

CHOOSING AND USING THE RIGHT SAW BLADE

Match tooth style to application—and keep the blade sharp.



The latest production machinery still cannot replace the skilled craftsman who exercises final judgement on trueness and the anvil tensioning.

by John Schultz

Circular sawblades come in many styles. What are these and how should you choose the right blade for a particular application? Some technical background is helpful:

Steel or Carbide?

First, consider what material is used for the cutting edge. The two materials commonly used in blades for home building are standard steel and carbide. There are also high-speed steel blades (for cutting brass), semi-high-speed steel (for friction sawing), high-carbon, high-chrome (best for many aluminum cutting jobs), Stellite-tipped (for some sawmill applications), and diamond-tipped (for a few mass-production jobs).

Carbide blades tend to last longer than standard steel circular saws, but cost more to buy and to sharpen. They have other disadvantages as well. Carbide teeth are more brittle. And because carbide blades are typically wider than steel blades, they tend to make rougher cuts, require more feed pressure, and draw more power. Despite these problems, carbide is well worth the money in many applications because of the longer life and longer time between sharpening.

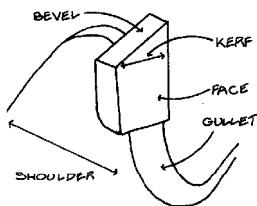
Dulling

Most people think that *abrasion* causes cutting edges to dull. In most wood-cutting applications, however, *high-temperature corrosion* is at least as important. This is a chemical reaction between the wood pitch, glues, and saw blade itself accelerated by the extreme heat at the cutting edge.

The heat of cutting drives pitch out

of the wood and bakes it onto the sides of the blade, making more friction, making more heat, driving more pitch out of the wood, and so on in a vicious circle. This means that it is very important to keep your blades clean. (Let them soak in sodium hydroxide or ordinary oven cleaner for an hour or so periodically.)

TOOTH PARTS



This is a typical top-bevel tooth. These are usually set in an alternating pattern to sever wood fibers first on one side, then on the other. Sawdust is carried away in the gullet. The taper from the widest part of the tooth (kern) to the base of the face is called the dish.

Although a softer blade can sometimes outlast a harder material due to special chemical properties (for example, Stellite vs. the harder carbide), for the most part, the old rule of thumb holds: harder edges cut longer.

What about the hardness of the

cutting tools than one might expect, due to the type and quantity of pitch in the wood.

What other factors affect dulling in a given cutting application? For one thing, once a blade gets a little dull, it starts to get duller at a faster rate. This is because the duller edge cuts less efficiently and generates more heat, increasing the rate of dulling, and so on. Therefore, extra-sharp "premium" sharpeners can pay handsome dividends.

In some applications, however, the edges don't really get dull, they get "chipped-up" by tough materials (dirty, knotty, etc.). For these applications, initial sharpness is less important. Also for these tough jobs, you should look for a chunky tooth shape. (See box on "Carbide Tips: Long vs. Chunky.")

The quality of cut desired will also help you decide when and how to sharpen. In many cases, for example, the material will still feed easily, but the finish is too rough. It's time to sharpen the tool. For these fussy applications, initial sharpness is extremely important. For such jobs, it's a good idea to keep a sample of a cut made with a sharp blade. Then you have a benchmark to tell you when it's time to sharpen.

Carbide Tips: Long vs. Chunky

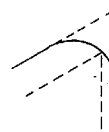
Long-tip shape
.410 long
.090 deep



Chunky-tip shape
.310 long
.120 deep



In applications where teeth get dull by becoming *rounded*, choose chunky tips because each sharpening will remove perhaps .005 inches from the tops and .002 inches from the faces. So after 25 sharpenings, the tips look like this:



.285 long
.040 deep
too brittle a sliver



.185 long
.070 deep
a small usable tip



In applications where teeth get dull by becoming *chipped*, choose long tips because each sharpening will remove perhaps .015 inches from the tops and .003 inches from the faces. After 15 sharpenings, the tips look like this:



.185 long
.045 deep
a small usable tip



.085 long
.075 deep
a useless chip



CHOOSING THE RIGHT BLADE

(A) **Rough ripping—heavy green timbers.** Few teeth (10-inch by 10 to 20 teeth) with large full-size gullets, pronounced dish, and very high hook.

(B) **Rough ripping—thinner dryer wood.** Few teeth (10-inch by 18 to 24 teeth) with pronounced dish and very high hook angle.

(C) **Glue-joint ripping.** Moderate number of teeth (10-inch by 24 to 40 teeth) with slight dish, high hook, and not square-top grind. Premium strongly recommended.

(D) **Ultra-smooth ripping.** Moderate number of teeth (10-inch x 30 to 40 teeth) with minimal dish, high hook, and not square top grind. Premium strongly recommended.

(E) **Rough cut-off (cross-cut).** Moderate number of teeth (10-inch by 24 to 40 teeth) with standard dish, normal or even negative hook angle, depending on machine.

(F) **Moderate cut-off.** High number of teeth (10-inch by 48 to 60 teeth) with standard dish, normal or even negative hook depending on machine, triple chip for greater longevity, beveled teeth to sever fibers cleanly, and rakers to help ease of feed.

(G) **Fine cut-off, any cut-off for thin wood, plywoods and veneers.** Very high number of teeth (10-inch x 72 teeth and up) with standard dish, normal or even negative hook depending on machine, triple chip for greater longevity, beveled teeth to sever fibers cleanly, rakers can help ease of feed.

(H) **Composite boards, high density plastic laminates.** More teeth for finer cuts, fewer teeth for roughing, triple chip grind, standard dish, normal or even negative hook, depending on machine. Thinner kerf for finest cuts. Premium blades for finest work.

(I) **Low density plastic laminates.** Maximum number of teeth (10-inch x 80 teeth and up) thinner kerf, extra high bevel angle. Premium blades strongly recommended.

(J) **Rough combination (rip and cross-cut).** Moderate number of teeth (10-inch x 24 to 30 teeth) with standard dish, hook angle depends on machine. Beveled teeth with rakers to ease feed and increase longevity.

(K) **Moderate combination.** More teeth (10-inch x 40 to 50 teeth) with standard or modest dish (less dish will rip smoother, but dull quicker). Beveled teeth for severing fibers, rakers for ease of feed, clustered teeth to help with gullet capacity for thicker rip cuts. Insufficient for thicker rip or fine cut-off. Premium blades will salvage the most possible from this case of the unhappy medium.

(L) **Smooth combination.** Because of minimum bite requirements for efficient cutting with carbide saws, and the difficulty of putting adequate hook angle into a fine tooth carbide saw, this category basically is limited to steel hollow-ground planers. A moderate tooth cut-off blade (10-inch x 60) can function adequately as long as all the ripping is in thin, dry stock. ■



A



B



C+D



E



F



G



H+I



J



K



L

Tooth shape also affects dulling rate. For example, you need pointed teeth to sever fibers cleanly for smooth cross cuts in solid wood or plywood. But points are much more vulnerable to chemical wear and to abrasion than more protected tooth shapes such as square-top or triple-chip (see illustration). The extra pointy points, which are so effective in cutting Malamine and similar materials, really take it on the chin in terms of dulling rate. These blades must be sharpened very frequently.

Rule of thumb: Blades without points (such as triple-chip or square-top) will perform longer, but are less versatile. You can use them for rough cuts and for most applications that don't involve severing fibers.

How dull is dull?

As a cutting tool gets dull it develops a wear surface. There's no standard size for this surface that will tell you when to resharpen. But monitoring the size of this surface (with a 2 or 3 power magnifier) is useful. There are, in fact, several other useful indicators that you can monitor and record if you want to optimize the use of your cutting tools. As blades get duller:

- feed pressure increases
- arbor draws more power
- sawdust gets smaller and/or darker
- cutting is noisier
- finish or workpiece deteriorates
- pitch builds up on tool

Experience will teach you which of these are the most practical for each of your applications.

Side clearance

All saw blades need clearance between the sides of the cut and the body of the blade. Since the sides of the cutting teeth make the cut, these must be offset from the body.

On tipped saw blades, the body itself usually plays no role in this. On steel blades, however, the sides of the body may be tapered to achieve this. These blades are called hollow-ground because the tapering is achieved by grinding.

Flat-ground blades have the teeth spring set (bent alternate ways) or swaged (mushed out both sides). Because hollow ground blades have greater accuracy from tooth to tooth, and a gentler angle of clearance, they produce a smoother cut on the wood. Hence one type of hollow-ground blade is called a planer blade.

The smoother cutting steel blade, however, has its drawbacks:

- tends to burn the workpiece more
- tends to bind in the cut more
- feeds harder (because of increased friction)
- dulls faster (because of the heat)

• costs more to service (the heat can warp the plate)

• costs more to buy

The taper on the side of a carbide tip is called the dish. The usual dish on a carbide saw is about one degree. By cutting this angle down to near zero you can achieve the same planing action on the sides of the cut that a hollow-ground steel blade achieves.

You also have all the same trade-offs. The relative increase in price, however, is greater because the blade needs to be side-ground more accurately, flattened more carefully, and be much more uniform in thickness than a conventional saw blade. These drive the initial cost way up, and continued reflattening drives the service cost up. The better the plate is to start with, the less reflattening it will need over the course of its service life. Also, since these blades are used to produce smooth results, they should be sharpened early and often. This is the type of application for which you should keep a benchmark.

Plate flatness

In general, thinner blades require higher quality and more costly saw plates. Thinner blades (kerf-reduction) can have three basic advantages:

- draws less power and feeds easier
- chips less in some materials
- makes less saw dust

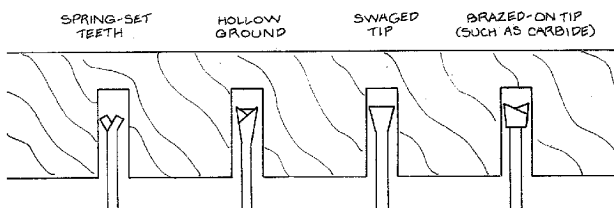
The third advantage can dramatically reduce the amount of raw material needed in some industrial applications (for example, making pencils). It also reduces dust collection problems. But for most cabinet shops and home builders, the other points are more important.

It is important to know at what speeds the body of the blade resonates causing excessive run-out and an uneven and oversized cut—called "snaking." This information allows proper tensioning of the blade.

How flat does a plate have to be? For some applications, blades should have a run-out (variation out of plane) of no more than .001 inch. Most applications are less fussy and can

Ways of handling side clearance

There must be clearance between the side of the body and the sides of the materials being cut.



Square-Top Grind

Generally for coarser blades and general ripping, especially for power feed.



Alternate Top Bevel (ATB)

Points useful for severing fibers. Good for cross-cutting solid wood or plywood. However, very vulnerable.



ATB with Rakers

Tends to be for finer blades and especially for hand-feed or slow power-feed rates. Good for cross-cutting, but vulnerable.



Triple-Chip

Very durable protected tooth style good for many plastics, and rough cuts and ripping in wood. Also good for poorly aligned machinery.



handle up to .003 inch (for a 10-inch blade). Beyond that, you'll get problems such as splintering, saw marks on your stock, and faster dulling.

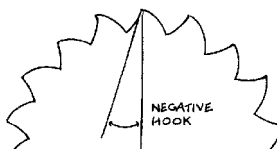
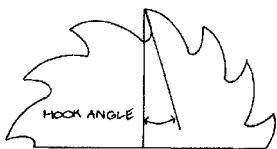
You can get a reasonable idea of a blade's run-out by rotating the blade by hand and measuring with a dial indicator. The important number however, is the run-out when the blade is spinning at its operating speed. It is also important to know at what speeds the body of the blade resonates causing excessive run-out and an uneven and oversized cut (called "snaking.") This information allows proper tensioning of the blade (similar to balancing the wheels of your car). Both these measurements require sophisticated test equipment, and indicate some of the differences between standard industrial blades (or servicing) and premium.

Hook Angle

The hook or "rake" angle (see illustration) is the most important angle on the blade—with the possible exception of the dish. It is also a hard one to generalize about. A negative hook angle maximizes shoulder strength and cutting edge strength (for example, for cutting non-ferrous metals) and can decrease the tendency of the blade to grab the work. A very high hook angle can decrease the feed pressure needed and make the teeth cut much more efficiently (e.g., ripping—particularly of green wood). The more teeth in a blade, the lower the hook angle has to be because lots of teeth and a high hook angle both tend to weaken the shoulders (by making them skinnier). This effect is especially pronounced in carbide saws, because part of the shoulder is removed to make room for the tip.

Hook or rake angle

A high hook angle can make the teeth cut more efficiently, but weakens the shoulder of the tooth. A negative hook angle makes a strong shoulder and is good for non-ferrous metals.



Tooth Bite

If the bite (thickness of the chip removed) per tooth is too small—and this is particularly true of carbide saws—the cutting points rub rather than cut properly. This causes burnishing of the work, premature dulling of the blade, and warping of the plate. A telltale sign is powdery sawdust.

There are five ways to increase the bite: (1) decrease the saw speed (rpm); (2) increase the feed rate; (3) decrease the number of teeth; (4) change top grind; and (5) change angle of attack.

1) The first approach is almost never a good idea since blades need a minimum rate of surface feet per minute for a given application.

2) Increasing the feed rate can be a good solution on power-feed equipment, but you should never feed by hand faster than you are comfortable. Remember, however, not to needlessly underfeed the work, especially with carbide blades. This will cause burnishing and dulling (watch the sawdust).

3) Decreasing the number of teeth is a good approach for rough work. It can also work very well for smooth rip blades, but demands a high quality plate or flattening at every sharpening.

4) To prevent rubbing, each bite must be thick enough. In a square-top blade, each tooth cuts like the one just in front of it yielding a small bite. In a triple-chip or an alternate-top-bevel blade, each tooth cuts in the same position as the tooth two in front of it cut—doubling the bite thickness, but halving the width of each chip. In top-bevel blades with rakers the effective bite is increased even further.

5) The full bite for a given blade is only achieved when the saw cuts straight through the work as a band-saw does. Unfortunately this is rarely feasible with circular saws, since they cut best near the outside of the blade (that is, with the blade set shallow in the stock).

Gullet Size

The gullet is the space between teeth that carries away the sawdust. If the gullets are too small to hold the sawdust, it will overflow onto the sides of the plate, causing fast pitch build-up and burning on the sides of the cut. This problem occurs more with thicker wood (obviously) and more in ripping because the sawdust is bulkier.

Fine tooth blades have less gullet capacity overall. To increase the total gullet capacity, you must reduce the number of teeth, which generally means a rougher cut. So don't use an 80-point blade as a combination saw or it will burn.

Quality Levels

Saw blades and other cutting tools range from very cheap to very expensive. We refer to the low end of the price and performance spectrum as "economy" tooling, the upper part as "premium" tooling, and the stuff in between as "standard" or "industrial" tooling. The same classes pertain to quality of different sharpening jobs.

To be worth the investment, more expensive tooling and servicing have to save you money somewhere. Better tooling (or servicing) will save you money in some instances by saving on:

- labor (perhaps even eliminating a whole step)
- frequency of service
- set-up time after servicing
- tool changing time
- scrapped workpieces
- raw material costs
- the number of tools needed

Four rules of thumb: (1) The better the desired results, the better the tooling you need. (2) The higher the volume, the better the tooling you should have. (3) The less control you have over what goes through the saw, the cheaper the tooling. (4) The more expensive the raw material, the better the tooling.

While the performance difference between premium and economy tooling will be more pronounced on fancy machinery, there can still be a significant difference even on very plain machinery, particularly if it is carefully aligned and maintained.

Make your decisions carefully. Most people should use somewhat better tooling than they do, and tooling costs are small compared to potential savings.

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