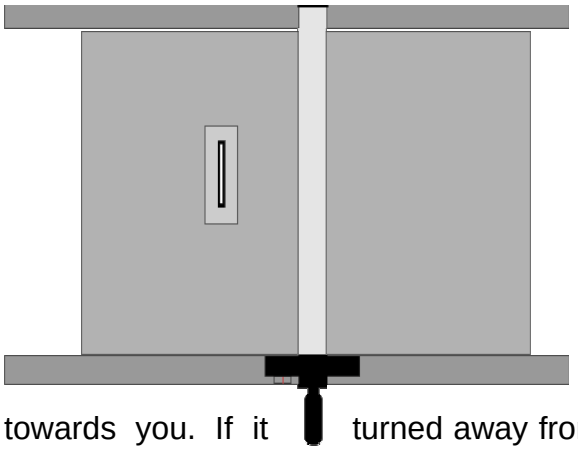
Table Circular Saw Kickback - The Nightmare Explained

Source: http://www.raygirling.com/kickback.htm

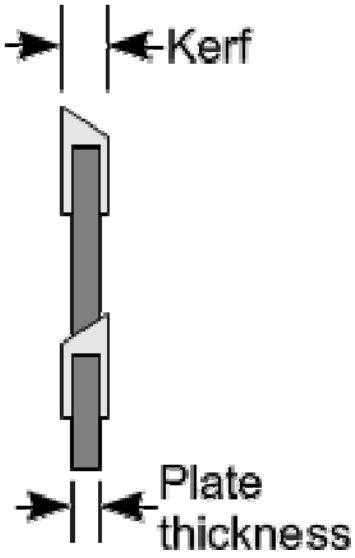
Most table circular saw owners dread kickback without necessarily understanding what it is and more importantly, what causes it. Knowing that it involves a piece of stock coming back towards you is fine, but as with most technical matters, once you understand how and why it happens, you've got much more chance of preventing it. These words and pictures are an attempt to get back to basics and de-mystify the subject.



Here's a simplified view of the BT3 saw from above, showing the throat plate surrounding the blade, the fence assembly and the fence rails.

Whilst most will recognize the importance of having the fence parallel to the blade, the reason for this might not be obvious and bears further (later) explanation.

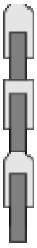
The table circular saw blade rotates at high speed towards you. If it turned away from you, it would not cut wood, but it would be ideal for launching the stock into space! The blade itself can have a variety of forms, depending on the use it is intended for. The circular steel saw plate, which gives the blade its size and shape as well as fixing it to the motor arbour, is also the surface onto which the cutting teeth - usually carbide (an alloy of cobalt and tungsten) - are attached. There are four common ways of configuring the teeth, a summary of which may help:



The "kerf" of a blade is the amount of material it removes from the stock, or, in other words, the width of the cutting teeth (and therefore, the cut). The saw plate thickness is less than that of the teeth, as can be seen in this diagram, which provides relief between the stock and the blade.

There are other parts of the blade that assist in its efficiency, but we are not concerned with them in this explanation. The blade profile pictured here is an Alternate Top Bevel (or ATB), so called because each alternate cutting tip's bevel is on the opposite side, as shown. The bevel angle is usually 15 degrees and although two teeth will span the width of the kerf, this configuration will leave a slight "V" in non-through cuts.

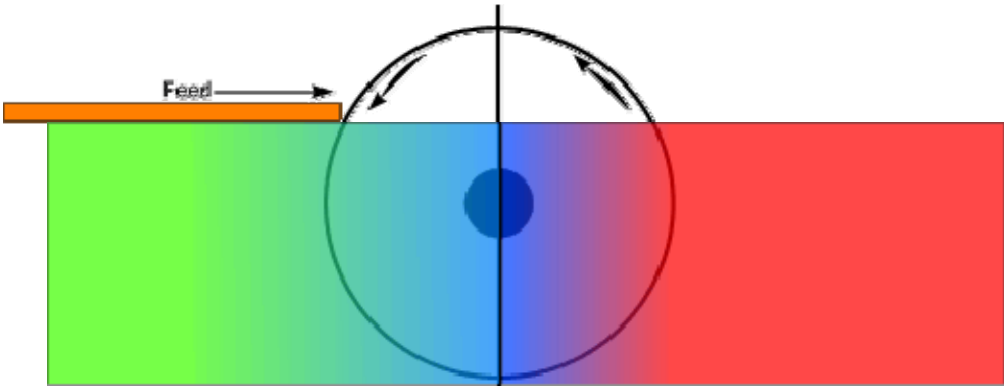
Another configuration is the Square Top Tooth, designed for heavy cutting applications. The cutting teeth are ground square, perpendicular to the side of the saw plate.



The first tooth (the lead tooth) has a double 45-degree corner bevel. This is followed by a flat-topped raker tooth, which is ground slightly lower than the lead tooth. The raker removes the corners of the cut left on both sides by the bevelled lead tooth.

The final popular configuration is the Planer Combination. This uses a single raker with four alternating top bevels. The raker is ground both slightly lower and narrower than the ATB teeth. The raker removes the central "V" portion left by the ATB teeth, resulting in a very smooth cut.

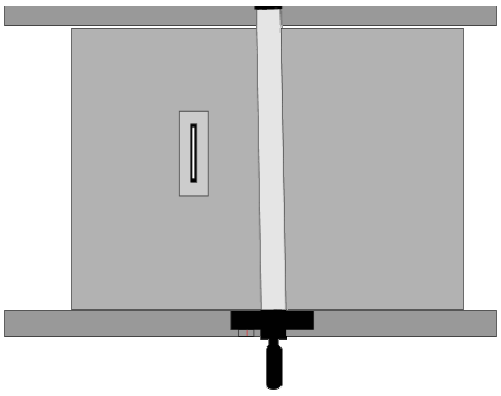
No matter what profile the blade teeth have, the kerf will be wider than the saw plate. This allows the plate to run free within the kerf already cut into the stock as it is passed through the blade. If the saw plate were as wide as the cutting teeth, then the whole face of the saw plate would be in friction contact with the sides of the cut. This would generate a great deal of heat, which in the early part of the cut would be inconvenient, possibly marking the stock.



However, once the stock has passed the “centre” of the blade (the vertical black line in the above diagram) and therefore the centre of rotation, the “back” of the blade would then lift the stock upwards as soon as it overcame the weight of stock and/or any downward force applied to it. Once the stock weight (and/or force applied) has been overcome, the friction of the blade upon the stock will act just like a clutch in stick-shift, gaining a grip on the side of the cut by friction and propelling the wood in the direction of travel of the blade. This, unfortunately, is upwards and towards the front of the blade and - therefore - towards YOU!

The circumference (perimeter) of a 10-inch saw blade is 31.4 inches. If the saw blade travels at 4,800 revolutions per minute (rpm), then the teeth are travelling at 150,720 inches per minute. To put that another way, that’s 9,043,200 inches per hour, or 142.72 mph! Even allowing for the fact that some of the blade speed will be lost through load, that’s still **120 mph** if 15% of the speed is lost – usually, an over-estimate. It is not surprising to realise, then, that any piece of stock propelled by a blade moving at that speed has the potential and inertia to travel a great distance and become *a very dangerous projectile*.

Thankfully, saw plates are not as wide as their cutting teeth and - in a perfect setup - will run freely within the width of the kerf of the cut and remain cool. The trouble is that "perfect setups" don't happen automatically, or naturally. Some saws may be perfectly set up right out of the box and may also remain so for their entire working life. I haven't found one or heard of one yet that has done both! Checking the setup of your table circular saw is not only essential for accuracy, it is also essential for your health and safety. Regular checking of a "perfect" setup is also necessary, as many things can affect it over use and time, particularly rough handling and/or poor technique.



Look at this diagram:

The fence is not parallel to the blade – it is skewed towards it at a slight angle.

As the stock is fed into such a setup, it will become pinched between the fence and the blade and the further it is pushed through, the worse the pinching

effect will be. A square piece of stock will not pass through a smaller opening!

This is kickback waiting to happen (fence-induced kickback) - the stock cannot pass cleanly through the blade and will be forced sideways into the back of the blade by the fence. This is why it is ESSENTIAL to make sure that your fence is parallel to the blade.

Some woodworkers adjust their fence so that it “leans away” from the blade, even by just half the thickness of a business card. This removes the potential for such fence-induced kickback, whilst not adversely affecting the workpiece.

Riving Knives

The riving knife is a device that will greatly reduce the possibility of kickback, provided that it is properly adjusted.

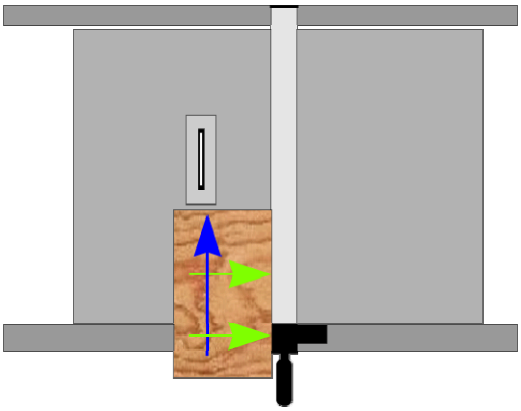
If your riving knife is the same thickness as the blade kerf, adjust it to be in line with the blade. If your riving knife is thinner than the kerf, adjust it so that it aligns with the fence side of the kerf, as shown in the above diagram. The purpose of the riving knife is to prevent sideways pressure on the blade from stock which is passing through. Once the leading edge of the workpiece reaches the knife, it also serves to guide the cut and prevents the up-running teeth at the back of the blade from unnecessarily scoring the kerf.

Another function of the riving knife is to serve as a form of rear guard, preventing off-cuts and knots from being caught by the up-running teeth and thrown towards you. Sometimes the kerf can narrow as it leaves the cutting teeth. When this happens it can pinch the back of the blade, causing the workpiece to be violently thrown upwards and forwards towards you. A properly adjusted riving knife will prevent this from happening, as it holds the cut open behind the blade.

If the opposite happens and the kerf spreads, the now-wider workpiece will press against the riving knife and the fence. This can increase the force required to feed the stock through the blade and should immediately alert you. However, if there is no riving knife, or it is incorrectly fitted, the sideways pressure can push the workpiece against the up-running teeth and cause kickback.

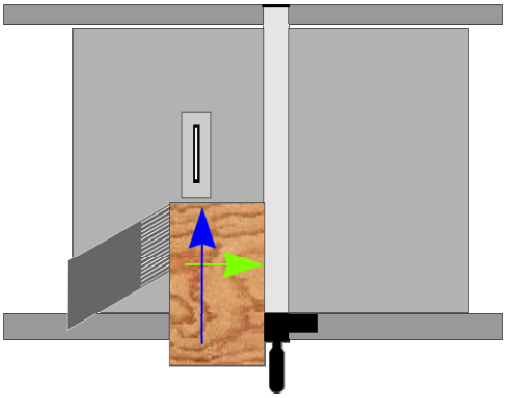
Timber can become "case-hardened." When the material is cut, internal stresses are released. Some wood may have twisted or interlocked grain, or may have high moisture content. All of these conditions increase the possibility of kickback.

Prevention is Better Than Cure!



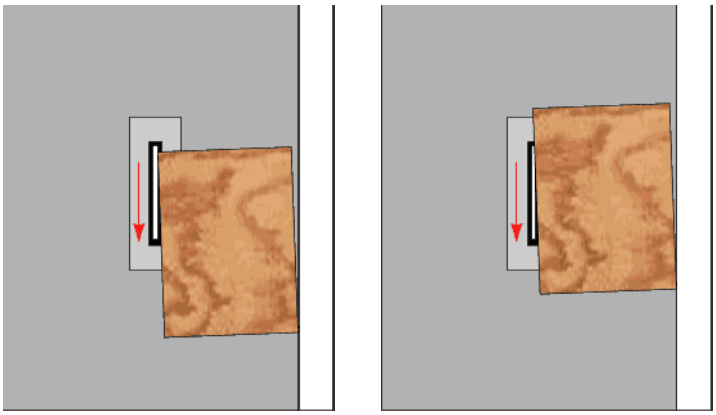
When feeding stock, ensure that it is held firmly against the fence by pressure in the direction of the fence (the green arrows). Once a good contact has been established with the fence, feeding can begin (blue arrow).

A featherboard can greatly assist in keeping stock tight against the fence, but can only be used horizontally in front of the blade.



Featherboards can also be used by clamping them vertically to the fence, where they will provide a downward force on the stock.

If you allow the stock to twist or skew, as soon as it reaches the back edge of the blade, the up-running teeth will launch it at you, in the direction of the blade rotation (red arrow).



Using a Stop Block

Using a Stop Block, a small piece of wood attached to the rip fence (as shown in the diagram below) will eliminate kickback on small pieces.

The Step Block is also important when you are cutting a number of pieces the same size.

Note that the Stop Block must be clear of the end of the piece being cut before the leading edge of the piece contacts the blade. If this is not done then kickback **WILL** occur.

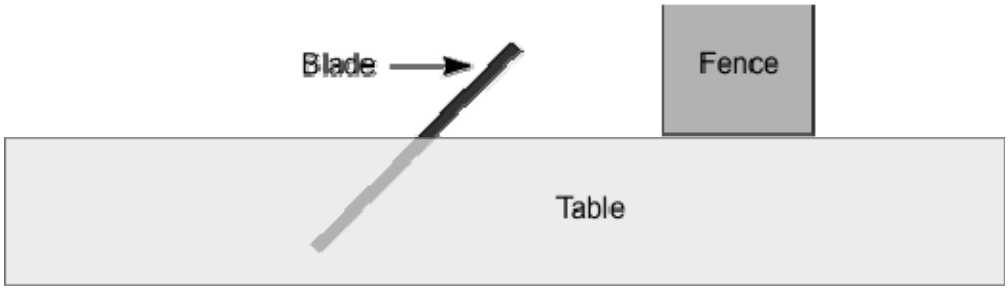
Causes and Effects

Always ensure that the edge of a workpiece against the fence is straight. If it is not straight, a crooked cut will occur.

Always use the rip fence to guide the workpiece in a straight line when ripping. ***Never freehand-cut a workpiece. Free-handing causes crooked cuts and potential kickback.***

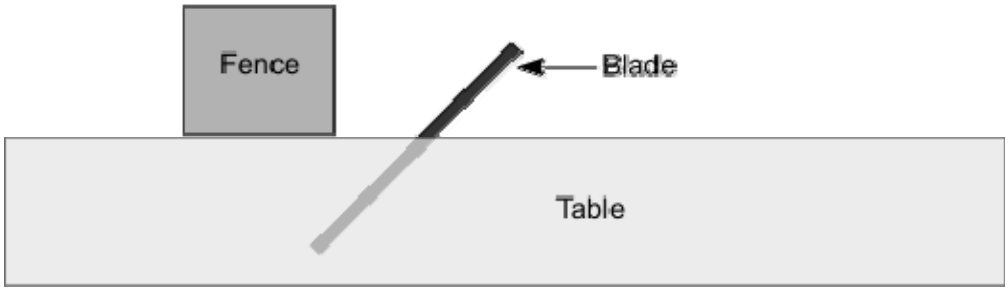
Never tilt the blade so that the workpiece is trapped in the angle between the blade and the fence. This is a condition that has a very high potential of causing kickback:

WRONG



Move the fence to the left-hand side of the blade, like this:

RIGHT



Final "Do"s and "Don't"s

- A dull blade may cause a kickback. Keep your saw blades sharp.

- A build-up of pitch or sap on the surface of the saw blade will increase the thickness of the blade and therefore increase friction on the saw plate. These conditions will increase the likelihood of kickback. Keep your saw blades clean.

- Do not cut wet wood, it produces higher friction against the saw blade. Additionally, the blade can load with wet sawdust, which again increases the likelihood of kickback.

- Be very careful with pitchy, knotty or warped wood. These flaws are much more likely to create pinching and - therefore - kickback.

- Never use a bent, broken or warped saw blade. The potential for binding and therefore kickback is greatly increased.

- A build-up of sap on the blades, dullness and free-handing a cut can all cause a blade to overheat. Overheating a saw blade can cause it to warp and create kickback.

- Never use the Sliding Miter Table in such a way that the wood is also in contact with the rip fence at the point of cut! To cut repeat lengths using the SMT, clamp or T-nut a short block of wood (a stop-block) to the fence close to the front rail and set this block the required distance from the blade. Butt your stock to the stop-block to set the correct length, then as you move the SMT towards the blade to make the cut the wood will clear the stop-block and be guided only by the SMT, which will ensure that the stock is not in contact with the rip fence.