Choosing

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Sandpaper BY SCOTT GIBSON

For power-sanding, new abrasives are worth the extra cost

ew woodworking shops would get far without sandpaper. It's used for everything from flattening rough panels to polishing delicate finishes. Its versatility comes from the variety of available grits, coatings, and backings. Following is a primer on the combinations that work best for the types of sanding you are likely to do.

Manufacturers offer a variety of sophisticated abrasives, backing materials, and adhesives. Sandpaper is engineered for specific uses, depending on the material to be abraded and whether the paper is designed for hand- or machine-sanding.

Some of these new high-performance abrasives have migrated into woodworking from other industries. While they make

sanding faster, they also cost more than the old standbys.

For woodworkers, striking a balance between cost and performance amounts to knowing what you are buying and understanding what the abrasive is designed to do. Manufacturers put a variety of abrasives into belts, disks, sheets, rolls, and sanding sponges, and these products come in several price ranges. There is a sandpaper for just about any purpose.

Printed on the back of most sandpaper is information about abrasive type and grit size (see "Pay attention to your grades" on p. 60). You also might find the weight of the backing and the type of glue. The information, however, isn't likely to be all that helpful.

For example, unless you know there are three conventions for grit size (in addition to the generic coarse, medium, and fine found on some inexpensive papers), you might not really know how coarse or fine the sandpaper is. Do you need an A-weight or a C-weight paper for sanding varnish between coats? Knowing the basics of abrasives, backings, and coatings can help you sort through the jumble of trade names and murky product codes.

Abrasives: the sand in sandpaper

Although manufacturers still use a few natural minerals, synthetic abrasives coat most of the sandpaper we buy. The most common abrasives-aluminum oxide, silicon carbide, and ceramics-are synthetic,

Beltsanding abrasives must withstand heat



The minerals make the difference

Abrasive performance is a balance of hardness, sharpness, durability, and friability. Friability is the highly desirable tendency to fracture with wear and expose new, sharp cutting edges. For general use, aluminum oxide seems to present the best compromise, although several other abrasives have specific uses that make them worth keeping in the shop.

ALUMINUM OXIDE: THE SHOP WORKHORSE

Aluminum oxide is the most common abrasive in woodworking sandpaper. It works well on a number of materials, including bare wood, painted surfaces, and metal. In its most basic form, this furnace-produced mineral does not fracture easily. It tends to wear down until it becomes too dull to cut efficiently. More expensive forms are friable or semifriable. A number of companies offer more than one grade of aluminum oxide in sandpaper. More expensive, heat-treated versions of the mineral tend to go into higher-priced product lines, such as Norton's 3X or 3M's Sandblaster. Generic aluminum oxide, with its familiar brown and black flecks, is used in tandem with hide-glue adhesives on less expensive sandpaper.

SILICON CARBIDE: FOR LEVELING FINISHES

Also a synthetic, silicon carbide is sharper and harder than standard forms of aluminum oxide. It has needlelike grains that resemble shards of broken glass. These hard, sharp grains cut glass, plastic, and metal very well under light pressure, but silicon carbide is not a very tough mineral. Its elongated shape shears off easily, making it too friable for bare-wood sanding because the abrasive wears down too quickly, according to manufacturers. It's an excellent choice for smoothing finish between coats, and for rubbing out film finishes like lacquer and shellac, because it cuts quickly and produces a very uniform scratch pattern. Waterproof versions won't degrade when used with water or oil.

while garnet and emery (used mostly in metal-working) are the only common abrasives that occur naturally.

Manufacturers have concentrated their research on aluminum oxide and newer ceramic abrasives, designing abrasive grains that are friable or semifriable, meaning they break down to expose fresh cutting edges as the sandpaper wears.

"Friability is an excellent thing," says Chris Minick, an advanced product development specialist at 3M and a consulting editor to *Fine Woodworking.* "What it does is rejuvenate the points, so it extends the life of the sandpaper. Second, it gives you a much, much more consistent scratch pattern than you'd get with a nonfriable material."

Most sandpaper for woodworking has an open coat, meaning that abrasive grains cover between 40% and 70% of the backing. The space between grains gives saw-

dust a place to go, so the paper doesn't clog as readily. On the other hand, closedcoat sandpaper produces a more uniform scratch pattern, making it a good choice for sanding finishes.

Coatings keep abrasives on and saw-

dust out—Stearates are no-load coatings that help to prevent clogging when sanding painted surfaces between finish coats or resinous wood like pine. Stearated paper costs more, and it's not really necessary when sanding dry hardwood.

Unlike some of their predecessors, modern stearates are engineered not to interfere with water-based finishes. However, there are anecdotal reports to the contrary. Jeff Jewitt, a frequent contributor of finishing articles to *Fine Woodworking*, claims good success using 3M's 216U Frecut Gold and Mirka's Royal papers, as long as he

Turning abrasive grit into sandpaper

Paper or cloth, glue, and abrasive particles are combined to make durable and reliable sandpaper.



Sandpaper starts as a huge roll of cloth or paper backing. The thicker and stiffer the backing, the more aggressive the sandpaper.

GARNET: THE NATURAL

One of the natural minerals still on the shelves is garnet, a relatively soft substance with a characteristic orange color and without fancy trade names. Garnet is garnet. Although it won't last as long or cut as quickly as aluminum oxide or the ceramics, traditionalists think garnet produces a finer and softer scratch pattern for final sanding. You'll find it in sheets for hand-sanding or for use on an orbital block sander for fine finish work. Garnet is steadily being replaced by newer aluminum oxides—Norton sells less garnet every year, and Mirka lists no garnet products.

ALUMINA ZIRCONIA AND CERAMICS: THE TOUGH ONES

A tough alloy of aluminum oxide and zirconium oxide, alumina zirconia outlasts aluminum oxide but costs about 20% more. Because its greater durability is most evident under heavy loads, alumina zirconia is used mainly in products for power sanding.

Other high-performance abrasives include ceramic aluminum oxide from 3M (Cubitron) and a similar mineral from Norton (SG). Ceramics are extremely tough, sharp, and long-wearing—and at least several times as expensive as anything else. They often are blended with other abrasives on premium belts and disks. Norton's 3X random-orbit disks, for example, combine its SG mineral and aluminum oxide. 3M makes disks and belts with both aluminum oxide and Cubitron (they're purple and called Regalite).

2 The backing passes between rollers, which apply measured amounts of hide glue, urea-formaldehyde, or phenolic resin as the first, or "make," coat.



A pass through a second roller coats the paper with the second, or "size," coat of glue, followed by more baking, then with the application of any special coatings or backings.

ABRASIVE

A static charge of about 20,000 volts applied to the gluedup paper attracts a uniform coat of abrasive. A trip through an oven sets the adhesive.

() In the final step before packaging, a large press die-cuts the paper to the shape you'll use in your shop.

Sanding disks come in many flavors

Random-orbit sanders can be fine finishing machines, or nearly as aggressive as belt sanders. Consequently, disks for these sanders are available in almost the entire range of backing-paper weights, abrasive types, and coatings. Most are perforated for dust collection.

FIVE- AND EIGHT-HOLE DISKS

UNIVERSAL DISKS

Holes allow dust

collection. Five- and eight-hole disks are intended for specific sanders, while the universal type fits any machine of a matching diameter. A mesh alternative, Mirka's Abranet, comes in grits from P120 to P600 and is intended for virtually dust-free sanding. It's said to work on hookand-loop bases, but an adapter is also available.

MESH DISKS

wipes down the stearate-sanded wood with alcohol. Jewitt says this technique works best on closed-grain woods. On open-grain woods such as oak, stray accumulations of stearate can remain in the pores.

Backings also affect performance. Backing paper comes in five common weights—A, C, D, E, and F. A-weight paper is the lightest, used for finer grits. E and F weights are found on disks for heavy grinding. Cloth backings are more durable but not quite as smooth as paper. Cloth comes in J-weight, the most flexible, and X, Y, and Z.

Beltsanding: Look for cloth backing and tough abrasives

Belts for stationary sanding machines come with either a cloth or paper backing. Belts for portable sanders are always cloth, typically X-weight. Because of their short length, belts for portable sanders run hot; paper-backed belts wouldn't last long.

The standard abrasive for portablesander belts is aluminum oxide. Manufacturers also offer belts coated with alumina zirconia or ceramic aluminum oxide, which stand up to heat and pressure better than ordinary aluminum oxide.

Open-coat belts don't clog as readily, and belts with P-graded abrasives (see the sidebar on p. 60) produce a more consistent finish. Butt-joined belts can run in either direction, so they are easier to put on the machine and last slightly longer.

> Bargain hunters should think twice about stocking up on belts for their portable sanders. According to Lisa Beard, manager of technical services at Klingspor, the adhesives used

NORTON

PREMIUM ALUMINUM OXIDE Coarse 60 Grit

• 3 times faster cut • 3 times longer life

EDIJIESIE

180

 Superior performance for heavy solution paint, next and other costing.

Grain Gros 60 La mellieur cheix pour l'éstimination i matérias sur le bols, le métal eu aut matérias sur le bols, le métal eu aut

D'ÓXIDO DE ALUN Grano Grueso 60

 La mejor elección para res material en madera, meto finationiento superior pr

> 3 9 in X 11 in (28 mm X 279 mm)

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to join belts last for only about a year. Belts that have been sitting around too long can pop apart when they're put on the sander. Beard suggests buying no more than will be used in a year.

Random-orbit sanding: A variety of disks for the finishing touch

Between Coats

Most random-orbit disks have either five or eight holes that feed dust into the sander's collection system. Some disks come with slots instead of holes and so can fit any base with a matching diameter.

Disks can be had with paper, film, or cloth backings, although C-weight paper seems to be the most common. Cloth backings are more durable but not quite as smooth as paper. The edges of a cloth random-orbit disk don't crease or tear as readily when sanding into a corner, but for most applications, paper works fine. Flatter and more expensive than paper, film backing often is used in automotive finishing. It may be overkill for sanding wood.

Because random-orbit machines don't generate a lot of heat and pressure, they don't take advantage of the properties of premium alumina zirconia or ceramic abrasives to the same degree as do belt sanders. Manufacturers offer these abrasives on

Are high-performance abrasives worth the cost?

At the time of this printing, a major woodworking outlet sold a 3-in. by 24-in. aluminum-oxide belt on X-weight cloth for about \$1.40. An alumina-zirconia belt cost about \$3.10, and a ceramic-grain belt was about \$3.80. Premium belts wear slowly and can be cleaned repeatedly to nearly new condition with a rubber cleaning stick. Likewise, the alumina-zirconia and ceramic random-orbit disks I've used seem to cut faster and wear more slowly than conventional aluminum oxide. However, meaningful tests for abrasive life and efficiency require expensive testing equipment that I don't have. In writing this article, I spent a lot of time sanding wood, and while I may lack the scientific data, my subjective

take is that high-performance belts and disks are worth the extra money. High-performance abrasives really shine when used under high heat and pressure, like machine sanding. I'm less con-

vinced that high-tech abrasives are worth the money for hand sanding, considering that most of the hand-sanding I do is limited to light fin-

> ish work. I will pay extra, however, for a waxy coating called stearate. Stearated papers don't clog as quickly, and often are used for sanding out finishes.

> > -S.G.



High-tech abrasives pay for themselves in time saved. Not only do they cut faster, but premium sanding belts and disks last longer under the heat and pressure of power sanding than do traditional abrasives.



No-load coatings work great for sanding finishes. Uncoated garnet sandpaper (left) clogs quickly, while stearated paper (right) remains clean and effective longer.

Pay attention to your grades

Manufacturers grade the size of abrasive particles using the CAMI standard, the FEPA standard , and micron grading (identified by the Greek letter μ). The first two are the most common. CAMI is the old American standard. FEPA is the European standard, but appears more and more often on products in the United States. It is sometimes identified with a "P" placed in front of the numbers that designate grit size. In both CAMI and FEPA scales, the higher the number, the finer the grit.

> FEPA-graded abrasives are more uniform in size than CAMI abrasives, and thus leave a more uniform scratch pattern, which is better for fine finishing. CAMI and FEPA grits are roughly the same until they get above 220. Above this grade, FEPA papers are significantly more abrasive than identically numbered CAMI papers.

The most accurate scale, micron grading, sometimes is found on finishing films, more common in auto-body work than in woodworking. Micron-graded papers in very fine grits aren't necessary for most woodworking. For more on sandpaper grades, see

FWW #176, pp. 117-118.

As of this printing, the four major manufacturers whose products are available in the United States use the CAMI and FEPA scales as follows:

- 3M: Both CAMI and FEPA; FEPA papers all carry the P designation. CAMI abrasives are silicon carbide and garnet.
- Klingspor: All FEPA; some marked, some not.
- Mirka: All FEPA and marked.
- Norton: Most FEPA, but unmarked; silicon carbide is CAMI grade.



random-orbit disks nonetheless, promising longer disk life over standard aluminumoxide products.

For sanding finishes, random-orbit disks are available with stearate coatings. Some even come in extremely fine grits: Mirka's Abralon pads, useful for polishing highgloss surfaces such as a rubbed-out finish, are available in grits up to P4000.

Disks are available with either pressuresensitive-adhesive (PSA) or hook-and-loop backs. Hook-and-loop systems are worth the extra cost because they can be reused. PSA disks stick only once, so if you need to switch between different grits frequently, count on wasting a lot of paper.

Hand-sanding: Rolls and sponges add versatility to the old standby, sheets

Power sanders help take the tedium out of sanding, but it's still sometimes less trouble

to pick up a sanding block or a scrap of sandpaper and do the job by hand. A bit of sandpaper wrapped around the pad of your thumb quickly takes off milling marks from the inside curve of cove molding, and several suppliers sell detail-sanding blocks that match a range of profiles.

Hand-sanding offers outstanding control when sanding between coats, and a final hand-sanding with the grain can eliminate even a random-orbit sander's minor crossgrain scratches.

You can buy abrasives intended for handwork in just about any form—sheets, rolls, sponges, and even thin cord on 50-ft. spools. Rolls come in a variety of widths, typically from 1 in. to 6 in., in lengths of 10 ft. and 25 ft., and they can be had with either hook-and-loop or PSA backing. A new class of abrasives, nonwovens, isn't sandpaper in the traditional sense at all.

Hand-sanding requires a variety of abrasives ...

For hand-sanding as well as machine, aluminum oxide is the first choice for rough work. Garnet is still loved by many for the last sanding of bare wood because of its soft scratch pattern. Silicon carbide cuts quickly with light pressure and so is great for wet-sanding finishes.





Nonwovens resemble nylon scrubbing pads used in the kitchen and are intended for contoured areas and for rubbing out finishes.

A standard sheet of sandpaper, which measures 9 in. by 11 in., can be cut into four equal pieces to fit a sanding block. Sheet sandpaper also can be had with a lightweight cloth backing that's more flexible and more durable than paper. Look for a no-load coating when sanding resinous softwoods or finishes.

Sanding sponges, which combine flexible foam blocks and sandpaper in one, are available in different foam densities and thicknesses, so they can be matched to the application. Firm rectangular blocks get into corners more easily than a folded piece of sandpaper or a conventional sanding block.

Will you find the huge range of modern abrasives in your local hardware store? No, but you are likely to find most of what you use from day to day. And every product mentioned in this article is easily found in catalogs or online.

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... on a variety of backings

If you can imagine an abrasive backing, someone's probably already making it. Abrasive cords of varying diameters get into the nooks and crannies of intricate turnings. Sanding sponges conform to molded surfaces to remove machine marks. **Abrasive-loaded plastic** wool knocks down finishes. Flat paper comes in adhesive-backed rolls for quick sticking to sanding blocks. **Despite the variety of** specialty backings on today's market, the old standby, 9-in. by 11-in. sheets, remains viable. Found on the shelves of every hardware store, sheets are effective abrasives, and generally the least expensive option.