Shopbuilt Thickness Sander

A low-cost alternative to handplaning

by S.R. Cook

Having earned my living from one form of woodworking or another for the last 15 years, I feel qualified to talk about ways of making sawdust. I began as an apprentice pipe organ and harpsichord maker, moved on to furniture, folk instruments, and cabinets, and, during the lean times, turned to plain old nail swatting. My style of woodwork, whether for cabinets or furniture, leans heavily toward frame-and-panel construction, using ¼-in.-thick solid wood panels rather than plywood. In the old days, I cut mortise-and-tenon joints for frames and handplaned each panel to its final thickness. Three kids and no savings account later, however, I began doweling all my cabinet joints and traded my meditative stints with handplanes for ear plugs, dust mask and belt sander. As I spent more and more time hanging on to that digging-in, corner-dipping belt sander, I yearned for a better way to surface wood. This yearning became a necessity when I fell for a $300 bargain and ended up with 1,500 bd. ft. of rough-sawn birch from a local mill. After doing a little research on surfacing machines, I concluded that a power-feed drum sander was what I needed. The price was a bit of a snag, so I decided to build my own sander. My design was inspired by the planers offered as kits and plans by Kuster Woodworkers, P.O. Box 34, Skillman, N.J. 08558 (see box). A machinist friend and I modified the original idea to suit my needs and budget, and produced the machine shown on the facing page. It can sand panels up to 24 in. wide, down to 180 grit. With 36-grit abrasive, I can quickly dress a whole batch of rough lumber to a consistent thickness, then switch to finer grits and bring the lot to a smooth finish—all at a cost of $150 for parts and 50 hours assembly time.

My sander consists of three basic mechanical units: the sanding drum, the feed roller/speed reduction mechanism, and an extremely accurate table-height adjustment mechanism based on bicycle chains and sprockets. These parts are supported by a wooden box-like frame: the upper part of the box holds the drum and feed rollers, the lower helps support the table-height adjustment mechanism. Four sturdily braced legs attached to the box complete the machine.

The box must be strong and stable; I originally used 2-in. birch lumber, as shown, but later replaced this with 5½-in. by 24-in. sides made of two sheets of ¾-in. Baltic birch plywood, laminated face to face. Lay out the sides carefully, making sure both sides are square and mirror images of each other. Inaccuracies now will mean alignment problems later. After cutting the box pieces to size, glue the hardwood crosspieces and vertical supports to the side pieces. Reinforce the rabbet joints with long sheetrock screws, but don't add the screws until you've installed all the hardware, to make sure that the screws won't interfere with any mountings. For added rigidity, you might want to add a ¼-in. plywood bottom to the box. A 1-in.-square batten, glued and screwed to each end, accommodates the ends of the threaded adjustment rods.

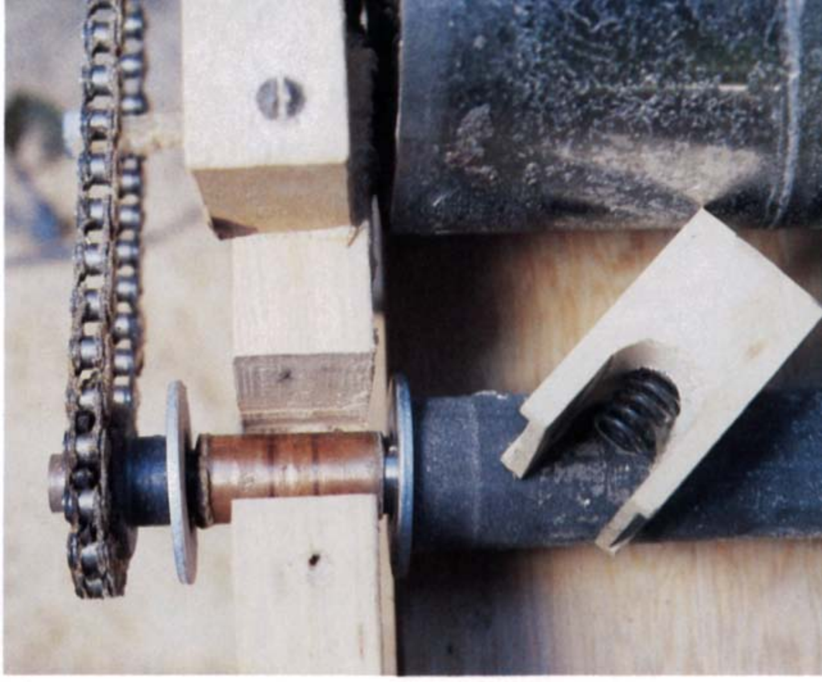
When the box was completed, I added four legs long enough to raise the plywood sander table 34 in. off the floor. After using the sander, I decided it would be better to set the table at 30 in. to 32 in., about the height of my hands when they hang by my sides, to make it easier to lift the stock and feed it into the sander.

The table mechanism consists of four ½-in. threaded rods, one in each corner of the frame, as shown in the drawing. I had a machinist turn both ends of each rod down to a straight 5⁄16-in. shaft, so the end resembled the tenon and shoulder on a chair rung. The lower end of each rod sits in a 5⁄16-in. hole drilled in the corner of the frame's 1-in. by 1-in. lip, as shown on the facing page, far right, and its shoulders bear on a large washer embedded in the lip. The washer prevents the rod from wearing through the wood. The top end of each rod fits in an upper angle-iron support screwed to the frame.

Between the upper and lower supports, each pair of rods is threaded through a 28-in.-long piece of 1¼-in. angle iron, which is, in turn, screwed to a 1½-in.-thick laminated plywood table. The four sprockets bolted to the threaded rods are connected together with a taut length of roller chain (bicycle parts work well and are readily available). When you turn the adjustment wheel welded to the top of one of the front rods, all the threaded rods turn simultaneously, and the threading action raises or lowers the plywood table, giving you the ability to set the sander's depth of cut. I got my wheel from a scrapped tablesaw, but you could make one by brazing a metal handle to a steel disc.

To make the mechanism, bore a hole through the angle iron and weld a ½-in. nut over the hole. Then, thread a sprocket welded to a nut, a free nut, and one end of the 28-in. angle iron onto each rod. The free nut is used to lock the sprocket to the threaded rod. Don't install the chain until after the drum is aligned.

I made the sanding drum from a 24-in. length of 6-in. steel pipe. A machinist cut a lip inside the pipe to accept 5¾-in.-dia. discs cut from ¼-in. steel plate, and welded them in. Next, I bored a ¾-in. hole through the center of each end and ran a 32-in. by ¾-in. shaft down the length of the drum through the end caps, offsetting the shaft so it's longer on the drive-pulley side. After welding the shaft to the end caps, we chucked the entire assembly in a metalworking lathe and turned it true. The drum will probably still be out of balance and spin roughly. To check the balance, I slid the ball bearings onto the shaft, set the drum in the sander frame and spun it several times. If the drum always stops with the same side down, you know it's out of balance and the down side is



Steve Cook's shop-built abrasive sander, left, can flatten and thickness 24-in.-wide panels with 36-grit paper, then, with progressively finer grits, bring the whole batch to a smooth finish. Cook built the unit using bicycle parts, pipe, wood and commercially available rollers for about $150 and 50 hours assembly time. To mount the feed rollers, he slipped a copper pipe bushing over each shaft, added washers as shims to keep the roller from sliding back and forth, then secured the assembly with the spring-loaded wooden cap screws shown above. The sander table is adjusted by means of four threaded rods, right, running through nuts welded to an angle-iron frame. The bicycle chain connecting the sprockets on the rods makes it possible to raise or lower all four corners of the table simultaneously.

the heavier side. I corrected the imbalance by drilling shallow ¼-in. holes straight into the heavy side. Remove a little metal each time, and don't go all the way through the drum wall. I made about 50 holes before the heavier side seemed to disappear and the drum began to spin smoothly. Also, have the machinist mill a 2-in. start groove through one end of the drum to anchor sandpaper strips.

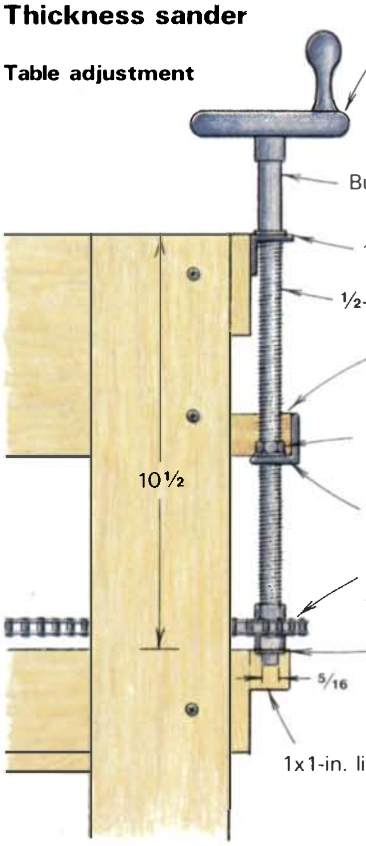
Next, install the bearings and wooden pillow blocks to hold the drum. I used caged automotive ball bearings with an inside diameter that fit over the ¾-in. shaft and a 2-in. outside diameter to fit the pillow blocks. On the drive side, bearings with double ball rows were used to accommodate side thrust. Slide the bearings over the ends of the drum shaft and position the shaft's long end on the drive-belt side. Place the bearing and shaft in the V-notches cut in the frame sides, place the notched caps over the bearings and bolt them down tightly. The pressure of the V-blocks is the only thing holding the bearings in place. To prevent the drum from moving left to right, I shimmed the space between the end of the drum and the sander frame with several large washers. The pulley or sprocket on each end of the shaft outside the frame secures those ends.

After installing the drum, I used the threaded rods to align the table parallel with the drum. Adjust the front side of the sander first. Turn the threaded rods individually to bring the table close to the drum. Then, using a long piece of ⅟₁₆-in. stock like a feeler gauge between the table and drum, twist one or both of the threaded rods until the wood gauge fits snugly along the whole length of the drum. Lock the sprocket in place by tightening the free nut against it. Remove the wooden gauge without moving the threaded rods, and repeat the adjustment process for the back side of the sander. Your table and drum should now be perfectly aligned. To make sure you don't lose this accurate adjustment, install the bicycle chain as tightly as possible. There shouldn't be any play in the chain or between the sprockets. The lengths sold by hardware stores and bicycle shops come with two master links, which are a snap to use for joining lengths of chain together.

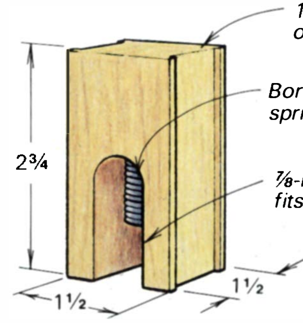
Since the feed rollers are the most expensive parts of the sander, I tried to come up with a way of making them in the shop, but I've found no substitute for the commercially available models featuring a steel shaft bonded with a thick cushion of rubber. I ended up investing $76 for two rollers from Kuster Woodworkers. The rollers must be mounted keeping three things in mind: they turn at around 50 RPM, they have up and down movement of nearly ¼ in. (they should hang ⅛ in. to ³⁄₁₆ in. lower than the bottom of the drum for positive contact with the wood), and they must be fitted with stiff 1-in.-long, ½-in.-dia. coil springs to keep steady pressure on the wood being sanded. Each spring in the bushing blocks should exert about 20 lb. to 25 lb. of pressure. I used a short length of copper tubing as a bushing on either end of the roller, as shown above. The spring bears against the tube, which slides in the vertical 1½-in.-square notches cut in the frame sides. Pack each

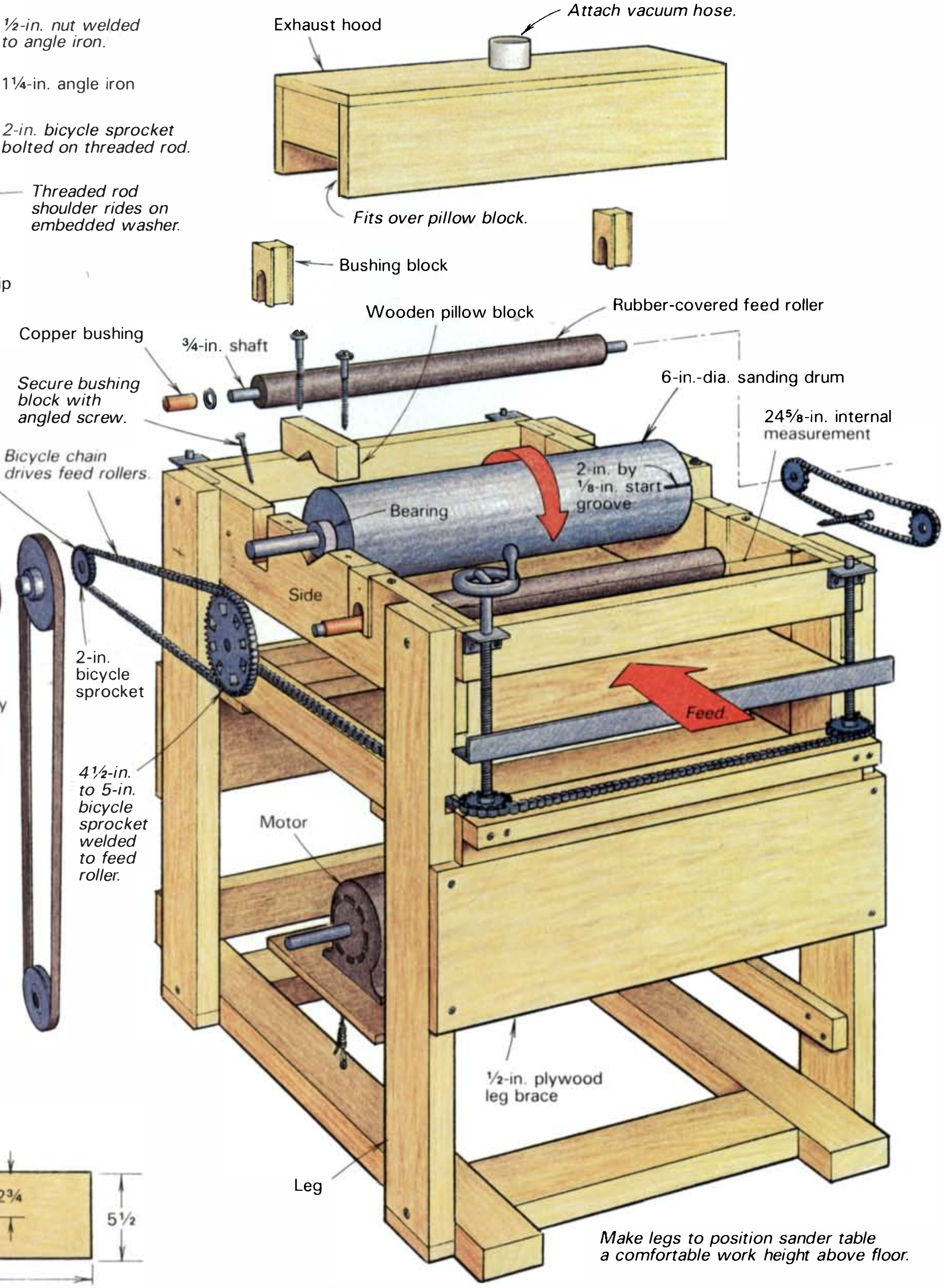
Thickness sander

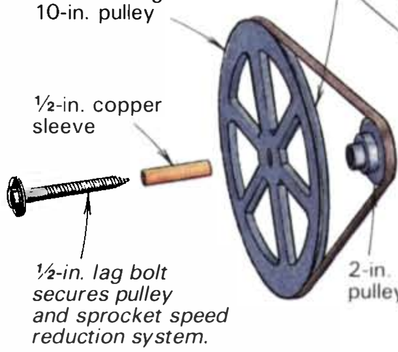
Table adjustment



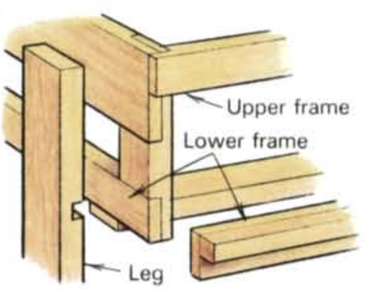
Bushing block



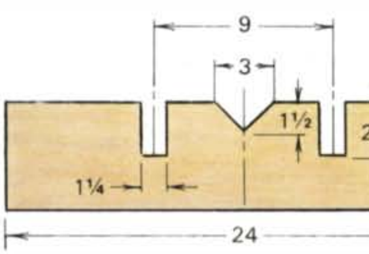




Detail: Frame at corner



Detail: Upper frame side piece



Drawing: Lee Hov

copper tube with grease before inserting the feed roller.

To drive the drum at about 1,200 RPM, I mounted a 3-in. pulley on the shaft of my 1,725-RPM, 1-HP electric motor. The drum rotates clockwise, in the same direction you're feeding in the wood, so dust builds up on the outfeed side and is carried away. My feed-roller drive consists of a 2-in. pulley on the drum shaft, driving a freewheeling 10-in. pulley and a 2-in. bike sprocket screwed into the frame. I welded the 10-in. pulley and 2-in. sprocket together and bored the unit to accept a piece of ½-in. copper pipe as a bushing, greased the inside, and mounted the unit to the frame with a ½-in.-thick lag bolt. You need that heavy lag bolt because it has to handle a great deal of torque here, due to the difference in diameters of the two pulleys. The freewheeling sprocket, in turn, drives via a bike chain, a 4½-in. or 5-in. sprocket welded on the end of the infeed roller. This arrangement produces a feed rate of 21 ft. per minute. On the other side of the machine, weld a 2-in. sprocket on each feed roller and connect them with a taut length of bike chain. This drives the rollers together. I line up the pulleys and sprockets by eye, sliding them on the shafts until they are aligned, then tighten the set screws or tack weld them in place.

I buy 3-in.-wide rolls of open-coat aluminum oxide paper that are 75-ft. or 150-ft. long (available from Kuster Woodworkers). Wider belts work too, but they're harder to put on. It takes about 12 ft. of 3-in. paper for the 24-in. drum, but for narrow stock it's not necessary to paper the entire drum. The best way I've found to attach the strips is to spray the drum with a light film of Weldwood Spray Glue adhesive available from local hardware stores, then immediately apply the sandpaper. I tape the end of the paper to fit the start groove, secure the end with a wooden shim, and wrap the paper on in a spiral fashion, as shown above right, in the direction opposite to the direction of drum rotation. Grit changes can be done in less than five minutes, and the paper stays put.

To operate the sander, put a rough board on the sander table and crank it up until the drum starts cutting. The maximum depth of cut with 36-grit paper is ⅓₂ in. If the feed jams during a cut, crank the table down and take a lighter cut. I use 36-grit for roughing stock to thickness, then progress to 80, 120, and finally, 180 grit. As each board comes out of the sander, whack it to remove some of the sawdust and continue planing. Keep the paper

To change sandpaper, Cook sprays adhesive on the sanding drum (note the holes drilled to balance the drum), then wraps on the abrasive. The paper spiral runs in the direction opposite to the drum rotation.

clean with a rubber sanding-belt cleaner. On the last pass, run each board through the sander twice without changing the depth setting. This will compensate for any table flexing and ensure that the stock is accurately flattened.

Except for the sandpaper changes, the sander doesn't require much maintenance. Keep the bushings greased. You might want to drill and tap the ends of the feed rollers and lag bolt for grease fittings and bore holes through the diameter of the shafts for grease flow. Unless you do all your work outside, you should also build a hood to go over the drum, so the machine can be hooked up to your shop vacuum or dust collection system. Otherwise, you'll have problems preventing the sawdust from clogging the machine, and your shop. The simple hood I made is shown in the drawing. Building a guard over the feed drive mechanism would be a good idea, too. Feel free to use your own ingenuity to improve on, or change, my basic sander. □

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An abrasive solution

by Curtis Erpelding

I'm a proponent of the hand-planed finish for one-of-a-kind pieces. Planing can be faster than sanding, and nothing can beat a hand-planed surface for clarity of figure and finish quality. But, for production work, handplanes can't always meet the demands of time and efficiency. I also hire assistants for production work, and it's not practical to teach part-time novice help to plane. For these reasons, I began investigating thickness sanders.

Thickness sanders looked more useful than belt sanders or stroke sanders. For my bent-laminated chairs, I need to surface ⅟₁₆-in. face veneers before gluing them to core laminates in forms. Prefinishing these faces eliminates the tedious job of sanding the curved surfaces after glueup. My other production work involves surfacing many dimensioned pieces, such as shelves, slats, box parts, and small panels. Belt sanding these parts wasn't faster than planing, and neither a belt sander nor a stroke sander was the solution for the veneer, even if I could handle the dust from a stroke sander. A thickness sander (I hoped) would handle the veneer, could quickly sand several pieces at once, and, with casters and port for a shop vacuum, fit efficiently into my work space.

I have friends who've had excellent results from simple hand-feed sanders, but I felt power feed was a must for production. Large abrasive-belt machines were out of my price range and even the Ultrasand, a ready-to-go drum sander manufactured by Kuster Woodworkers, P.O. Box 34, Skillman, N.J. 08558, was too large an investment for something I wasn't sure would work for me. After some deliberation, I chose the Kuster 24-in. Dynasand, a kit, which I thought I could adapt to suit my own needs.

I paid $660 for my 24-in. model, which included all metal parts and hardware, the gear motor to drive the feed rollers, and plans for a wooden base. I bought the wood and a 2-HP motor to drive the drum. I could have scrounged the parts more cheaply myself, but I'm glad I bought the kit and avoided a frustrating hunt for parts