The Circular Blade

By Gene Wengert

The workhorse of a circular sawmill is the saw blade itself. It looks simple—a spinning disk with sharp points on the outer edge. But the blade is actually a sensitive and critical piece of spinning metal, and the teeth are equally important. Let's examine the circular blade more carefully. The discussion here applies to all circular blades used in a sawmill on green logs or cants. Lets begin with some terminology...

BITE The amount that each successive tooth moves into the wood being sawn is called the bite. Generally, for softwoods the preferred bite is 0.125 inch and for hardwoods 0.110 inch. This means that after 10 teeth have cut the wood the saw will have moved 1.25 inches or 1.10 inches forward into the wood.

BODY or PLATE The body or plate is the main piece of metal used to make the saw blade. The teeth are fastened to the outer rim. The center has a hole to accommodate the arbor.

COLLAR The washers on each side of the blade when the blade is attached to the arbor are called the collars. The collar not only holds the blade to the arbor, but also stops wobble and effectively increases the blade stiffness.

The collar should be as large as practical for best stability, especially with thinner blades. (Many collars are too small, in my opinion.) The collar must touch at its outer perimeter, so often one of the collars is hollow ground, while the other is perfectly flat; or sometimes both are hollow ground. Overtightening the arbor nut can actually cause some collars to warp and lose contact and effectiveness.

EYE The exact center of the saw is the eye.

GAUGE The measure of the plate thickness is the gauge. A typical saw, for example, could be 7 gauge, which is 0.180 inch or approximately 3/16 inch in thickness. (Table pg 14.)

GULLET The space between the teeth and the body of the saw. This space holds the sawdust while the teeth are in the cut. The gullet must be large enough to hold all the sawdust produced. A full gullet means that no further cutting can be done; slower than normal feed speeds will have to be used, plus the blade may vibrate excessively. Larger gullets are required when making deep cuts (that is, when sawing thick pieces). Slow feed speeds when gullets are too small mean fine sawdust, low production, heating, and short saw life (rapid dulling). Gullets should be rounded without sharp corners to avoid cracks and breaks.

KERF The width of the slot in the wood made by the blade when sawing is the kerf. For practical purposes, the kerf is the same as the overall width of the saw teeth, called the set. Technically, after the teeth cut the wood, the wood actually closes the slot or springs back a very small amount giving a narrower kerf.

NUMBER OF TEETH Circular saws are specified based on their diameter and the total number of teeth they have. Teeth spaced too closely make more fine sawdust and potentially more heat, causing the blade to wander a bit at times.

SET In order to create enough room for the body of the saw to pass through the wood without rubbing, the saw teeth are made a bit wider than the body of the saw. The extra width on each side of the body of the saw is called the side clearance. The set is the total width of the teeth. Avoid large sets as they will greatly affect yield and profits. As a rough rule of thumb, each 1/32 inch of extra kerf is a 3% loss in yield.

SIDE CLEARANCE See set.

SIDE DRESSING It is often important that the sides of the teeth be perfectly aligned with one another (that is, protrude out the side of the saw the same distance), so that they produce a smooth surface. This process of aligning is called side dressing. Many saws have terrible tooth alignment and therefore cut very rough surfaces and waste wood (and money).

SWAGE (Rhymes with edge.) This is the process of mechanically (with a hammer and special tool) spreading the metal at the tip of the tooth out so that the tip of the tooth becomes the widest spot. After swaging, the tooth is sharpened normally. Swaging is normally done to solid-tooth saws, but rarely done to inserted-tooth saws.

TEETH The teeth are the part of the blade that cuts the wood. The teeth cut a slot, called the kerf, in the wood that is a little bit wider than the thickness of the plate, so the plate can move through the wood without rubbing.

TIP OF THE TOOTH The part of the tooth that does the actual cutting or scraping of the wood is the tip or top of the tooth. Some manufacturers of inexpensive saw blades do not have extremely sharp teeth when the "new" blade is shipped—this is "bad news." Even inserted teeth may not be well sharpened.

TOOTH POINT Same as "tip of the tooth."

Saw Blade Style

There are two styles of saw blades:

* Those with inserted teeth (that is, the teeth are replaced after being sharpened a few times). The saw will stay the same diameter after repeated sharpening.

* Those with teeth that are an integral part of the saw, called solid-tooth saws. Each time the teeth are sharpened and the gullet is ground slightly, the saw will decrease slightly in diameter.

Saw Diameter

The diameter is chosen based on the horsepower, expected wood density, log or cant size, tooth size, and so on. The larger the saw, the slower it must be run, the more teeth it will have, and the more horsepower required. Further, the larger the saw, the harder it is to maintain. Of course, the larger the saw, the larger the piece of wood that can be sawn. However, most mills will bypass a few large pieces of wood and use a smaller saw, rather than be able to cut everything and use a larger saw.

Detailed calculations of the best saw size can be done. For example, see www.fpl.fs.fed.us/documnts/misc/circsaw.pdf.

Saw Plate Thickness

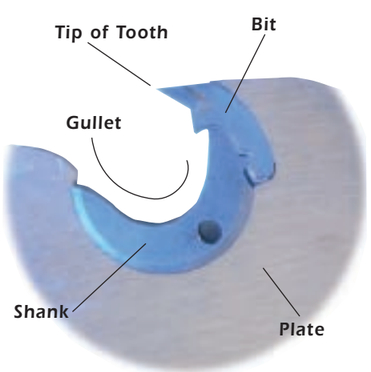
The plate transfers the power from the arbor to the teeth. The plate also keeps the teeth

Birmingham Thickness Gauge for Saw Plates

Gauge	Thickness (inches)	Approximate (inches)
3	0.259	17/64
4	0.238	15/64
5	0.220	7/32
6	0.203	13/64
7	0.180	3/16
8	0.165	11/64
9	0.148	9/64
10	0.134	9/64
11	0.120	1/8

running straight. Thick plates are needed when the wood is dense. Thinner plates can be used for lower density woods. If the plate is too thin, however, it will vibrate and the saw will wander in the cut.

The plate of a circular saw blade is typically 1/8 inch to 1/4 inch thick. Sometimes the plate is thicker at the eye of the saw and then tapers a bit toward the teeth. The thinner plate means that there is less sawdust and potentially less waste. However, thin blades, often called thin-kerf blades, are very sensitive to heating and wobbling, which in turn means non-straight (wavy or snaky) cuts. As a result of this one factor, most people opt for a thicker, and therefore stiffer, plate. When someone comes up with a thin-kerf, stiff plate, it will sell like hot cakes and improve wood manufacturing profits.



Suggested plate size for 40-inch- to 54-inch-diameter saw blades: For low density woods and smaller diameter logs or large cants, use a 9/10 gauge (9 gauge at the eye and 10 gauge toward the rim); for dense woods and large diameter logs or large cants, use a 7/8 gauge; for intermediate density and intermediate diameters, use an 8/9 gauge. Traditionally, the Birmingham gauge has been used.

Saw Blade Tension

When a saw blade is spinning, the outer rim wants to fly off due to centripetal force. The metal below the rim keeps the outer metal from expanding, however. In order to offset this centripetal force, the rim of the blade can get wavy. Of course, a wavy rim means wavy cuts. To correct this tendency, a saw blade is dished slightly when at rest. The amount of dish depends on the final speed of rotation. As the dished saw blade increases its speed, the rim gets longer by becoming un-dished or by "standing up straight." The process of dishing a saw is called tensioning the saw. It was done mainly by hammering the saw, but is now often done with automatic rollers and tensioning devices. In any case, a large diameter saw must be properly tensioned for it to run correctly–straight and true.

Saw Teeth

TOOTH MATERIAL Although many saws use steel teeth, many modern saws use a different material that is brazed onto the saw tip. The most common material is probably carbide. Carbide consists of a mixture of tungsten, carbon, and cobalt. It lasts 50 times longer when cutting wood than steel teeth. Carbide is very brittle, so the saw must be handled carefully once off the arbor. Hitting small pebbles embedded in the bark of a log can easily chip the carbide. Western red cedar is known to dissolve the cement that holds the carbide together, so often the teeth with this species are Stellite. Other tooth materials include high speed steel (HSS), diamond, and chrome.

INSERTED TEETH Sawmills have used inserted teeth for many decades. Certainly one advantage is that if a nail or other tramp metal is hit when sawing, it takes just a few moments to remove the damaged teeth (called bits) and replace them with new ones. The gullets do not have to be ground when resharpening the bits, although the edges of the gullets should be kept sharp. Further, the teeth are already wider at the tip than further back, so they do not usually have to be swaged. Inserted teeth can be used in saws from 12 inch diameter and larger, although sometimes solid tooth saws will have less kerf.

When specifying an inserted bit (and there is also the shank that goes with the bit to hold the bit in the saw body), the items that must be specified are style, gauge, kerf, type, and tip.

STYLE There are four common styles of inserted teeth: 2-1/2, 3, F, and B. The 2-1/2 and F styles are a bit narrower than the other two.

GAUGE The gauge refers to the thickness of the plate at the rim.

KERF The kerf is the width of the tip of the tooth.

TYPE Each of the above styles when made of HSS is available in a standard shape bit, in an extra long shape bit, and in a Standall bit (designed for frozen lumber, but often used on all lumber).

TIP The tip refers to the material, such as chrome or Stellite, put on the tooth's tip. Although solid tooth saws can be tipped with carbide or other materials, it is expensive to do so, especially when compared to an inserted tooth saw.

Hook, Sharpness, and Clearance Angles

The angle of the tooth face, compared to a radius from the center of the plate, is called the hook angle. (Rake is the same angle, but usually rake is applied to knives and hook to saws.) The larger the hook, the more the blade wants to climb into the wood; a saw with large hook is called an aggressive saw. It can feed so aggressively that the saw will stall. The large hook also means rougher cuts (that is, more tear-out). Blades with smaller than normal hook angles are hard to feed.

The clearance angle is the angle between the back of the tooth and a line drawn connecting adjacent teeth. This angle is required so that the back of the tooth does not rub on the wood as the saw is fed into the wood.

Generally, the hook is 43 degrees to 45 degrees. The tooth sharpness angle is 35 degrees to 37 degrees and the clearance angle is 9 degrees to 12 degrees. These three angles must total 90 degrees. Generally, be very careful not to change the angles from the factory settings.

Sharpening

Sharpening can be done with a handheld file, but almost everyone uses an electrically powered tool (that looks like a hand drill with a grinding wheel) called a Jockey Grander. It is critical to keep the angles the same as originally supplied, and to also keep the tip straight across and not angled. Avoid too much heating of the metal (turning blue is too much). Although sharpening is easy, it must be done carefully and skillfully to achieve the proper results and good lumber surface quality. Ask an expert (not necessarily your neighbor) for a quick lesson. ■

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