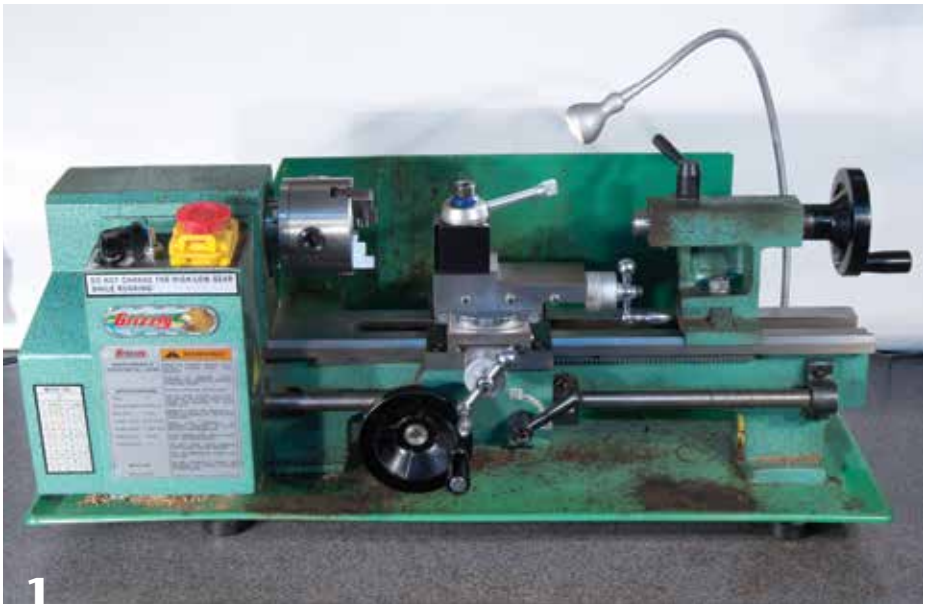
Mini METAL LATHE *for* WOOD

Bill Ooms



The Grizzly G8688 is a typical mini metal lathe.

A small metal lathe is useful to the woodturner for making precise cuts. It allows cylinders to be turned with flat outsides, insides, and tops. Snug-fitting lids on boxes are easily made to achieve a suction fit. With a bit more effort, threads can be cut with great precision. And, of course, you can make metal pieces for those special fixtures needed around the shop. A number of companies make mini metal lathes that sell for around $600.

Safety

A metal lathe is significantly different from a wood lathe. Be sure to read all of the safety information that comes with the machine. If you are uncomfortable with any aspect of working with a metal lathe, seek additional instruction. If you choose to use the equipment for cutting metal, be sure to get an instructional book or video on the proper techniques for safely turning metals. Always wear safety glasses. Do not remove any safety shields while running the equipment, and provide adequate lighting. ▸

Adjust the jibs on the dovetail slides with an Allen wrench and then gently tighten the locking nut.

A modification to the carriage saddle allows me to lock the carriage with a brass screw in a drilled and tapped hole.

A quick-change tool post with an assortment of tool holders and cutters.

The basic cutter is a ⅜" square HSS tool blank sharpened like a scraper on the end and one side.

Terms

The *carriage* is the assembly that moves along the bed of the lathe. It can be moved manually by rotating a handwheel, or it can move automatically at a constant speed by the lathe by engaging a *feed lever.* The direction can be set to move either to the right or to the left.

The *cross-slide* moves perpendicular to the bed of the lathe on a dovetail slide by means of a dial or crank.

The *compound-slide* is mounted on the cross-slide and moves in a direction that is typically along the axis of the lathe, but can be adjusted to some other angle. It moves on a dovetail slide by means of a dial or crank.

Gibs are narrow pieces of metal that fit between a dovetail and the adjusting screws of a slide.

The *tool post* is where the cutters are mounted. It is convenient to have a quick-change tool post to make it easy to switch from one tool to another.

Cut on the outside of a cylinder moving from right to left—note that the end of the tool is not scraping flat.

Cut on the end of a cylinder—note the tool is at a slight angle and the side is not scraping flat.

Cut-away view shows the use of a boring bar inside a cylinder moving from right to left.

Cut-away view shows the use of a boring bar on the bottom of a cylindrical hole.

Equipment

For a review of mini lathes, visit mini-lathe.com. Bookmark the website—it has a wealth of information on machines, accessories, and materials. My lathe is a Grizzly G8688, a 7 × 12, which means a 7" (18cm) swing and 12" (30cm) between centers *(Photo 1)*. There are shorter lathes, but the longer bed is important. I have had mine for seven years, so there may now be better options available.

Most metal mini lathes arrive packed in sticky red grease. Buy a gallon of kerosene, cheap paint-brushes, and plastic containers. Strip the lathe apart, clean everything (except the electronics, of course), and reassemble with good lubrication (like white lithium grease). This will also familiarize you with the machine. Be especially careful when taking apart the slides—note the orientation of the gib strips.

Adjustment

The slides on these inexpensive lathes must be adjusted regularly—if there is play in the slides, chattering will occur. Review your manual for instruction on adjusting the slides. The gibs, which are adjusted by setscrews and locked with locking nuts, must press snugly against the dovetail. Adjust by using an Allen wrench to keep the setscrew from turning while you gently tighten the locking nut *(Photo 2)*.

Adjust the compound-slide gib and the cross-slide gib so that there is a slight binding on the movement. Also, adjust the carriage for a snug fit along the bed of the lathe. On my lathe, there are adjustments on the underside in the front and the rear of the carriage. I remove the rear splashguard to get at the back, and remove the front apron to access the front. When I use the lathe a lot, I clean and adjust everything monthly. Don't rely on the angle indicator on the compound slide—use a square to make sure it is perpendicular to the cross slide; otherwise you may find your cuts are not square.

Slight modification

On my lathe, there was no lock to keep the carriage from moving left or right when I wanted it to stay in a fixed position while cutting. I made a modification by drilling a hole in the carriage saddle. I tapped the hole and inserted a brass screw with a lever added to it *(Photo 3)*. Allow sufficient clearance for the gib-adjusting screw. (Brass will not score the machined finished on the bed of the lathe.) To lock the carriage in place, I tighten the screw.

Accessories

There are several accessories you will want to add from the start. A good place to find them is at littlemachineshop.com (LMS).

- First, add a quick-change tool post, which makes it fast and easy to change cutters. A starter kit will have several tool holders to accommodate square cutters, round boring bars, and cut-off tools *(Photo 4)*.
- Buy a cut-off blade, which is like a parting tool (*Photo 4,* far right). The ones for metal work have a T-shaped cross-section with a slightly fatter portion at the top and narrower at the bottom. This greatly reduces friction when parting off pieces.
- A drill chuck that fits in the tailstock is useful. LMS Product # 1796 is a starter kit with a ½" 2MT to 33JT drill chuck, four short center drills, and five ⅜" (10mm) square HSS tool bits.
- Select boring bars to cut inside holes (*Photo 4,* far left). I have used the LMS Product # 1246 set for a number of years.
- A dial caliper is the best way to measure the inside and outside diameters of cylinders.

The dead center that may come with your lathe is not good for use with wood, but you will probably be able to use the live center from your wood lathe. Optional is a 1½"- (13mm-) diameter two-fluted end mill—it works well for drilling flat-bottomed holes. The ½" size gives enough clearance to insert a boring bar to enlarge the hole.

Mounting the work

The basic three-jaw chuck that probably came with your lathe has two sets of jaws—one for grasping the outside of the work and one for grasping the inside of a recess. I find it easiest to first rough turn the work on my regular lathe to make it round. Then it fits well in the three-jaw chuck. When changing jaws in the chuck, be sure to insert them in the numbered order. I scribed the numbers 1, 2, 3 on the perimeter of my chuck so that each jaw always goes back in the same position. A pencil mark on the wood allows for remounting in the same position.

Sharpening the tools

Most of the exterior cuts are made with ⅜" square HSS blanks, which are sharpened like scrapers *(Photo 5)*. In my experience, a negative-rake angle is not needed because the tool is held firmly in the tool holder, which prevents it from being drawn into the work. I sharpen my cutters to about 15 degrees from vertical on the end and about 5 degrees from vertical on one side. I make the angle between the side and the end (when viewed from the top) slightly less than 90 degrees—more on that later.

I have one tool sharpened on the end and left side for cutting in the left direction and another tool sharpened on the end and right side for cutting in the right direction. I grind the end of the cut-off tool back much like a regular parting tool. The boring bars are carbide tipped, so you won't have to sharpen them (although you can touch them up with a diamond stick).

Once a cutter is mounted in the quick-change tool holder, it is important to adjust the height. There is an adjusting nut that rests on the top of the tool post—adjust it so that the top of the cutter is right at dead center of the work. Then tighten the locking nut. Now you can swap tool holders and always be assured that the height of the tool is set correctly.

Basic cuts

In general, I keep the metal lathe set to the high rpm range, except when drilling. To cut the outside of a cylinder, you can move the carriage manually with the handwheel,▸

Make a clean and square cut on the end of the body of the box.

Make multiple cuts to reduce the outer diameter of the body of the box.

Drill out the bulk of the material with a Forstner drill bit.

Make multiple cuts with a boring bar to enlarge the inside of the cylinder to its final dimension.

Cut a tenon for the lid by taking multiple cuts to the final dimension.

Make a feature ring for the box by cutting a hole with the boring bar to match the size of the tenon on the box.

Part off the ring with the cut-off tool and catch the fragile ring with your finger.

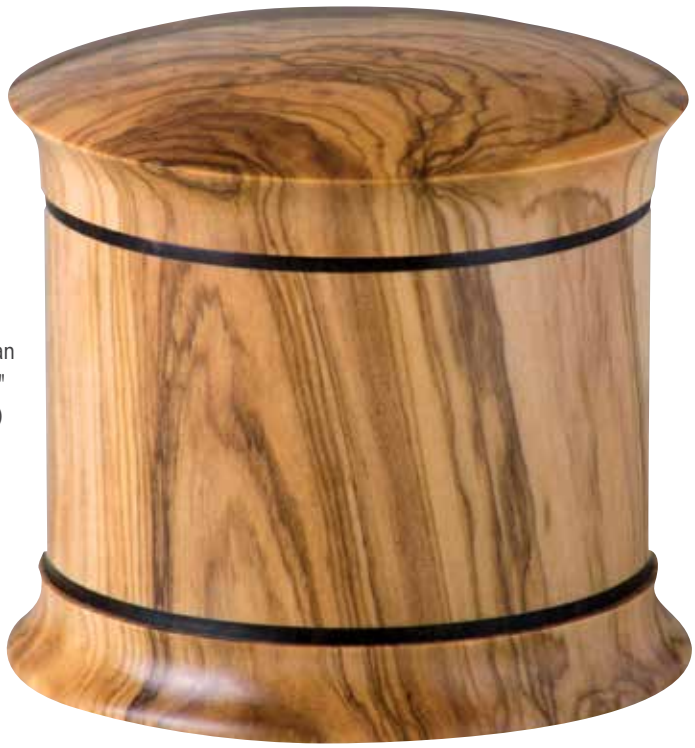
Glue the ring onto the tenon. When dry, clean up the surface to remove any glue.

or move it with the automatic feed feature by engaging the feed lever, or lock the carriage and use the crank on the compound-slide. There is a lever that sets the direction of the automatic feed (on the back side of my lathe). Just be sure to disengage the feed lever before your cutter crashes into the chuck!

I generally make cuts of about 0.020" (0.5mm) per pass and then make a final cut of 0.005" (0.1mm) or less for a smooth finish. The cutter should be positioned in a way that you cut with the very corner of the tool *(Photo 6). Do not scrape with the entire face of the tool!*

Loosening the mounting bolt of the quick-change post easily rotates the angle of the tool. Keep in mind that if you move the cutter in by some amount, the diameter of the work piece is reduced by two-times this amount.

To cut the end of a cylinder, lock the carriage in place and move the cutter into the work with the cross-slide crank (*Photo 7*). After backing the tool away from the work, move it laterally with the compound slide crank for another pass as needed. Again, don't scrape with the entire edge of the tool. Loosen the quick-change mounting bolt to rotate the cutter properly. The cutter's less-than-90-degree angle between the edge and the end allows me to set the angle of the tool just one time and use it both for cutting the edge of the cylinder and for facing off the end of the cylinder.



Box, 2012, African olive, 2¼" × 2¼" (57mm × 57mm)

To quickly get the majority of the material from inside a cylinder, use a Forstner bit with the drill chuck mounted in the tailstock. I prefer Colt Maxi-Cut bits because they don't overheat, even in the hardest woods. Drill out the inside of the cylinder to about ⅛" (3mm) smaller than the desired inside diameter. Then use a boring bar to do the final sizing of the interior (*Photo 8*). I find that for rough cuts, it works best to move left into the work using the handwheel, and then make a final cut (a few thousandths of an inch) going toward the right, coming out of the interior of the work using the lathe's automatic feed.

If you want a flat bottom inside the cylinder, use the boring bar to clean up the dimple left by the

Forstner bit (*Photo 9, highlighted in red*). You will not be able to take big cuts because the boring bars are nearly flat on the end. Lock the carriage and start with the corner of the cutter at the very center, advance the cutter to the left about 0.010" (0.3mm), then move the cutter outward with the cross-slide crank.

Parting cuts are easily made with the cut-off blade. Simply lock the carriage and advance the cutter into the work with the blade perpendicular to the surface. As with any parting operation, deeper cuts should be made with multiple cuts to widen the gap and prevent friction and binding.

Threads can also be cut using a rotating 60-degree angle cutter (as used with the Bonnie Klein jig). Threading is a separate topic, beyond the scope of this article.

Make a simple box

I started with a piece of African olive and rough turned it to a cylinder 2.25" (57mm) diameter and 3" (76mm) long. Unlike other olives, African olive is a stable wood. I marked the cylinder to allocate about ½" (13mm) for the base, 1.5" (38mm) for the center cylinder, and about ½" for the top and parted off the top for later use.

In the metal lathe, square off the bottom end of the cylinder, then flip it around and square off the top (*Photo 10*). Turn the outside of the cylinder to 2" (51mm) diameter by taking several cuts from right to left up to the pencil lines marking the cut-off point (*Photo 11*). I usually take about 0.020" (0.5mm) per pass moving the carriage with the handwheel, then the final 0.005" (0.1mm) with the automatic feed going from left to right for a clean final cut.

At a low rpm, drill a 1½" (38mm) hole with a Forstner bit going 1.5" deep. If the quill on your lathe does not have measuring marks to determine the depth, then count rotations of the crank—mine is 17 turns per inch (1.5mm pitch) so 25½ turns will get me to the proper depth (*Photo 12*).

Bore out the interior so that the wall thickness is 0.2 (5mm) (*Photo 13*). I usually take about 0.020" per pass moving the carriage to the left with the handwheel, and then the final 0.005" with the automatic feed going to the right for a clean final cut.

The dimensions of the tenon for the lid can be controlled precisely on a metal lathe. Touch the cutter to the end of the cylinder, lock the carriage, and set the dial on the compound-slide to zero. Then, touch the cutter to the outside of the cylinder and set the dial on the cross-slide to zero. Now you can read the dials to know how far you have moved the cutter and can control the tenon precisely. Cut the tenon to 0.100" deep. My lathe has a movement of 0.040" (1mm) per rotation, so that is two full rotations plus an additional 0.020" on the dial. Usually, I take a cut about 0.080" (2mm) wide (two turns on my compound slide). Make the width of the tenon 0.300" (7.6mm). The last time you cut into the work, keep the cutter at the final depth and move the cutter to the right with the crank on the compound-slide to make a final clean cut that should leave the diameter at 1.800" (45.7mm) *(Photo 14)*.

Feature rings

For the two feature rings, rough turn a piece of African blackwood to a bit over 2" (51mm) diameter on your wood lathe. Then in the metal lathe, square off the end and drill a ½"-(13mm-) diameter hole ¼" (6mm) deep. I prefer to use a two-fluted end mill as it gives a flat-bottomed hole. ▸

Part off the cylinder with the cut-off tool.

After making a tenon on the base and adding another feature ring, turn the outer diameter of the ring to match that of the box.

Make a recess in the lid with a two-fluted end mill.

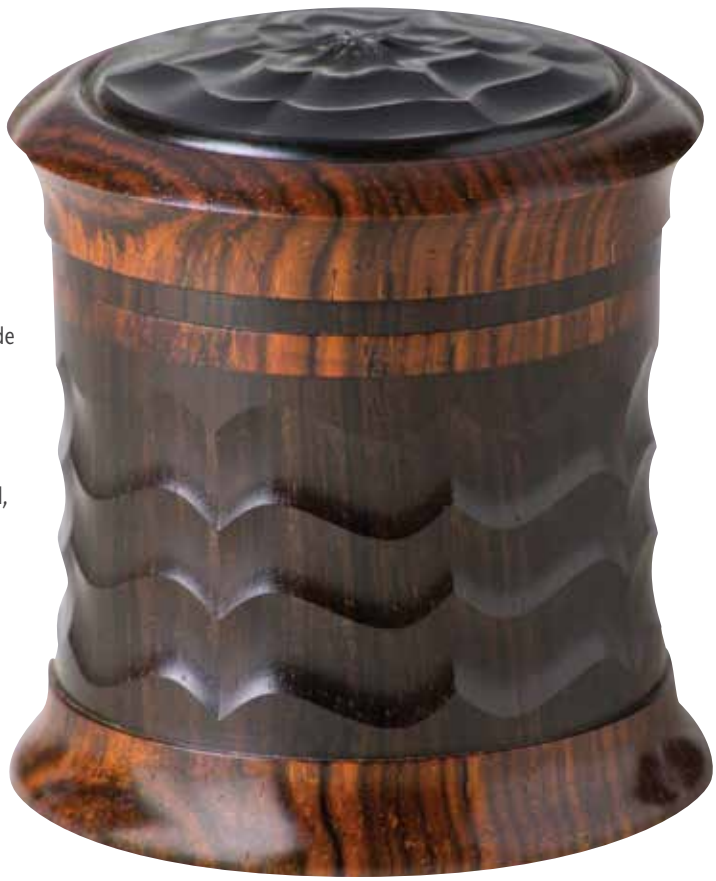
Enlarge the recess in the lid with a boring bar to provide a snug fit on the tenon on the body of the box.

On your regular lathe, turn a profile on the base of the box.

Turn a profile on the lid of the box while the lid is held in place securely with the tailstock.

Turn the top surface of the lid.

Final turn the bottom of the box.



This is a more ornate example of a box made on the metal lathe, then decorated on a rose engine (inspired by a Steven Kennard box) 2011, Blackwood, cocobolo, 2¼" × 2" (57mm × 51mm)

With a boring bar, touch the end of the cutter to the end of the cylinder, lock the carriage, and set the compound-slide dial to zero. Insert the end of the boring bar into the hole by 0.080" and cut outward using the crank on the cross-slide (*Photo 15*). The final size of the hole should be 1.805" (1.8mm), which is 0.005" larger than the tenon you previously cut. As you get close to the final dimension, stop and check the size with a dial caliper.

Gently part off the ring to a width of 0.050" (1.3mm). The best way to measure is to line up the right side of the cut-off tool with the right side of the wood, lock the carriage, and set the compound-slide dial to zero. Now crank the compound-slide over by 0.050". Note: I use my finger to catch the fragile ring (*Photo 16).*

Glue the ring onto the tenon of the box with the parted side up using regular polyvinyl acetate (PVA) glue. When it has dried, remount the work into the chuck, using the pencil mark to align it to the same jaw. You can now clean up the top edge of the ring and any glue squeeze-out (*Photo 17*). Gently cut the outer diameter of the ring to match the outside diameter of the cylinder by taking small cuts from right to left.

Sand and part off the cylinder

This is a good time to sand the inside of the cylinder.

Then, to part off the cylinder, first measure the actual depth of the bottom of the cylinder. Part off just a bit less than that dimension—you want the cut-off tool to cleanly cut through the cylinder (*Photo 18*) and catch the cylinder with your finger. To get the bottom of the cylinder perfectly flat, gently sand on a piece of 150-grit abrasive placed on a flat surface.

Clean up the top surface of the base piece that is left in the chuck. Cut it back enough to remove the dimple left by the Forstner bit and then sand that surface. Cut a tenon in the base to match the inside diameter of the cylinder, which should be 1.600" [41mm]. Make the width of the tenon 0.150" (3.8mm) and cut another blackwood ring as before. Glue the ring and cylinder onto the base, being careful to align the grain of the wood. When dry, carefully trim the outer diameter of the ring to match the outer diameter of the cylinder (*Photo 19*). This is a good time to sand the outside of the cylinder.

Lid

Mount the lid piece that was set aside earlier and clean up the inside surface. With the ½" end mill, drill a hole 0.270" (6.9mm) deep to allow a bit of clearance for the tenon on the box, which should be 0.250" (6.4mm) (*Photo 20*). With a boring bar, enlarge the hole by advancing into it about 0.080" each time and cranking out with the cross-slide until you are close to the desired dimension of about 1.800" (*Photo 21*). Approach the final dimension carefully to achieve a snug fit between the lid and the box. Generally, I take one thousandth of an inch (0.001) on a pass, bevel the corner a bit with abrasive, and then check the fit. When the desired fit is achieved, sand the inside of the lid.

Remount to a wood lathe

The rest of the work can be done on a regular lathe. I mount the box with expanding jaws inside the box. Covering the jaws with blue masking tape to protect the wood, trim the base to the desired size, and turn a recess in the base. You could also make a jamb chuck to do the same. Now I can hold the box with expanding jaws in the recess and turn a pleasing shape on the bottom (*Photo 22*). Sand.

With the lid held on the box securely with the tailstock, I turn a matching curve on the lid (*Photo 23*). For turning the remainder of the lid, I mount it in expanding jaws covered with a bit of blue masking tape and create a gentle dome shape (*Photo 24*). Sand.

To cut away the recess from the bottom of the box, I mount the box in expanding jaws covered with a bit of blue masking tape (*Photo 25*). Note: you want the top of the box to set flat on the jaws of the chuck. My jaws have a bit of a fillet so I use a space of scrap wood to permit the top of the box to seat flat without interference from the fillets.

Finish as desired.

The simple box was intended to teach the various techniques using a metal lathe for wood. Once you master these basic skills, you will be surprised how often you will use the metal lathe to make precise cuts on many of your other projects. Admittedly, the same box could have been made with plain turning, however, in my next article, I will discuss how to make multiple thin layers on the outside of a similar box. The thin layers can only be created with the precision of a metal lathe. ■

Bill is a second-generation woodturner and learned basic woodworking from his father. As a young man, his desire was to envision and create new things, which led to a career in engineering. In retirement, he has returned to his roots as a full-time woodworker. Recently, he has been working with rose-engines and ornamental turning, which combine his woodturning skills with his math and engineering background. More of Bill's work can be seen at billooms.com and a profile of him appeared in Woodturning *magazine, November 2012, no 246.*

Upcoming in April!

Layered Box, 2012, thin layers of African blackwood and bloodwood over a core of coffeewood burl with pink ivory on the lid, 3" × 2" (76mm × 51mm)

In the next issue of *American Woodturner,* Bill will extend these techniques and describe how to use the metal lathe to create a box with multiple thin layers on the outside. Cutting through the layers with an ornamental lathe will create unique patterns as the layers are exposed through the cuts.