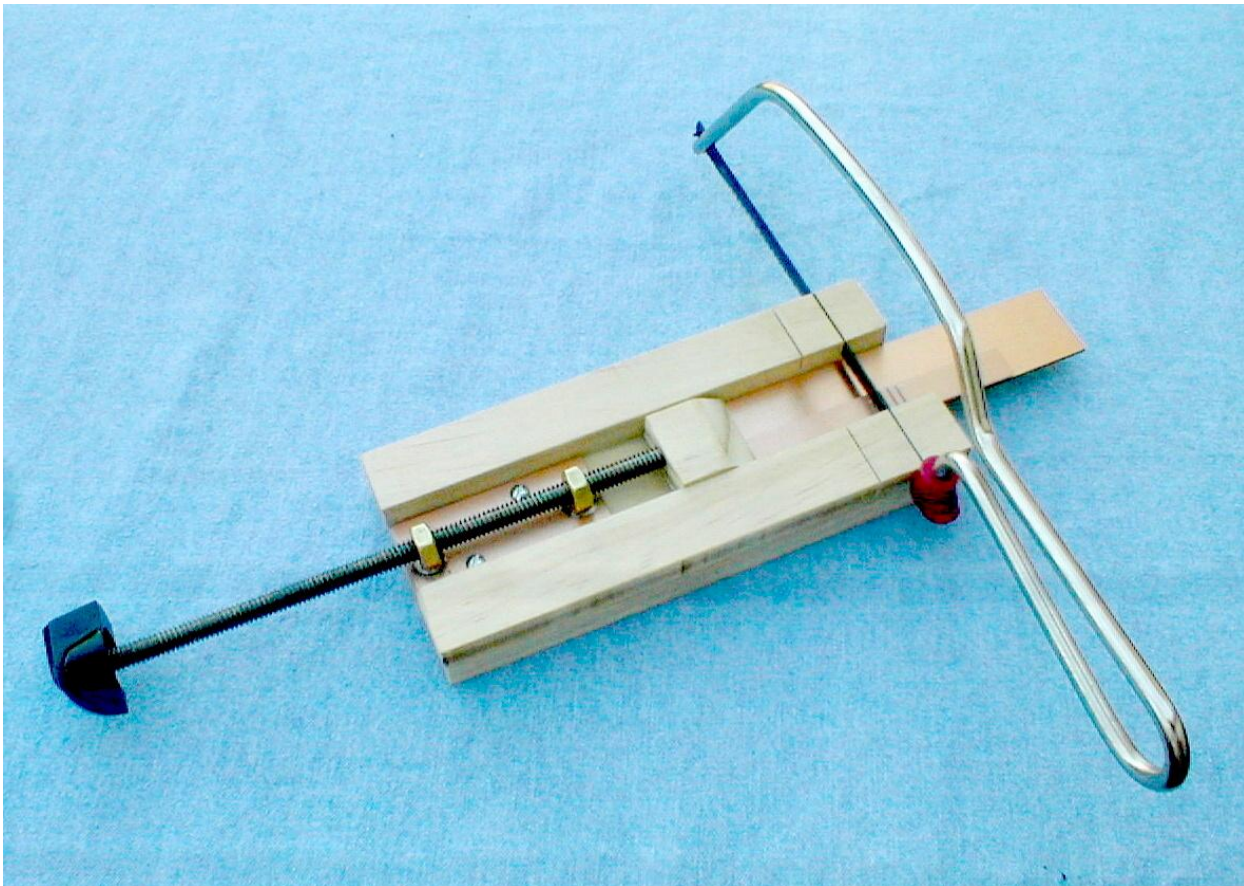
Extra Figure A. Materials gathered to begin construction.



Extra Figure B. Completed jig showing fine-toothed hobby saw in use.



Extra Figure C. Completed jig showing mini hacksaw in use.



Extra Figure D. Completed jig.