How to Build a Coffee Roasting Machine

By Jon Stika

Build and operate your own roaster for full control over the color and flavor of the beans in your brew.

Until the early 20th century, roasting coffee, like baking bread, was one of many common weekly household tasks folks did themselves. Much of the coffee was roasted in an open pan on top of a hot stove. The green coffee beans would be stirred as they popped and crackled, until they reached the desired degree of color and flavor. Later, as the nation recovered from the Great Depression, roasted coffee became more readily available, and home coffee roasting quickly faded away. But now, roasting coffee at home has been making a comeback as people strive to become more self-reliant and learn to appreciate a truly fresh cup of joe.

As in years past, home coffee roasting can be as simple as stirring beans in a pan over a heat source. However, roasting a batch of coffee beans still takes time. Manually keeping beans in constant motion for 15 to 20 minutes can be a bit tedious, and the process can generate enough smoke to set off smoke alarms.

In the years I've roasted coffee beans at home, I've gone through a progression of roasting devices with varying degrees of success. I began with a hot-air popper, which did a good job of roasting the beans but couldn't handle extended use at high temperatures, and various electronic components would burn out and need to be replaced with regularity. Hot-air poppers also limit the amount of coffee that can be roasted at one time, so I needed to roast beans multiple times a week.

My next coffee roaster was a repurposed popcorn popper of the stovetop variety. It was a simple machine that I could heat with an electric or gas burner. It was reliable, and could handle up to a pound of beans at a time. The main drawback to this roaster was that I had to turn the crank that stirred the beans in the bottom of the pot for the time it took the beans to roast. Sometimes, turning the crank by hand seemed to take an eternity, so I developed a motor-driven coffee-roasting machine that would do the tedious part of the procedure for me! This liberated me so I only had to monitor the progress of the roast until the beans were ready to be dumped into a colander to cool.

To assemble this machine, I only needed to design a motor to turn the handle, since I already had an electric burner and the repurposed popper pot. Fortunately, I found a geared motor that turned at an

appropriate speed (45 rpm), with a pulley radius that matched the radius of the popper's handle rotation. This was perhaps the most critical component of my coffee-roasting contrivance, and it was available from American Science and Surplus.

The essence of this whole project was to line up the center of the pulley shaft with the center of the popper shaft so the two would rotate together as one. Here's how I did it.

Tools and Materials

- Wood saw
- Chisel
- Hammer
- Screwdrivers
- Drill and bits
- Hole saw or coping saw
- Rat tail file, rounded wood rasp, or sandpaper
- Wire-stripping pliers or knife
- 2-1/2-inch deck screws or other wood screws
- #10-32 by 2-inch machine screws
- #6 or #8 pan-head screws
- Great Northern popcorn popper pot
- Cusimax 1,500-watt electric hot plate
- 45-rpm geared 24-volt DC motor and pulley
- 24-volt DC power supply
- 2×4 lumber (2x8s, 1x8s, plywood, or wood shelving material can make things easier)
- Toggle clamp

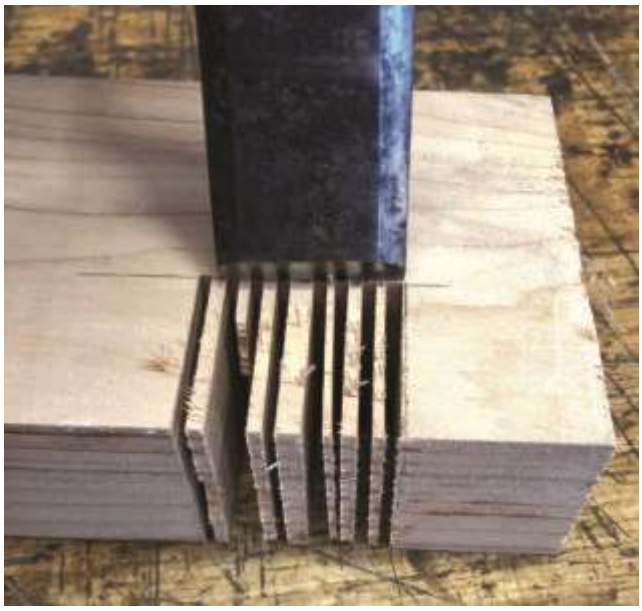
Build the Coffee Roaster Base

Assemble all the necessary lumber and parts for the roaster.

Cut a piece of wood to 7 inches wide by 21 inches long for the base of the unit. A piece of 2×8, 1×8, plywood, shelving, or two 2x4s laid side by side with the edges glued together could all serve as the base.

Step 1

Cut two pieces of 2×4 to 13 inches long for the motor support and pot handle support, and three pieces of 2×4 to 7 inches long for the other blocks (see Photo 1).



Step 2 Chiseling the notch.

Make a series of 1-1/4-inch-deep cuts between 10-1/2 and 11-7/8 inches from the bottom end of one of the 13-inch pieces of 2×4 to create a notch for the pot handle. Use a chisel and hammer to clear any remaining wood from the notch (see Photo 2).

Step 3 Smooth the bored hole.

Using a hole saw, bore a 1-1/2-inch-diameter hole centered on the wide side of the other 13-inch-long 2×4, with the center of the hole 9-7/16-inches from the bottom of the 2×4. Or, instead of using a hole saw, you can drill a hole and then insert the blade of a coping saw or jigsaw to cut out the rest of the hole. Use a rat tail file, rounded wood rasp, or sandpaper to smooth the inside of the hole (see Photo 3). This hole is for the motor. You'll also need to counterbore a shallow (approximately 1/4-inch-deep) hole that doesn't go completely through the piece of wood; use a 3/4-inch-diameter drill bit centered 1 inch above the top edge of the hole you drilled for the motor (see Photo 4). This counterbore will allow some space for the gearbox shaft to sit in so the whole gearbox will sit flat to the 2×4 (see Photo 11).

Step 4 Recess Gearbox shaft.

Now, you'll need to drill four 3/16-inch-diameter holes for each of the #10-32 machine screws that you'll use to fasten the gearbox to the 2×4. Each pair of holes needs to be centered on the 2×4. Drill the

holes 2-3/8-inches apart from side to side, and 2-1/2-inches apart up and down, surrounding the 1-1/2-inch hole for the motor. The lower pair of holes should be 9-3/8 inches from the bottom of the 2×4. The upper pair of holes should be 11-7/8 inches from the bottom of the 2×4.

Step 5

If you have shorter #10-32 machine screws, you can counterbore the holes for them through the 2×4 with a 3/8-inch-diameter drill to allow the heads of the machine screws to fit below the surface of the 2×4 (see Photo 5). Drill the counterbores only as deep as necessary to allow 1/2 inch of the screws to protrude from the 2×4. Marking your drill with a marker or tape will help you gauge the depth of the counterbore (see Photo 6).

Step 6 Counterbore Mark

After you've cut and drilled all the 2x4s, sand them to remove burrs, splinters, or roughness.

Align one of the 7-inch-long pieces of 2×4 on edge across the bottom board to leave 11-1/2 inches of space for the electric burner to sit on the base. Mark the position of the 2×4 on the base, and then fasten the 2×4 from the underside of the base with two 2-1/2-inch-long deck screws. Pre-drill 1/8-inch-diameter or 7/64-inch-diameter holes for each screw to prevent the wood from splitting. You can also use a countersink bit to create a tapered opening to each hole to prevent splitting and ensure that each screw will penetrate the wood to its full length. It's also helpful to clamp the pieces, or to have a helper hold them in place, prior to driving the screws.

Align the 13-inch notched 2×4 against the back side of the 2×4 that's fastened to the base, with the notch on top and facing toward you, and the bottom of the 2×4 squarely against the base. The edge with the notch at the top should be 3 inches from the edge of the base.

The back edge (opposite the notched edge) should be 1/2 inch away from the edge of the base. Secure this piece from the underside of the base with two 2-1/2-inch deck screws (see Photo 1).

Step 7 Test fit set up.

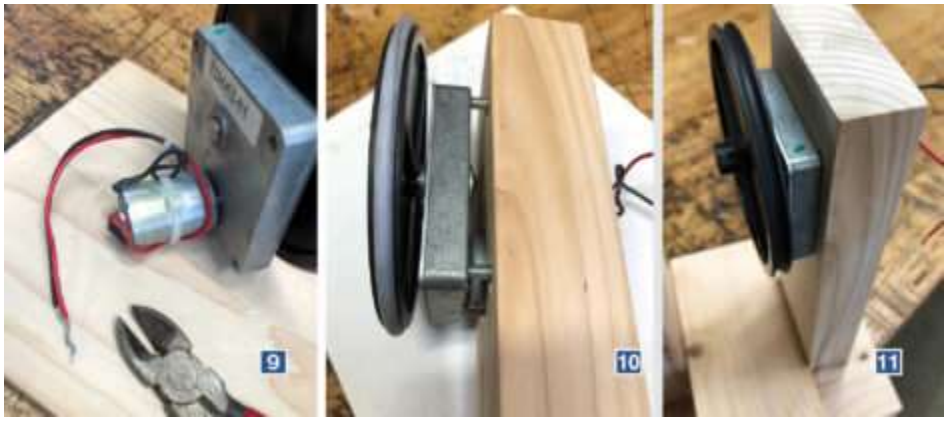
Place the electric burner on the base against the first 2×4 that was fastened to the base, and center it on the base. Place the pot on the electric burner so it’s centered side to side and the handle edge aligns with the edge of the burner. The handle of the pot should fit easily into the notch of the 2×4 without binding or tipping the pot (see Photo 7).

Step 8 Clamp block in place.

Screw the two remaining 7-inch-long pieces of 2×4 together flatwise to form a block that's 3 inches tall by 3-1/2 inches wide. Place the assemblage screws facing down (to hide them), snug against the notched upright 2×4, and flush with each side of the bottom board. Clamp the block in place, and then secure it to the base from underneath with two 2-1/2-inch deck screws (see Photo 8).

The last piece to attach to the base is the 2×4 with the holes and counterbores. This 2×4 should be centered side to side on the base, with the side that has the shallow counterbore facing the end of the base where the burner will sit. Secure the 2×4 from underneath the base with two 2-1/2 inch deck screws driven through pre-drilled and countersunk holes.

Assemble the Coffee Roaster



Steps 9-11

Carefully snip the plastic zip ties that secure the wires to the motor and the wires to each other (see Photo 9). This will free the wires on the motor and gearbox so the motor can be inserted into the 1-1/2-inch hole, and the gearbox shaft can sit in the 3/4-inch counterbore. Insert four #10-32 machine screws in the holes in the 2×4, and carefully start the screws into the threaded holes on the gearbox by turning them a few clockwise rotations (see Photo 10). Once all four screws are properly started into the gearbox holes, tighten all the screws evenly so the gearbox is flat and snug against the 2×4 (see Photo 11).

Step 12 Adjust popper crank.

Pry the cap nut off the end of the handle of the popper, and remove the wooden knob to expose the end of the crank (see Photo 12). With the burner on the wooden base and the pot on the burner, move the popper's handle into the notch in the 2×4. The center of the popper shaft that passes through the popper's wooden handle should now align with the center of the pulley shaft. Carefully rotate the handle to see that the end of the popper crank matches the outside rim of the pulley evenly from side to side and top to bottom. If the rotation of the popper handle matches up pretty well with the pulley, you can proceed to mount the toggle clamp that will hold the popper handle securely in the notch. If the rotation of the popper handle doesn't line up reasonably well with the pulley, you may have to adjust the position or length of one or both upright 2x4s to achieve better alignment.

Step 13 Cut notch in pulley and sit popper crank inside.

Once everything is aligned so the popper handle and pulley are well-synchronized, pick a spot on the pulley that's between reinforcement ribs, and carefully cut a notch in the pulley to receive the end of the popper crank (see Photo 13). A hacksaw works well to make the initial notch by cutting down to the point where the end of the handle will slide into the pulley without binding. Make two outside cuts with the hacksaw, and then another in between. Then, using a thin coping saw blade, drill, or utility knife, carefully remove the plastic from the notch and smooth the notch with a rat tail file or a piece of sandpaper. Be cautious when making the notch to avoid damaging the pulley or injuring yourself.

Once you've formed the notch, position the popper on the hot plate again, put the popper handle in the notched 2×4, and slide the popper toward the pulley until the end of the crank is flush with the backside of the pulley notch. You don't want the end of the handle to extend beyond the back side of the pulley, as it could hit the gearbox

and cause problems. Rotate the pulley manually to ensure that the crank follows the rotation of the pulley without causing the popper pot to move around on the hot plate. You can adjust the depth of the notch with a rat tail file or sandpaper if necessary to allow the end of the popper handle to rotate without binding or shifting the pot.

Step 14 Install toggle clamp.

Next, install the toggle clamp on the notched 2×4, just below the notch, and adjust the nuts on the rubber-ended bolt so the clamp secures the popper pot handle in the notch (see Photo 14). It’s best to pre-drill the holes for the #6 or #8 pan-head screws before turning them into the wood to avoid splitting. A finish nail with the head removed works well for a drill bit if you don’t have a small standard drill bit to drill these pilot holes.

Step 15 Connect the power supply.

Cut the plastic Molex connector off the end of the wires on the motor, and strip the insulation from about 3/16 inch of the ends of the motor wires (see Photo 9). Loosen, but don't remove, the screws on the DC female connector that came with the power supply. Slip the stripped end of the black wire from the motor into the slot marked "+" and the end of the red wire into the slot marked "-" on the DC connector, and retighten the screws. Then, fit the barrel end of the power supply lead into the DC connector. Secure the power supply body and its wires to the 2×4 with staples, tape, double-sided adhesive strips, or zip ties to prevent them from catching on something or being pulled apart or off the roaster structure (see Photo 15).

The supply of power to the motor can be turned on and off by simply plugging or unplugging the end into a standard 120-volt outlet, but I found it more convenient to install an inline lamp cord switch as a control. With the power cable unplugged, carefully remove the outer

sheath from a small section of the power cable without cutting into the wires underneath, and then snip the black wire and strip the ends to expose about 1/2 inch of bare wire. Wrap one of the ends of stripped wire clockwise around one of the brass screws in the switch, and the other stripped wire end around the other brass screw in a similar fashion. Secure the wires under the screws by tightening the screws. Then, fit the switch cover over the wires so it closes completely without damaging the wires or cable insulation, and screw it back together.

Plug in the power supply and test the switch. You may see a short delay from the time the switch is flipped to when the motor starts. Set the electric burner on the roaster base, place the popper on the burner, and secure the handle in the notch with the toggle clamp so the end of the popper handle fits in the pulley notch. Switch on the motor to test that it turns the popper handle smoothly while the popper is sitting flat on the burner. If all is well, you'll have successfully completed your coffee-roasting machine!

How to Operate the Roaster

Operate the roaster in a well-ventilated garage or on a deck or balcony, as the roasting process can produce smoke. Don't leave the roaster unattended when in operation! Assemble the machine, plug the hot plate and motor power supply into an outlet, and preheat the pot for a few minutes with the burner set to 4 or 5. Start the motor, pour the unroasted beans into the pot through the hinged half-lid opening, and close the lid.

Learn how to roast to your desired style by observing the sound, aroma, and color of roasting beans.

Allow the beans to roast until they achieve your preferred degree of color and flavor (typically 10 to 20 minutes). Some experimentation and observation of the sound, aroma, and color of the beans will teach you how to roast to your desired style. When the beans are sufficiently roasted, switch off the burner and motor, and wait for the motor to stop. Then, release the clamp on the pot handle, remove the pot from the burner, open one side of the lid, and dump the beans into a metal colander or pan to cool. Gently stirring the beans in the colander or pan will help cool them down quickly so they don't continue to roast.

Store the cooled beans at room temperature. Never freeze roasted coffee, or it will irreversibly lose its flavor and aroma. Once you roast your own coffee and enjoy how fresh it tastes and smells, you may never buy roasted coffee at the store again!