Making Sense of Sandpaper

Methods for sanding efficiently

Sanding a rough surface smooth in preparation for a finish seems a pretty straightforward proposition. For a board fresh out of the planer, woodworkers know to start with a coarse paper, perhaps 80-grit or 100-grit, and progress incrementally without skipping a grade up to the finer grits. At each step, you simply erase the scratches you made previously with finer and smaller scratches until, at 180-grit or 220-grit, the scratches are too small to see or feel. But there are a fair number of opinions on how to do this most efficiently.

Don't skip grits, usually--Skipping a grit to save time and sandpaper is a common temptation, but not a good idea when working with hardwoods. You can remove the scratches left by 120-grit sandpaper with 180-grit, but it will take you far more work than if you use 150-grit first. You will also wear out more 180-grit sandpaper, so you don't really save any materials. When sanding maple, for instance, skipping two grits between 80 and 180 will probably double the total sanding time. This, however, is not as true with woods such as pine. Soft woods take much less work overall to sand smooth. Skipping a grit will increase the work negligibly and may save you some materials.

Sand bare wood to 180- or 220-grit--For sanding bare wood, 180-grit will generally give you a surface that looks and feels perfectly smooth and is ready for a finish of some kind. Sanding the surface with a finer grit is only necessary if you're going to use a water-based finish. These finishes will pick up and telegraph the smallest scratches. Sanding the wood to 220-grit or finer will prepare the surface better. However, it's not always wise to sand to a finer grit. You will waste your time if you can't tell the difference, and you may create problems in finishing. Maple sanded to 400-grit will not take a pigmented stain, for example. Pigments work by lodging themselves into nooks and crannies on the surface; without them, they will have no place to stick.

Sand faster across the grain--How many times have you been told never to sand across the grain? True enough. The scratches are much more obvious, look terrible and are hard to remove with the next finer grit. But what holds true for planing wood is also true for sanding. You will plane and sand faster and more easily when the direction of your cuts is between 45° and 60° to the grain, because the wood-fiber bundles offer the least resistance to the cutting edges. Cross-grain scratches are harder to remove simply because they are deeper.

Use a combination of cross-grain and with-grain sanding to get the smoothest surface in the fastest manner. First make passes at 45° to 60° to both the left and the right, making an X-pattern on the workpiece. Then, with the same grit, sand with the grain to remove the cross-grain scratches. Do this with each grit when belt-sanding and hand-sanding. The non-linear sanding action of random-orbit and orbital sanders can't take advantage of the wood's grain properties. When I use my orbital, I just sand with the grain.

Choosing from the four abrasive minerals

Four common abrasive minerals are aluminum oxide, silicon carbide, ceramics and garnet. Except for garnet, they are all manufactured, designed if you will, for different cutting properties. Harder and sharper minerals cut deeper scratches and, consequently, sand the wood faster. But these deep scratches leave a

coarse finish, whether you sand with or across the grain.

Softer minerals within the same grit size will cut far more slowly but leave a smoother finish. For example, if you sand a board on one side with a 120-grit ceramic, the hardest abrasive mineral, and the other side with 120-grit garnet, the softest, you will be able to feel a distinct difference between the surfaces. It will seem as if you sanded the two sides with different grit sizes.

It's easy to rate each mineral's hardness and sharpness, but it's not as simple to prescribe specific uses beyond generalizations. There are many other factors that influence the appropriateness of a sandpaper for a job (see the Minerals).

Some fine points about grading scales

If you don't mind that we have two measurement systems, the U.S. Customary (foot, gallon) and the International (meter, liter), then you won't mind that we have three major abrasive grit-grading systems. In North America, the Coated Abrasives Manufacturers Institute (CAMI) regulates the U.S. Standard Scale. CAMI-graded sandpapers simply have numbers, such as 320, printed on them. The Europeans have the P-scale, regulated by the Federation of European Producers Association (FEPA). These abrasives are identifiable by the letter P in front of the grit size, such as P320. Finally, to make sure everyone is really confused, there is a totally different micron grading system. This system is identified by the Greek letter mu, as in 30µ.

The chart below is helpful in comparing grits of the three grading systems, but it doesn't tell the whole story. Abrasives on the P-scale are graded to tighter tolerances than CAMI-graded abrasives. This means that the CAMI-scale tolerates a wider range of grain sizes within the definition of 180-grit than the P-scale. Tolerances are even tighter for micron grading. P-graded and micron-graded abrasives give more consistent cuts with fewer stray scratches from outsized minerals.

Micron-graded abrasives on polyester films are about three times as expensive as paper products and probably not worth it for sanding wood. I have a hard time telling the difference between wood sanded with a 100µ finishing film abrasive and standard 120-grit sandpaper. But for polishing a high-gloss finish, I find micron-graded abrasives make a substantial difference.

The most common grading systems used in North America are CAMI, FEPA and micron grading. CAMI and FEPA are similar in grades up to about 220. Beyond that, they diverge greatly.

CAMI (U.S. Std.)	**FEPA** (P-scale)	**Micron** (µ)
1200		5
1000		9
800		
600	1200	15
500	1000	
400	800	20
360	600	
320	500 400	30
280	360	40
240	320 280 240	45 50
220	220	60
180	180	
150		80
120	150	100
100	120	
80	100	150 180
60	80 60	
50	50	
40	40	
36	36	
30	30	
24		
20	24	
16	20	

The three systems grade particle size to different tolerances but by the same methods. From the coarsest grits up to about 220, particles are graded through a series of wire mesh screens. The smaller grit sizes are graded through an air- or water-flotation process that separates particles by weight.

Micron-graded abrasives are most uniform in size and best for sanding finishes.