

Shopmade Threading Jig

Screw the lids onto boxes, jars, and urns

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Boxes with screw-on lids

Boxes and jars like these can be fit with threaded lids using a shopmade lathe jig and a 60° rotary cutter. Most close-grained hardwoods can handle a 16 tpi thread (left) but coarse woods like oak (right) do better with a coarse 10 tpi thread.

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Ever thought about adding threads to your lidded boxes, jars, or urns? Well-fitting threads can add pizzazz to many turning projects. And best of all, you can make a threading jig for a fraction of the cost of the commercial equivalent, and for even less than the \$75 - \$85 you would pay for a pair of hand-thread chasers.

I made the threading jig shown here for my JET 1014 mini lathe using wood with readily available metal parts. This project does not require specialized metalworking skills, although fitting it to your lathe may require some tweaks. Most of the parts will be available locally; some items probably will need to be ordered online.

The thread is formed by a 60° rotary cutter mounted in a drill chuck or collet in

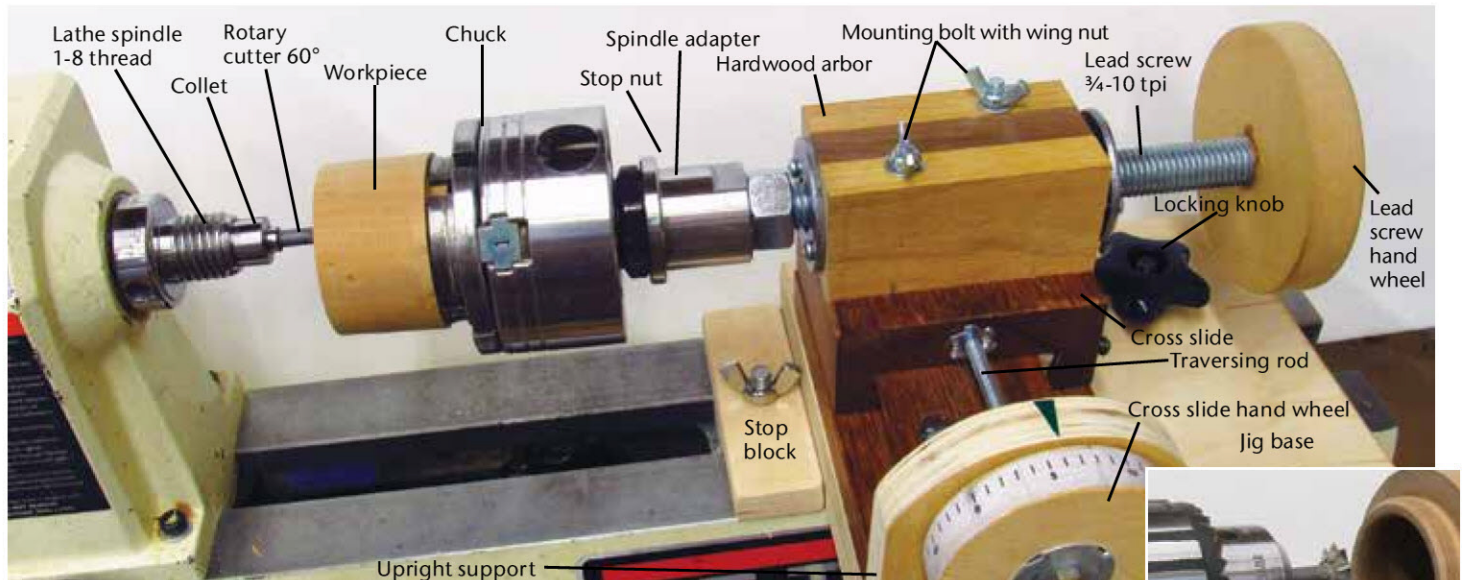
the lathe headstock. To set up for threading, the operator transfers the chuck and workpiece from the lathe spindle to the jig's lead screw. The lead screw feeds through two nuts inside a hardwood arbor mounted on a shopmade cross slide. Turning the cross-slide handwheel moves the lead-screw assembly transversely to suit the diameter of the workpiece and whether you want inside or outside threads, and to set the thread depth. The operator turns the lead-screw handwheel to rotate the workpiece while feeding it to the spinning cutter. This compound motion enables the cutter to duplicate the pitch of the lead screw in the workpiece.

This jig features interchangeable hardwood arbors carrying different lead

screws to cut threads of various pitches. It is versatile and can cut threads in diameters up to the swing of your lathe. Wood movement, of course, would prevent a 10" (25cm) threaded lid from fitting very long!

Lead-screw assembly

I made two lead screws, as shown in *Photo 1*. The assembled lead screw uses a threaded rod 3/4"-16 tpi, 12" (10.5cm) long, to cut 16 tpi in the workpiece. I find this thread size suitable for most boxes. I was able to locate low-cost spindle adapters with female threads to match the threads on each rod. Both adapters match my 1"-8 tpi chuck and faceplate, and eliminate the bother and expense of machining. The unassembled parts pictured on the

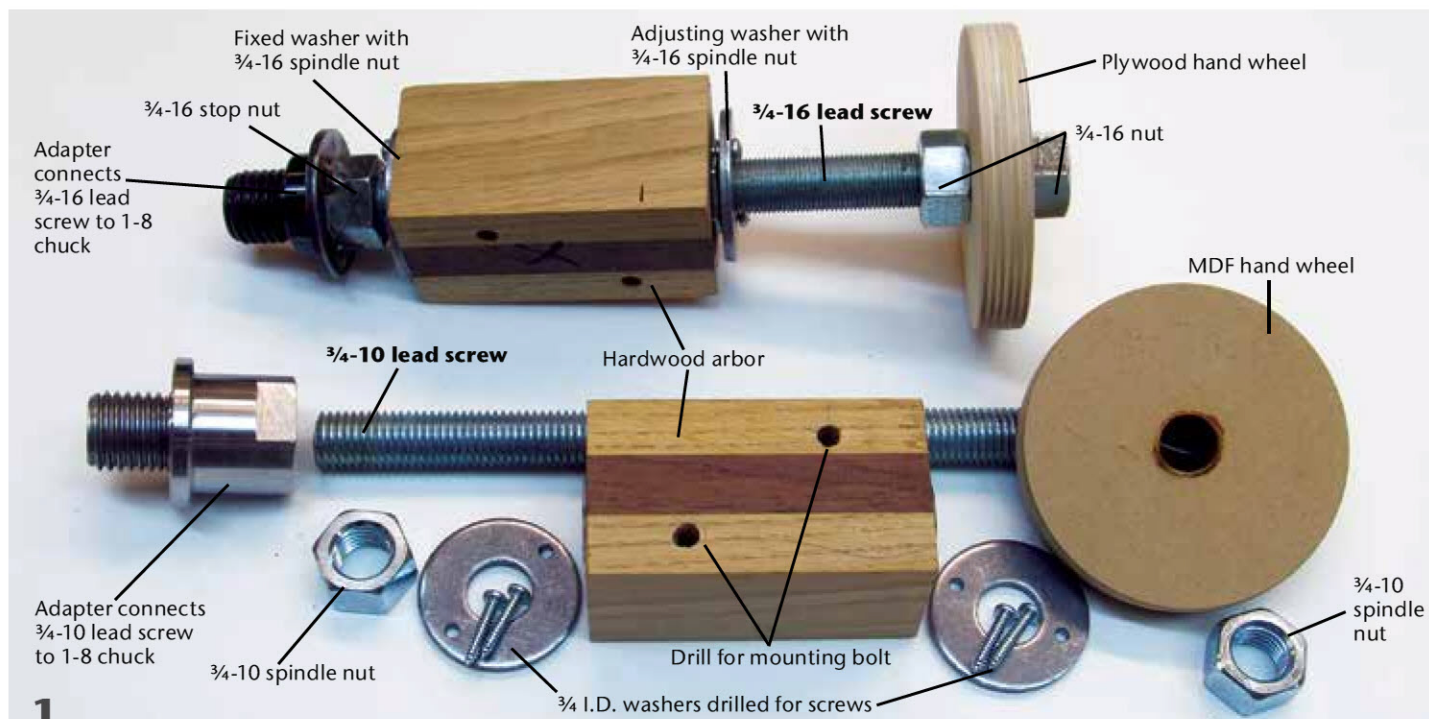


The threading jig

The threading jig consists of a cross-slide mechanism (dark wood) mounted on a lathe platform, with the hardwood arbor and lead screw mounted on the cross slide. The lathe drives the 60° rotary thread-cutting bit. The operator transfers the chuck and workpiece to the lead screw. The apparatus rotates the workpiece while feeding it to the spinning cutter, thus duplicating the pitch of the lead screw. The jig can cut inside and outside threads on diameters up to the lathe capacity.



60° rotary cutter in Jacobs chuck



Lead screw assembly

The photo shows two lead screw assemblies, the top one for making 16-tpi threads, the lower one for 10 tpi. To make the assemblies interchangeable, use identical blocks for the arbors.

bottom include a threaded rod $\frac{3}{4}$ "-10 tpi, 12" long, which should be readily available locally. The 10 tpi size is coarse and works for large lidded vessels such as burial urns, and also for woods that typically might not be a good candidate, like oak.

The lead screw is mounted in a hardwood arbor with a matching nut on each end. My arbor is glued up from kiln-dried oak and walnut but other similar hardwood should do fine. I made both arbors the same size with matching holes drilled for carriage bolts mounted in the cross-slide mechanism. This allows for swapping one lead screw assembly for another with a different thread.

Using a Forstner bit on the drill press, I drilled a $1\frac{1}{4}$ " (32mm) recess nut deep into each end of the arbor block. I then drilled the $\frac{3}{4}$ " (19mm) through-hole. The front nut is press-fit into its $1\frac{1}{4}$ " hole with a little epoxy to keep it from twisting. It is secured in place by a heavy washer, $\frac{3}{4}$ " inside diameter (I.D.) and 2" (50mm) outside diameter (O.D.), that has a pair of holes drilled for screws into the wood

arbor. Drill the holes near the outside of the washer with a little bit of wiggle room for the screws so you can tighten it down without it touching the threaded rod. Drill the washer for the back nut the same way, but don't epoxy the nut into the hole. Instead, use an epoxy for metal like JB Weld to glue the washer to the nut. If you have a welder, just tack-weld the washer to the nut. After the epoxy dries, push the nut into the rear hole, but leave the back of the nut with the washer protruding about $\frac{1}{8}$ " (3mm) proud of the hole. Tightening the two screws adjusts the back nut to take up any backlash.

The arbor fits into a $\frac{1}{8}$ " routed saddle on the cross slide. The saddle locates the arbor and keeps it from shifting in use.

I made one handwheel from a 4"-(10cm-) diameter circle of $\frac{3}{4}$ " plywood and another of MDF for the second spindle assembly. This 4" size is easy to grasp and turn with one hand. Cut them on the bandsaw and true them up on the lathe. Secure the handwheel with a $\frac{3}{4}$ " nut tightened on each side. I made one handle with a revolving crank but

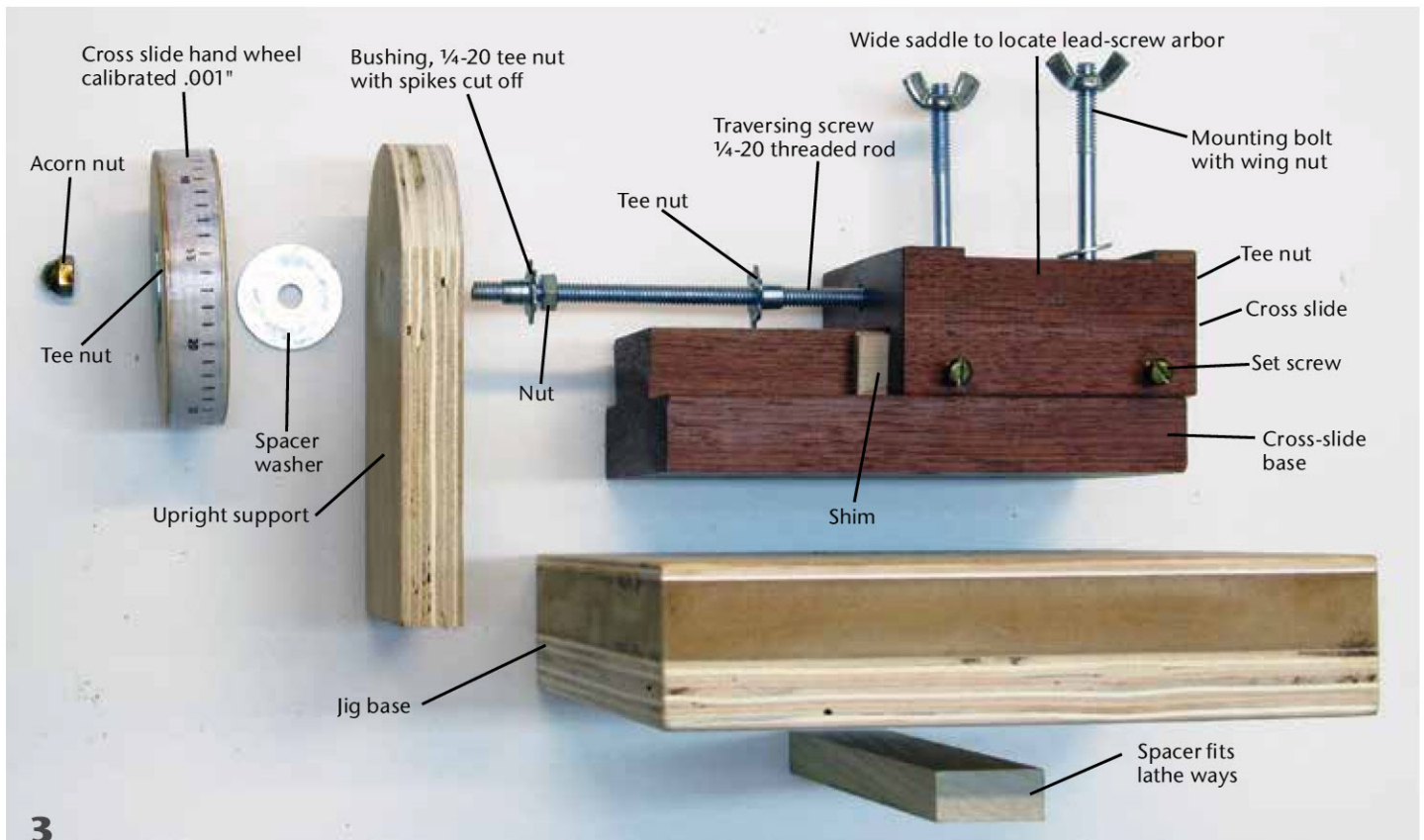
it seemed harder to turn smoothly than a simple handwheel.

The spindle adapter needs to be tightened to seat against a stop nut, the same way a chuck snubs against the machined shoulder on the lathe spindle. Since the nut is not a precision-machined part, the adapter might not run true, causing some run-out or wobble in the chuck or faceplate. A little run-out will not stop you from making acceptable threads. I had too much run-out on the 10 tpi rod, but wanted to avoid machining metal, so I made a wooden stop nut to backup the spindle adapter. I tapped a wood nut, and then screwed the wood nut on a mandrel made from a short length of threaded rod. By wrapping the rod with 14-gauge copper wire to prevent thread damage ▶



Wooden stop nut

To face off a wooden stop nut, thread it onto a mandrel from the same rod as the lead screw. Wrap the mandrel with copper wire to protect it from the chuck jaws.



Cross slide mechanism

The component view shows the arrangement of nuts and the tee-nut bushing on the traversing rod. Build the jig base so that the lead screw is at center height.

(Photo 2), I was able to mount it in the lathe chuck and face off the wood nut. The threads in the wood nut were so tight it didn't need any glue to prevent it from shifting.

Cross-slide mechanism

The cross-slide mechanism moves on a threaded rod the operator turns with a handwheel. The design must allow for smooth movement without any play.

Photo 3 shows all of the required parts. The 1/4" all-thread traversing screw is readily available locally. The 20-tpi pitch makes it easy to calibrate the handwheel for the fine adjustments needed to cut threads of precise depth.

Note in Photo 4, the tee nut that goes into the upright support is a bushing. I used a rotary tool with a cut-off wheel to remove its spikes. The handwheel is secured by a tee nut and acorn nut on the end of the rod, with a nut snug

against the bushing. This nut keeps the bushing secure on the traversing rod so it can turn with the rod.

There's a tee nut embedded in a 3/4" recess on the front and the back of the cross slide, so the cross slide moves when you turn the handwheel. The 1/4" fender washer between the handwheel and the upright support is a spacer to reduce friction between the wooden parts.

The cross-slide base and cross slide have matching dovetails done on a router table (Photo 4). You could cut this dovetail on a tablesaw with the blade tilted if you prefer. To accommodate wear and seasonal wood movement, there's a maple shim in the dovetail between the cross slide and its base, on the back side only. It is secured with two brass flat-head machine screws. With a very hard wood for the cross slide, you can drill holes slightly under-size and allow the screws to cut their

own threads. I had jatoba on hand, but oak or hard maple would work fine. Adjusting the setscrews against the maple shim will take out any play.

The rod is 20 tpi, so one revolution traverses the cross slide one thread width, 1/20", or 0.050" (1.27mm). I used a spreadsheet program to produce the paper strip around the handle. It is marked with 50 gradations for precise settings to 1/1000", or .001" (.025mm). The strip is glued down and sprayed with clear acrylic finish. I drew the triangle pointer on the support opposite the calibrated wheel. Photo 5 shows what the calibrated handwheel looks like and how you can use a power drill with a nut driver to speed-turn the traversing rod.

The base

For my lathe, the base measures 7 1/2" (190mm) long and 8 1/2" (215mm) wide.

I used plywood and MDF to build it up so the lead screw center would exactly match the lathe spindle, so the rotary cutter would cut on center.

The carriage bolts that connect the cross-slide mechanism to the base have their heads recessed on top and nuts recessed below in order not to touch the lathe bed. With the lead screw centered on the lathe spindle, the cross-slide mechanism needs to be able to move toward the operator about 2" (50mm) to accommodate a 3" (76mm) box.

A wood spacer under the base fits snugly between the ways of my JET mini. Make sure the spacer orients the jig so the lead screw is parallel to the lathe bed, and then permanently fasten it with a couple of screws from below. The darker walnut stripe on the arbor just happened to help with alignment, as did some double-sided tape. I made a rectangular clamp block $\frac{3}{4} \times 1 \times 2\frac{1}{4}$ " (19 × 25 × 57mm) so it would drop between the lathe ways and could then be turned 90° to clamp the jig. This allows mounting the jig without having to slide it on from the end of the ways. I fit a $\frac{5}{16}$ " (7.6mm) carriage bolt to this clamping block, long enough to protrude up through the wooden spacer and jig base. A plastic knob with a washer tightens the jig in place on the lathe ways.

I also made a stop block to place against the front of the jig and clamp to the lathe ways (*Photo 6*). The stop allows me to slide the jig back out of the way when trial-fitting the threads and then realign it to the correct position. The stop uses an identical clamp block as the jig, but I used a wing nut because it takes less room than a plastic knob. When the jig was completed, I put on a couple of coats of polyurethane for protection.

The cutter

My rotary cutter is a 60° double-angle cutter made of high-speed steel (*Photo 7*). It has a cutting diameter of $\frac{3}{4}$ " on a $\frac{3}{8}$ " (9.5mm) shank. You can hold the

cutter in a drill chuck with a Morse taper to fit your lathe spindle. On my short-bed lathe, the drill chuck projected out too far and limited the size box I could turn. So I bought a $\frac{3}{8}$ " collet to hold it in the headstock. To keep the cutter from coming loose, make a draw bar of threaded rod to fit your collet (probably $\frac{3}{8}$ "-16) or drill chuck (typically $\frac{1}{4}$ "-20).

Sources for parts

Some of the parts are standard hardware items readily available from local hardware or home improvement stores. Others may need to be ordered from multiple vendors. Depending on the source you may have to buy $\frac{3}{4}$ " nuts in packs of 25, and more threaded rod than you need.

Vendors I've tried include Enco (use-enco.com), McMaster (mcmaster.com), Penn State Industries (pennstateind.com), and MSC (mscdirect.com). Penn State is the only source I found for the spindle adapters (part numbers LA1834 and LA341018). Enco, MSC Direct, and bestwoodtools.com all carry the 60° double-angle rotary cutter.

Consider getting together with a woodturning buddy to save costs on shipping and to minimize waste. It takes little more effort to make multiple jig parts. This might even be a fun group project for your chapter.

Using the jig

Detailed instruction on using a threading jig is outside the scope of this article, but here are a few tips:

- Calipers that measure in millimeters will be helpful.
- Make the tenon length equal to 3 or 4 threads and the recess equal to 5 or 6 threads.
- Make the tenon diameter equal to the inside diameter of the recess plus enough wood to form the mating thread:
For 16 tpi thread, I.D. + 2 mm (.079")
For 10 tpi thread, I.D. + 3 mm (.119") ▶



Wood shim

To take play out of the mechanism, turn the two setscrews against the maple shim that fits in the dovetail between the cross slide and its base.



Power drive

Speed the cross slide on its traverse with the aid of a nut driver on a power drill.



Stop block

The stop block clamped to the lathe ways, and the calibrated hand wheel on the cross slide, enable accurate repositioning after withdrawing the workpiece for trial fittings.



Rotary cutter

The head of this 60° rotary cutter, center right, is $\frac{3}{4}$ " in diameter with ten teeth, on a $\frac{3}{8}$ " shank. It can be driven via a Jacobs chuck in the headstock, top, or a collet chuck, bottom. With either chuck, use all-thread rod to make a retaining draw bar.



A place to begin

You can get the feel of cutting threads with this simple setup. Mount the lead screw in an inexpensive X-Y drill-press vise bolted onto a lathe platform. This approach is quick and easy if you already have a suitable vise; if you're buying a vise, make sure it is not too tall for your lathe. The disadvantages include coping with the slop built into cheap vises, the setup's inability to tighten wobbly backlash out of the lead screw, and the difficulty of test-fitting and resuming the cut where you left off. Mike Peace's shopmade jig resolves all of these problems.

- Starting with the cutter just grazing the wood, adjust the cross slide to set the required thread depth:
For 16 tpi, 0.035"
For 10 tpi, 0.056"
- Lathe speed 2500 to 3000 RPM to minimize chatter.
- Keep your left hand on the lathe chuck to reduce vibration, keep a light chuck from unwinding when cutting male threads, and retard

thread advance. This also keeps your left hand fixed, minimizing chances of getting it in the cutter!

- Advance the lead screw slowly.

You can find more details on making screw-top boxes in Bonnie Klein's article in the spring 1994 issue of *American Woodturner* (vol 9, no 1), and in Nick Cook's acorn box project (*AW*, vol 20, no 1). You can find these online in

the Members' area at woodturner.org. Fred Holder has written an entire book on the topic, *Making Screw Threads in Wood*, and there are useful discussions in *Turning Boxes with Richard Raffan* and *Woodturning Techniques* by Mike Darlow. ■

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More twists and turns

Some commercial jigs, like the Baxter jig shown here, achieve great accuracy by using nicely machined metal parts. Other jigs use a dedicated router motor to drive the cutter, typically in an off-lathe setup. These may have transverse adjustments on the router instead of on the lead screw. Commercial jigs typically cost \$350 and up; try eBay as well as these websites: bonnieklein.com, bestwoodtools.com, and ar-liberty.com.

At the other end of the technology spectrum, try hand-chasing, using very slow lathe speeds and a matched pair of tools. These toothed scrapers come in male/female pairs costing about \$75—you need a different pair for each pitch of thread—and 16 tpi is a good place to start. Choose a hard, dense, and tight-grained wood such as dogwood,

Osage orange, bradford pear, or mountain laurel. While it does take practice to build skill, many turners find that chasing threads by hand is very satisfying.

