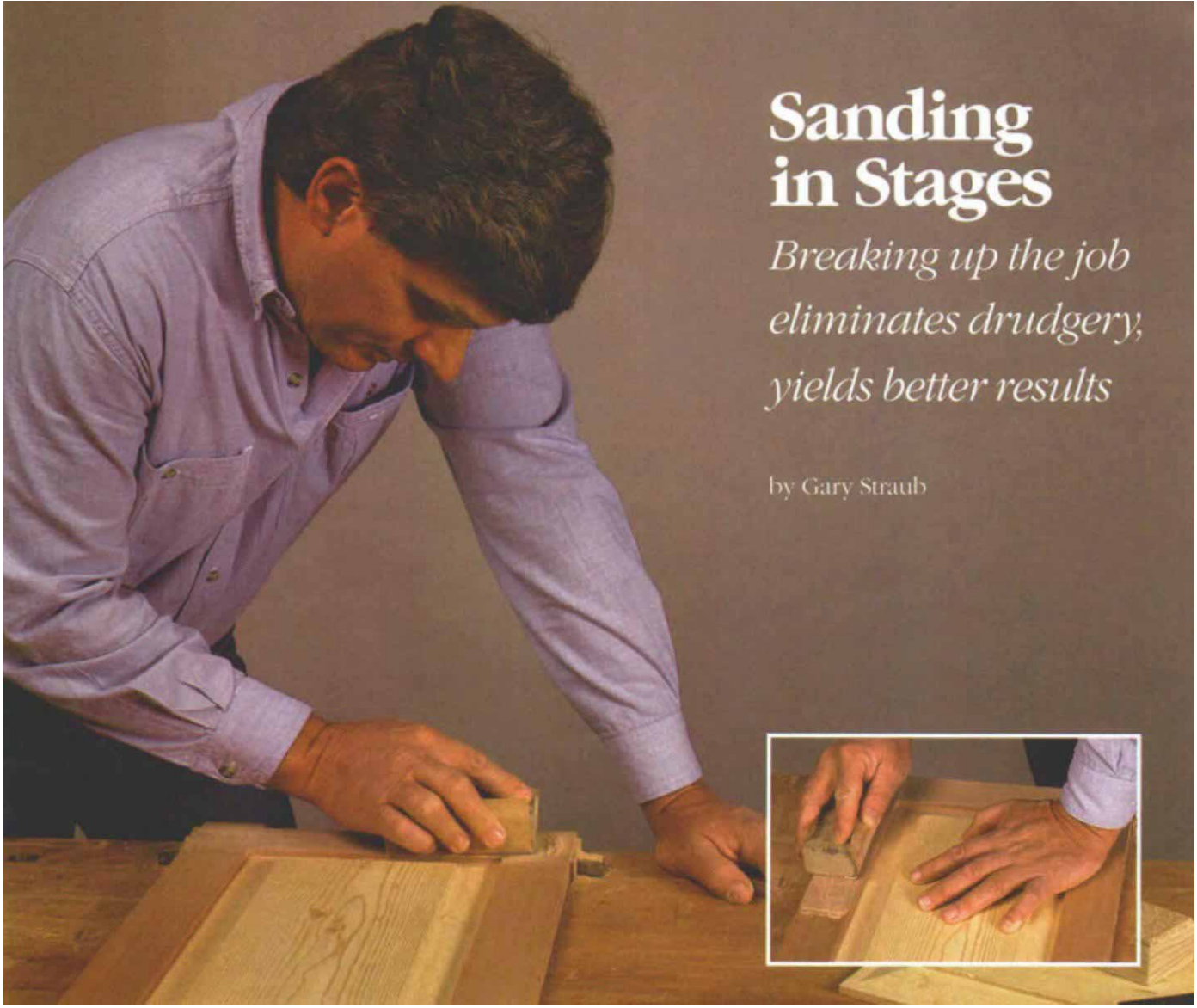
Sanding in Stages

Breaking up the job eliminates drudgery, yields better results

by Gary Straub



Sanding is just as critical to the ultimate success *of a piece of furniture as its design or joinery. Here, the author sands the frame of a frame-and-panel door, taking care of the tenoned rail first and then sanding the mortised stiles, thereby eliminating any stray scratch marks caused by sanding across the joint line. This process is repeated with each subsequent grit.*

Everything from sharp stones to sharkskin has been used to smooth wood. Today there's a seemingly endless array of sanding tools, aids and abrasives available, all designed to make our work faster, easier and better. If we look back at the methods used to smooth wood, we should appreciate the ease with which we can produce results far superior to those of our predecessors. Even so, most woodworkers still dread sanding.

That's too bad because sanding is one of the most important aspects of producing a fine piece. No matter how much time and care go into the making of a piece, its overall beauty is in large measure determined by how well it's been sanded. Although some finish representatives will tell you differently, no finish can cover up a mediocre sanding job.

Sanding doesn't have to be sheer drudgery, however, if you break the job down into its various stages and integrate the smoothing process with the construction of a piece of furniture. Before I've even ripped a board to width or crosscut it to length, I've beltsanded it to 100-grit. I remove all flaws with this preliminary sanding so that the only reason for further sanding is to remove the scratches created by the previous coarser grit. By the time I glue-up, everything's been sanded to 150-grit, which makes post-assembly sanding a breeze.

The result of this division of labor is a better sanding job, less tedium and a finer finished piece. The sanding system I've developed over the past twenty years of furnituremaking takes advantage of a wide range of abrasive materials. But before I explain my techniques, let's look at what's available today.

The materials

Sandpaper was invented when someone figured out how to glue screened panicles of glass or sand onto a paper backing. Today, of course, true sandpaper and glasspaper are practically unavailable. They have been replaced by papers that use much harder and sharper minerals, both natural and synthetic. New abrasive materials, more sophisticated screening methods and superior papers and glues have transformed the ways we smooth wood. Not long ago, abrasives came in grits from 12 to 600; now they go into the thousands (see the photo on the facing page). As if that weren't enough, we also have steel wool, abrasive cloths, pads, powders, liquids and pastes. Knowing what to use has become a challenge.

Abrasives—In ascending order of hardness, the materials used for coated abrasives are glass, silica sand, garnet, aluminum oxide, silicon carbide and zirconia alumina. The abrasive is applied to a backing as an open or closed coat. A closed coat means there is complete coverage while an open coat has 40% to 60% coverage. Closed-coat-

Photos: Susan Kahn

ed abrasives are more aggressive but clog easier. Open-coated abrasives are less aggressive but don't clog as easily. Most wood sanding is best done with open-coated paper, but some very hard woods can be sanded with closed coat. Wet sanding can be done with closed-coated paper (the liquid keeps the abrasive from becoming clogged).

Backing materials—Backing materials come in weights from A to X, with A-wt. being the lightest. I use mostly A-wt., or finish paper, and C-wt, cabinet or production paper. A-wt. is very flexible for hand- and finish-sanding. C-wt. is heavier but still fairly flexible for machine sanding. Discs are often E-wt. paper, cloth-backed sheets are J-wt. and sanding belts are usually X-wt. cloth.

***Paper- and cloth-backed abrasives are** available in a huge range of grits, which are bonded with a variety of adhesives to backings of widely differing weights. They are all still called "sandpaper" even though none are made with sand.*

Bonding agents—The abrasives can be bonded to the backing material with several different glues: hide glue for its flexibility, resins for their strength, or a combination of both. The grains may be electrostatically arranged, and often another coat of resin is added to maintain orientation. This is resin over resin and is used on better sanding belts and in other applications where strength of bond is more important than flexibility.

Reading the paper—Each company has its own method of displaying product information on the back of the sheets of sandpaper (see the top photo on p. 42). The type of abrasive is often written out fully (aluminum oxide or garnet, for example). The grit is displayed by a number, sometimes preceded by a letter, such as P100, and the coating may either be written out fully or abbreviated (Open Coat or OP). The backing weight may be shown as A or A-wt., or combined with either the grit designation (120A) or the information on coating density (AOP).

Choosing a paper—Generally, I use aluminum oxide papers with my portable sanding machines and switch to garnet for hand-sanding. Aluminum oxide lasts longer than garnet because it's a lot harder and so is more suited to machine sanding. It doesn't break down, however, so the sharp edges will become dull. The combination of a dull belt and the speed of the machine (especially a belt sander) can severely burnish the wood, which could affect how it finishes. Dull belts should be replaced. Garnet continuously breaks down, exposing fresh sharp edges, but because it's softer than aluminum oxide, I use it only for hand-sanding.

I sand from 80 to 220 using aluminum oxide and garnet papers but use silicon carbide for grits 240 to 320.1 also use coated abrasives on occasion. These papers are often silicon carbide, coated with a material, such as zinc stearate, that prevents the papers from clogging. I've found them helpful in sanding oily or resinous woods, but (contrary to what the manufacturers will tell you) there's a possibility of the residue contaminating the finish.

Non-paper abrasives—In addition to sandpaper, I also use 3M's Scotch-Brite or Norton's Bear-Tex nylon pads and steel wool. The pads are made of abrasive-coated fibrous nylon. They're very flexible, they last much longer than steel wool and they come in different grades, from coarse to ultra-fine. They're also good for wet sanding because they're unaffected by water, oil or solvents.

I use 00, 000 and 0000 (progressively finer) steel wool for finish work and sometimes use the coarser grades for stripping or for routine chores like metal cleaning. I like the steel wool for finish work because it cuts better than the abrasive pads, and the steel wool burnishes the wood slightly, which gives it a better sheen.

The method

The sanding process needn't be the hassle that we often make it. I've found that sanding as I go produces better results and takes much of the monotony out of the work. I first plane or re-plane all lumber for a piece before I start. I keep my blades very sharp, and I never take more than $^{1}/_{32}$ in. per pass. On smaller pieces, I use a handplane. Lumber planed at either the lumberyard or mill is very crudely done and of poor consistency. Trying to sand mill-planed lumber flat is a waste of time.

Using machines—After planing all the lumber to a consistent thickness, I sand each piece with a portable belt sander and a 100-grit belt. This sanding is crucial because this is when I remove any flaws. It's tempting to decide that you've sanded enough and that the next grit will take care of the rest. This is never true. If you remove all the flaws on the first sanding, subsequent sandings need only remove the scratches left by the previous grit, thereby saving time overall.

Using a portable belt sander takes some practice because it's quite easy to remove far more wood than you want. Most sanders are not well-balanced, usually weighing more on one side or the other, or more toward the front or back. To compensate for this, you must exert a slight pressure opposite the weight, striving to maintain total contact with the surface. At the same time, you must keep the pressure equal in all directions. Leaning the machine to one side or the other will create long gouges. Applying too much pressure either to the front or back will cause dips.

The proper technique is to move the balanced machine back and forth slowly, with the grain, reaching comfortably but not stretching. Don't move the machine directly to the side but rather let it drift to the side as you go back and forth. Moving it sideways will cause zig-zag clips that usually remain hidden until the first coat of finish is applied.

I change belts as soon as I feel myself applying more pressure to gel the belt to bite. Increasing pressure as belts dull is a primary cause of a poor sanding job. Unfortunately, the high cost of belts stimulate this bad habit. Cleaning the belt with a crepe-rubber bar bell-cleaning stick will stretch the life of your belts, but when they're dull, they're dull.

Having a brand new belt clog up with resin or glue can be very frustrating. I've had some success cleaning belts with a brass-bristled brush and in worse cases, using pitch cleaner with the brass brush. I do save all my used belts because they're still good enough for lathe work and for hand-sanding curved surfaces. I like Hermes aluminum oxide, resin-over-resin, open-coated belts. They're good belts at a fair price.

After sanding all flaws out of the lumber, I cut all stock to size, joint all the edges (finishing with a handplane), make all my joints and then dry-assemble. Next I glue up any wide panels such as tabletops. While they're drying, I sand the rest of the flat parts with a belt sander using 120-grit. All the parts that can't be sanded with a machine, I'll hand-sand with the same grit. Before sanding and

between each grit, I brush each piece thoroughly to remove any residual grit—the cause of those mysterious scratches that often appear.

This sanding goes very fast, but you must be careful, especially on the edges. The only object of this sanding is to remove the previous sanding scratches because I've already removed all defects with the initial sanding. I then check for any dings that may have occurred while cutting, and if there are any, I'll put drops of water on them to raise the fibers. By this time, any wide-panel glue-ups are dry enough to remove the clamps. I use an old plane blade to remove excess glue before it dries completely; otherwise, it will lock moisture into the joints, causing problems later on.

Next, I handplane any irregularities in the glued-up surface because it's just not possible to make a large panel flat with a portable sander. Once I get the surface satisfactorily flat, I sand it with the belt sander using a 120-grit belt. I sand the back first so that I don't take a chance on scratching the top when I turn it over. I then do any decorative routing, inlays or carving, and I plane or *hand-sand* the panel again with 120-grit paper. Now all the pieces are made and sanded to 120-grit, which is fairly smooth.

All you need to know about a sandpaper *is printed on its back. Manufacturers usually indicate grit, coating density (open or closed coat), backing weight and sometimes other information, such as whether a no-clog coating has been used, as is the case with the first (Lubrisil) and second (No-Fil) sheets above.*

For stripping paint *or varnish and for cleaning metal or going over a finish, steel wool and abrasive pads work better than sandpaper.*

Now I change to a half-sheet orbital sander and 150-grit aluminum oxide paper (I like Diamond Grit paper, made by the Carborundum Abrasives Co.), and then I go over all the flat surfaces before assembly. This makes problem areas—such as joints where the grain goes in different directions—much easier to deal with after assembly. I then dry-assemble the piece to check for any variation in wood thickness at the joints. Sanding these flush now makes post-assembly sanding much easier and pleasant.

When everything looks and fits right, I glue up. Because there's no turning back now, I make sure I'm satisfied that all is ready. I use glue sparingly, so there is minimum squeeze-out (but I make sure there's a little, so I know the joint isn't starved). While waiting for the glue to set, I sand any wide panels to the same 150-grit.

A good orbital sander does an excellent job of sanding, removing wood quickly while maintaining flatness. I use a Porter-Cable 505 half-sheet sander and a Makita quarter-sheet sander. I always use the largest sander that will do the job, usually the half-sheet machine. I move the machine back and forth slowly with the grain, letting the machine do the work. I apply only enough pressure to maintain control. The quickest way to ruin both furniture and machine is to apply a lot of pressure. By applying just a *little* more pressure on the back of the sander on the forward stroke and on the front on the return stroke, I have more control and the machine performs better.

Moving slowly is key to minimizing swirl marks because it gives the paper a chance to erase them. Just as with the belt sander, I shift sideways slowly as I'm moving back and forth to avoid creating any swirl marks, and I brush my work often to prevent pieces of grit from getting caught under the pad. On very large panels, I sand one area at a time so that I don't forget where I've been.

The next step depends on the finish I'm using. I put oil on most of my work (except tabletops.) because I like the way it allows the texture of the wood to be seen and felt. When finishing with oil, I stop at 150-grit. Oil is a penetrating finish, and the finer you sand, the less penetration you obtain. I apply the first coat (which does the most penetrating) before I go to finer abrasives.

For items requiring more protection, I use a surface finish such as varnish or lacquer. When I'm putting on a varnish finish, I continue machine sanding to 220-grit and for lacquer to 320-grit.

Hand-sanding—Regardless of the finish, I always hand-sand all the pieces (except bottoms, backs and other parts that will not show) with the same grit that I used on the last machine sanding. This removes any remaining swirl marks and provides a good opportunity to examine every inch of the work.

Hand-sanding is labor-intensive, but it's also the most rewarding part of sanding. Using machines requires good balance and steady hands, but handwork lets you feel what you're doing. You must learn to detect slight imperfections with your hands to judge whether a curve is fair or an edge consistent.

When sanding flat surfaces by hand, you must use a sanding block to keep the surface flat (see the top photo on the facing page). I prefer a solid-cork block, but I've also made sanding blocks by gluing bulletin-board cork (obtainable at most hardware stores) to a block of wood. Cork is firm enough to keep the paper flat and resilient enough not to destroy the paper. Some prefer felt- or rubber-faced sanding blocks. What's important is that you not use a block of wood alone, or it will quickly destroy the paper. The block I use takes a quarter sheet of paper.

I apply firm pressure to the block, stroking back and forth, carefully following the curves of the grain. I'm very careful with edges and corners, taking care not to round them off or taper them. If they're square, I try to keep them sharp for now. For miters, I hold the block at the same angle as the joint and sand up to the intersection from each direction. I deal with right-angle joints by sanding the tenoned section first. Then, when sanding the mortised section, I can remove any stray scratches.

Overexertion quickly leads to a hurry-up and get-it-done attitude. I take my time as if I were cutting feather-thin dovetails, sanding a small portion at a time and stopping often to brush away any loose grits. I check my progress frequently, using my bare hand to tell me where I need to sand a little more. When 1 finish one section. I dust thoroughly, wipe with a soft clean cloth and then feel the surface again, making sure it's right.

The last step is to eliminate any sharp edges that I've left. Using the finest grit I've sanded with to this point, I go over the edges by hand, without a pad. I twist my hand slightly as I'm moving forward, which softens the edge more quickly than if I kept my hand fixed, and it prevents the edge from getting stuck in a groove in the paper. A very light touch will produce a corner that cannot be duplicated

by any machine. A little more pressure will yield a 1/16 in. radius in no time.

Sanding irregular surfaces—Sanding curved pieces is much the same as sanding flat surfaces except you have to begin hand-sanding right from the start. A flexible sanding block is important; I use rubber sanding pads, varying in firmness. Their flexibility allows them to bend to fit most curves.

For smaller curves and for sanding on the lathe, I tear a strip of whatever size I need from a used sanding belt I've saved. The heavy cloth back of the belt is pliable enough to fit the curve yet firm enough to maintain the shape. For small concave shapes, such as on moldings, I cut a piece of dowel that fits the groove and wrap it with A-wt. paper.

I also use rubber Tadpole Contour Sanding Grips (available from many mail-order woodworking catalogs). They come in various diameters, both concave and convex, and the flat grip section is shaped at the top to allow sanding in tight places. They come in sets, some include flexible sanding pads. They've made life easier, and they're very inexpensive.

Carve as smoothly and crisply as possible, so only minimal sanding is required. Carvings present the most difficulty because any sanding will alter the character of a carving. If it's a geometric carving or a large in-the-round carving, sanding with A-wt. paper works well. For heavy carvings, without fine detail, steel wool or abrasive pads conform well to irregular shapes. When I do a lot of sanding with my fingers, I wear finger rubbers (available at most office supply stores). They're made for office workers to flip easily through papers, but they're also perfect for protecting fingers, and giving a good grip on the sandpaper.

For highly detailed carvings, I use a stiff nylon-bristled brush—shaped like a toothbrush—and a slurry of powdered pumice and mineral spirits. Pumice is made from a type of lava and has been used through the ages as an abrasive both in the solid and crushed form. Powdered pumice is graded like steel wool except in *F's* instead of 0's. I use the finest grit that will work.

Smoothing the finish—After I'm satisfied that everything is smooth and ready for the finish, I wipe everything clown with a soft rag dampened in mineral spirits. This serves three purposes: first, it cleans any contaminants that may have gotten on the wood, especially oils from my hands or drops of sweat from working on a hot summer day. It also gives me an idea how the piece will look finished and reveals any remaining imperfections. These are far easier to deal with now than after applying a finish.

The smoothing process isn't over when the finish goes on. Each coat must be abraded slightly before the next is applied either to ensure adhesion, as with varnish to remove dust specks in lacquer, or to finish the smoothing of an oil finish. I sand varnished and lacquered surfaces with 320-grit silicon carbide paper, often with water on varnish. But for my oil finish, I use steel wool starting with 00 and changing to the next finer grade with each coat. I prefer steel wool to the nylon abrasive pads because it not only smooths the surface by abrasion but also gently burnishes the oil-filled wood, creating a higher luster and a smoother feel.

Always sand with a cushion *to keep your surface flat. Cork blocks, cork-faced blocks and rubber sanding pads all will work. The rubber Tadpoles (right, background) allow sanding of concave and convex moldings, and the finger rubbers protect the fingers while providing a good grip on the sandpaper. The solid wood block is useful as a backing for the nylon abrasive pads.*

Polishes further refine the finish. *They include pumice and rottenstone as well as modern ultra-fine automotive products. In either case, felt is the best applicator.*

The final coat of finish must also be smoothed or polished. A slurry of rottenstone (a very finely powdered mineral) mixed either with water or paraffin oil makes an excellent polish. Mixed with water, it gives a higher polish; mixed with oil, it gives a more satin finish.

Felt is the best material for the final rubbing. Felt blocks that look like sanding blocks are available commercially, but you can also make your own. The best felt comes from old felt hats that you might find in your father's attic or in used-clothing stores. The texture of that felt is very uniform, and it's stiff enough to use without a block for curved and carved parts. I just dip the felt in the slurry and rub with the grain. I rub with the felt by itself (no rottenstone) for oil finishes because I'm able to get the luster I want without abrasives. I rub harder and longer, though, because there's no danger of cutting through, now that the finish has become part of the wood.

There are many polishes for wood today that surpass rottenstone, so rottenstone is fading into history. Most finish companies either make a polish for their finish or recommend one. Also there are many automobile polishes that give excellent results on varnished or lacquered finishes. In fact, there are so many polishes available today that it's difficult to keep track of them all. I've been happy with Meguiar's Mirror Glaze, a brand I find at the local auto parts' store. It comes in varying degrees of abrasiveness. One caveat: Be careful when using polishes on wood whose grain has not been filled. The residue of many polishes will fill the grain and dry to a very unnatural color, which is extremely difficult to remove.

The last step is to remove any remaining polish with a very soft cloth. Cotton diapers are excellent but in short supply in this disposable society. Lint-free polishing cloths are available from finish suppliers or auto parts' stores. Wipe your piece down, and step back to admire a job well-done. □

Gary Straub has been building (and sanding) furniture in Columbia, Mo., for 20 years.

Sources of supply

Sanding (and other abrasive) supplies are available from many general woodworking catalogs. There are also a number of companies whose specialty is abrasive products. Below are two that the author buys from.

Pyramid Products Co., 7440 E. 12th St., Kansas City, MO 64126; (800) 747-3600

Skates Belting, 321 Southwest Blvd., Kansas City, MO 64108; (800) 821-5041