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Carlton®

## Special Note:

This maintenance manual was prepared from the most accurate information available at the time of printing. It offers general saw chain theory and maintenance instructions for Carlton products. Carlton Company strongly suggests that you follow the maintenance instructions provided by the manufacturer. When in doubt, contact the manufacturer or an Authorized Service Dealer before performing service on any brand of product.

# Introduction

The purpose of this manual is to help you obtain all of the life, performance and cutting efficiency that was built into your Carlton Saw Chain, Guide Bar and drive sprocket.

Carlton Company's marketing philosophy is based on sales through education. Without a doubt, the most misunderstood part of a chain saw is the cutting chain. We stress the importance of maintenance as a means to promote repeat sales. In other words, we want to teach you how to get the most out of our products as our way to convince you to buy more!

You might think that you need expensive grinding equipment and specialized training to properly maintain your Carlton Saw Chain and Guide Bar. Nothing could be further from the truth.

## By reading through this handbook you will learn:

- How saw chain actually cuts wood on your chain saw.
- The basic differences between the various cutter tooth styles on the market.
- The proper way to maintain Carlton Saw Chain cutter teeth and depth gauges.
- How to maintain Carlton Guide Bars.
- How to identify the wear patterns caused by improper maintenance that can lead to saw chain, guide bar and drive sprocket failure.
- How to recognize rotational and linear kickback along with some simple, common sense tips for the safe and comfortable operation of your chain saw.
- Information regarding the voluntary kickback standard ANSI B175 as it pertains to aftermarket cutting attachments.

If you prefer not to perform your own maintenance, please keep in mind that your Authorized Carlton Dealer is trained to service Carlton products. The important thing to remember is that a properly maintained saw chain and guide bar make any chain saw cut more safely and efficiently.

Finally, thank you for purchasing a Carlton Company product. We at the Carlton Company still measure our success one loop at a time.

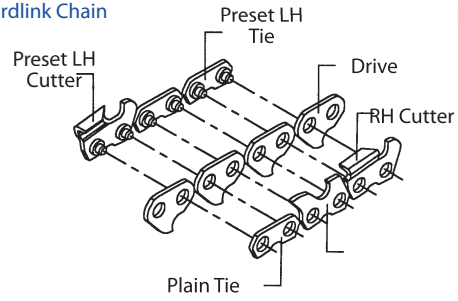
CARLTON® SAW CHAIN

THE PROFESSIONAL CHOICE

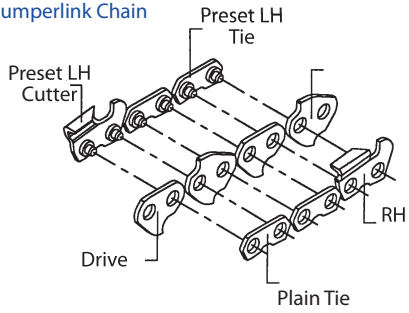
To help you understand saw chain, a brief review of the component parts is helpful. Please use this page to reference the terms used in this book.

## Exploded View of Saw Chain

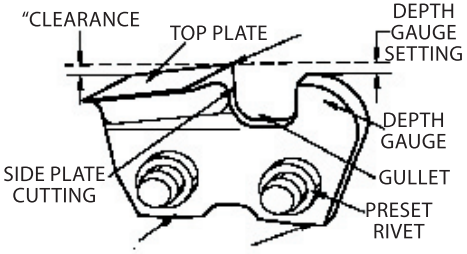
Guardlink Chain



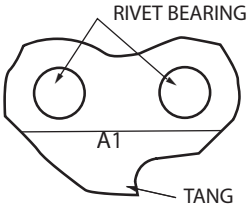

Bumperlink Chain



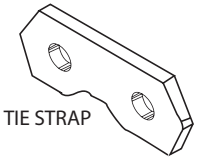

## The Cutter Tooth

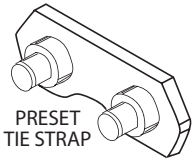



## The Drive Link

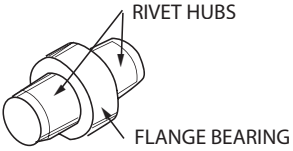



## Tie Strap




## The Rivet



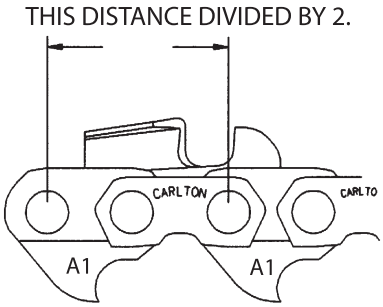

### Carlton Technical Tip

Saw chain parts may look alike but they are not interchangeable! Never install used repair parts or mix different manufacturer's parts when repairing or making up chain loops Always use only the manufacturer's replacement parts.

It is important to know the pitch and gauge of saw chain.

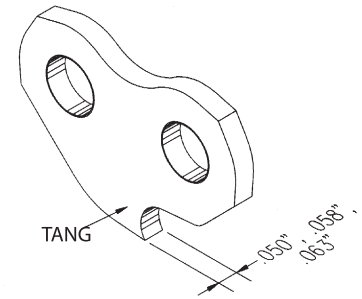
## Saw Chain Pitch

The word pitch actually means size. The larger the pitch (measured in thousandths of an inch) the larger the saw chain. Pitch is determined by measuring the distance between the centerlines of three consecutive rivets and dividing this distance in half. In other words, 3/8 pitch saw chain (.375") measures 3/4 of an inch (.750") between the centerlines.




## Saw Chain Gauge

Saw chain gauge refers to the thickness of the drive link tangs that fit into the guide bar groove and is also measured in thousandths of an inch.There are three standard gauges for hand held chain saw cutting chain; .050", .058" and .063". It is important that the saw chain's gauge match the guide bar gauge.



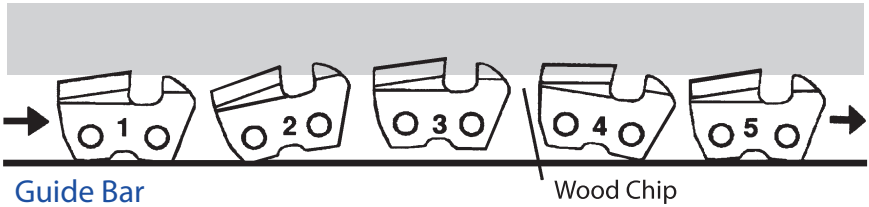

### Carlton Technical Tip

l. Saw Chain pitch must match the pitch of the drive sprocket and the guide bar sprocket tip.

2. Saw Chain gauge must match the gauge of the guide bar.

Any mismatch of the items listed above will lead to premature

To help you properly maintain your Carlton Saw Chain, avoiding the problems of poor maintenance and recognizing the wear patterns that can cause saw chain and guide bar failure, it is essential to first learn how saw chain cuts wood with your chain saw. You might be surprised to learn that a cutter tooth must actually leave the guide bar to cut wood efficiently.




All saw chain cuts with a rocking motion. When cutting properly, saw chain resembles a dolphin swimming in the ocean. As the cutter enters the wood, the "leading edge" starts to bite (#1) causing the cutter to rock back as far as the depth gauge will allow (#2). The cutter is now in the "attack position". The cutter jumps off the guide bar and into the wood (#3). Chain tension and power from the saw pull the cutter back out of the wood and the severed chip exits from the underside of the cutter (#4). The cutter then returns to its original position (#5). Any condition that upsets this smooth and efficient rocking motion will have a negative effect on the life, performance and cutting efficiency of any saw chain.

## Depth Gauges

Depth gauges are often called rakers because some think they "rake" out the severed chips, just like raking leaves. The actual function of the depth gauge is to determine how far the cutter will rock back in position #2 and ultimately how large a bite the cutter will take. Also, it is normal for the depth gauge to sink into the wood under certain conditions as illustrated in positions #2 and #3.

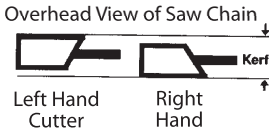
## Clearance Angle

The "clearance angle" of the cutter on page 3 is the reason why saw chain is able to cut with an efficient rocking motion. As you can see, the rear of the top plate is lower in height than the front which allows it to tip forward as in position #4 and exit the wood cleanly. Without a "clearance angle", the cutter would not be able to rock out of the wood. Finally, this "clearance angle" in the cutter's top plate complicates the process of depth gauge maintenance

and will be discussed in detail later in this manual.

## Kerf

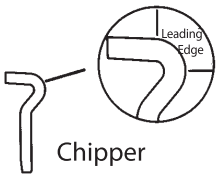
Kerf is the overall width of the cut that the saw chain makes in the wood. Technically, kerf is determined by the outsides of the left hand and right hand cutters.



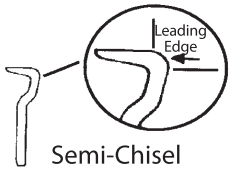

## Chipper, Semi-Chisel and Chisel Cutters

Tooth size, shape and "leading edge" determine the efficiency and durability of saw chain and provide a history lesson in saw chain design. Most of the saw's power is consumed by cutting the cross grains of the wood.

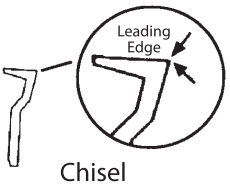
The first modern cutter design is called Chipper. It has a thick top plate and side plate as well as a large radius to the leading edge. This chain is very durable but requires a lot of power.

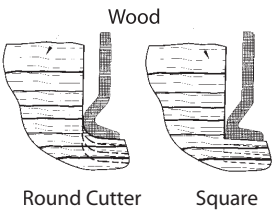



Semi-Chisel chain is essentially a streamlined chipper design. It features a tapered top plate, a relieved side plate and a smaller radius to the leading edge. This greatly increases cutting efficiency without sacrificing much durability.




Chisel chain is designed for all out Chisel performance by making the leading edge a pointed square corner. The bottom graphic shows that chisel chain's squared cutter also cuts faster by severing all of the wood fibers in the kerf in one pass. The actual leading edge of the "point" does most of the cutting and is easily damaged in abrasive conditions. As a result, chisel chain is best suited for clean, standing timber.




### Carlton Technical Tip

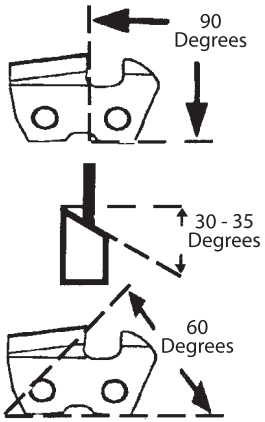
It's best to match the chain to the cutting conditions. Chipper chain is the most durable for abrasive conditions. Chisel chain is popular, but the leading edge "point" on chisel chain allows it to cut faster while sacrificing durability. Once the point becomes damaged, the chain will not cut well at all.
This makes chisel chain a poor choice for abrasive conditions. For most applications Semi-Chisel chain is the best compromise of speed and durability. The leading edge is larger, rounded and, as a result, more durable.

## Introduction

Products requiring routine maintenance (including saw chain) should always be serviced according to the manufacturer's recommendations.
This chapter offers factory instructions for maintaining Carlton Saw Chain. The cutting angles and depth gauge settings designed into your Carlton Saw Chain at the factory have proven the best for a wide range of cutting conditions. Maintaining your Carlton Saw Chain to factory specifications will ensure chain life and cutting efficiency. It will also allow you to cut more wood with less effort. We offer a tool to do this.

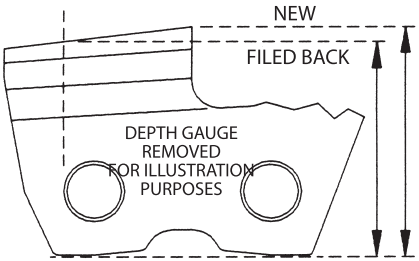
Two things must be done to properly maintain a saw chain; sharpening cutters and lowering depth gauges. One without the other is less than effective. As you will learn, there is a big difference between just filing a chain and actually sharpening a chain.

Cutters lose their sharp "edge" and become dull from extended cutting, abrasives in the wood (sand, ashes, etc.) or from hitting foreign objects such as dirt, nails, rocks, pavement, etc. A good sharpening job restores each cutter's leading edge with specific filing angles recommended by the factory. The leading edge is the most important part of the cutter because it does most of the work. But this is only part of the job.




As a cutter is repeatedly sharpened, the tooth gets shorter simply because it is being filed away. Due to the "clearance angle" designed into the top plate of the cutter, the overall cutter height actually becomes lower as it is filed back.

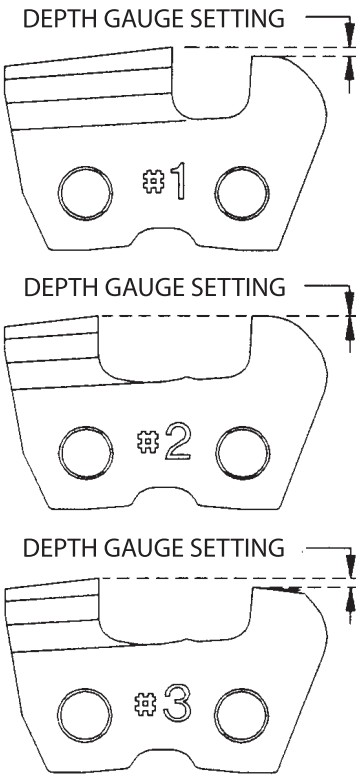
Remember that the height of the depth gauge in relation to the height of the leading edge of the cutter determines the size of the bite that the tooth can take. Consequently, the depth gauge must be lowered in proportion to the decreased cutter height to keep the saw chain self-feeding into the wood.




Overall Cutter Height
New versus Filed Back

## Maintaining Depth Gauges

Referring back to the illustration on page 3, the depth gauge setting is the distance between the height of the depth gauge relative to the overall height of the cutter and determines the size of the bite that a cutter can take. As the cutter is filed back, its overall height becomes lower. The depth gauge must be filed down as the cutter gets shorter (and lower) to keep the chain self-feeding into the wood.




As the illustrations to the right demonstrate, a new cutter (#1) has a depth gauge setting and will feed efficiently into the wood. Cutter #2 has been partially filed back without lowering the depth gauge. This cutter cannot feed into the wood because it has no depth gauge setting. In fact, the depth gauge in cutter #2 will actually hold the cutter tooth away from the wood. Cutter #3 has the same cutter length and height as #2 but the depth gauge has been lowered to compensate for the shorter cutter height. As a result, cutter #3 will cut as efficiently as cutter #1.

The most misunderstood part of depth gauge maintenance (aside from not knowing that depth gauges need to be maintained at all) is how much to file the depth gauges down each time the cutter is sharpened. If the depth gauges are not lowered enough, the chain will not cut efficiently. If depth gauges are lowered too much, the chain will cut very roughly.

There are many theories on how to properly maintain a saw chain; we believe ours is the best. A bit of background information about the evolution of chain saws and saw chain is helpful to understand more about the proper way to sharpen cutters and maintain depth gauges.

### Carlton Technical Tip

Depth gauges do not wear down by themselves! They are made from the same hardened steel as the rest of the cutter. Depth gauges must be filed down as the cutter is filed shorter in length and lower in height to keep the chain "self feeding" into the wood.

## About Chain Saws...

Most saw chain and guide bar failures are directly related to improper maintenance. This is due in part to the evolution of the chain saw itself. Modern chain saws have much smaller and lighter engines and feature a limited range of peak power. However, they are able to out-perform older, heavier, slow revving saws that had more "brute power". These new generation saws accomplish this by relying on chain speed versus raw power and require sharp cutters and properly maintained depth gauges to perform well.

In the past, chain maintenance was less important because of the large amount of raw power and the slower speeds involved in older big saws. Proper chain maintenance is critical to the performance of modern chain saws. However, sharpening techniques in the field have not always kept pace with the changes in chain saw design.

### These next paragraphs explain most chain and bar failures!

As previously mentioned, an understanding of how saw chain cuts wood is essential to learn how to sharpen a saw chain properly. For whatever the reason (high depth gauges, dull cutters, improper maintenance, rocks, nails, etc.), anytime a saw chain is unable to cut wood with a smooth rocking motion it will not perform well and ultimately will fail.

When a power tool such as an electric drill stops cutting, the operator's normal reaction is to apply more feed pressure to force the drill bit to work. When a saw chain stops cutting, the reaction is to apply more feed pressure either by pushing down on the saw handles or by digging in the bumper spikes (if the saw has them) and pulling up on the rear handle.

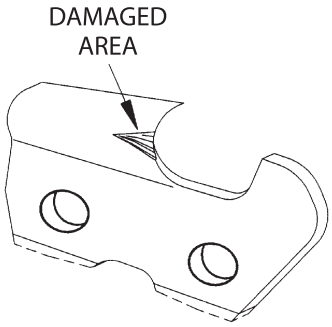
This forces the chain into the wood but also creates additional friction between the bottoms of the cutters and tie straps and the rails of the guide bar. The bar and chain oil eventually breaks down resulting in worn cutter bottoms and excessive bar rail wear. The heat generated from this friction causes the metal in the chain to temporarily expand giving the appearance of stretch. On the other hand, if the chain is filed so aggressively that the saw cuts rough or wants to stall in the cut, the result will be peened cutter bottoms, tight joints where the chain parts are riveted together and chipped and/or cracked guide bar rails.

If either situation mentioned above is not corrected, the saw chain and guide bar will ultimately fail. If the cause is improper maintenance and the operator does not make corrections (or does not know what he may be doing wrong) the same symptoms keep returning. When failures persist, the operator may conclude that the chain and/or guide bar is "defective."

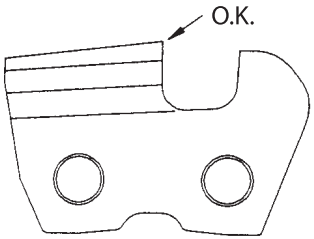
## Common Saw Chain Maintenance Errors

The purpose of sharpening cutters is to remove any damaged area and to restore the "leading edge" of the cutter. A good sharpening job leaves:

- Damaged area filed away to leave a clean line of chrome plate on the leading edge to maintain sharpness.
- A leading edge that is thin enough to cut efficiently but well supported underneath to give it durability.
- Consistently accurate top plate angles.
- A clear gullet for chip clearance.



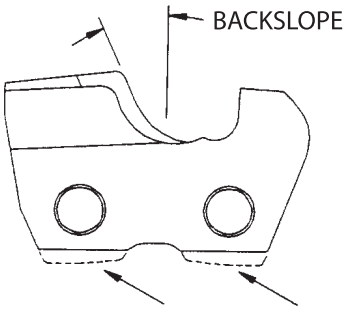

### The two biggest mistakes made in sharpening cutters are backslope and hook.

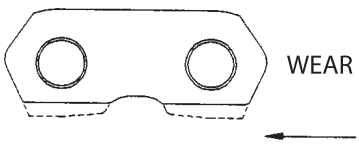



## Backslope

A backsloped cutter is filed so that there is no leading edge. Backslope is caused by using a file that is too large for the chain or by holding the file up too high into the tooth when filing

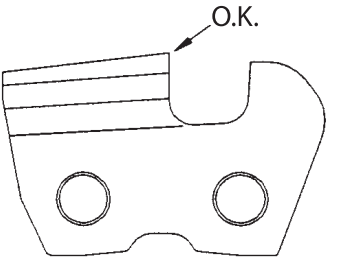
As a backsloped cutter tries to enter the wood, the blunt edge will not bite; even with the proper depth gauge setting. There is no rocking motion because the cutter only skids along the bar on it's heel. The operator applies more feed pressure causing increased wear on the bottoms of the cutters and tie straps which can lead to eventual chain breakage. When resharpened using the same technique, the same results are achieved. Over time the operator may come to the wrong conclusion that the chain must be “soft” because the cutters have worn heels and will not stay sharp.

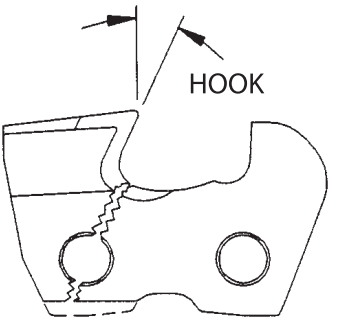


## Hook

A hooked cutter can be compared to a razor blade. They both cut aggressively but will get dull very quickly because the actual cutting edge has very little metal underneath to support it. Hooked cutters are caused by using a file that is too small for the chain or by holding the file too low into the tooth. The chain will cut more aggressively for a while but will not stay sharp for very long. After the cutter becomes dull, the chain will stop cutting. The operator applies more feed pressure causing the bottoms of the chain to wear against the bar rails. In addition, hooking a partially worn chain can weaken the cutter in the gullet area, causing possible breakage. Continuing to refile (not resharpen) with a hook will result in poor stay sharp, rough cutting, breakage, stretch and complaints that the chain is "soft".

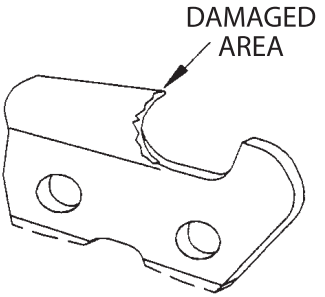


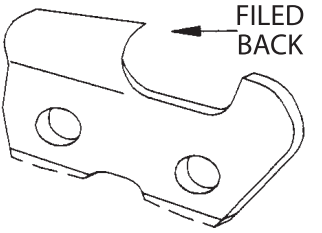




## Damaged Cutters

Most quality brands of saw chain (including ALL Carlton Saw Chain) have chrome plating on the top and side plates of the cutters. This hardened industrial chrome is not shiny like a car bumper but is there to hold the sharpness of the cutter's leading edge.

Cutters that hit foreign objects (dirt, rocks, nails, pavement, etc.) become damaged and must be filed back to restore a clean line of chrome to the leading edge of the cutter.

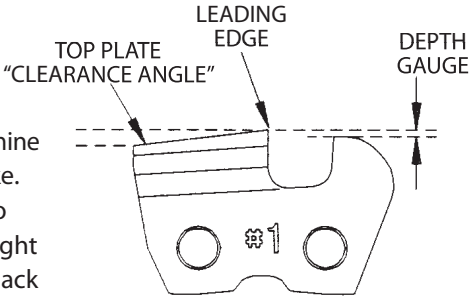


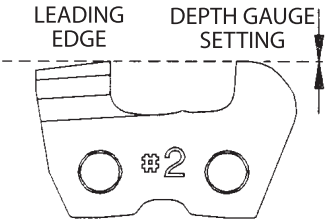

## Top Plate Angles

Manufacturers grind a top plate angle (generally 30 - 35 degrees) that allows for the widest range of cutting conditions. For best results, always follow the manufacturer's recommendations for top plate angles.

## Maintaining Depth Gauges

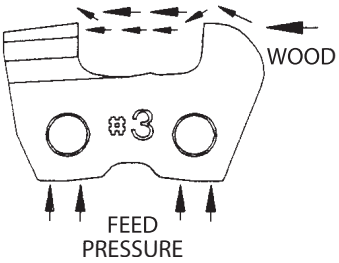



The most misunderstood part of a saw chain is the depth gauge. As mentioned before, depth gauges determine the size of the bite that the cutter can take. Because of the "clearance angle" built into the top plate of the cutter, the overall height of the tooth becomes lower as it is filed back and becomes shorter in length. Therefore, the depth gauge must be constantly lowered in proportion to this gradually lowering height of the cutter as it is filed back. The most common problems with depth gauges are either high depth gauges or low depth gauges.



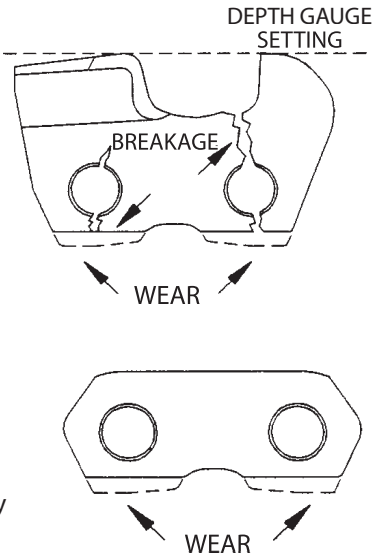

## High Depth Gauges

High depth gauges exist when the height of the depth gauge is near equal or higher than the overall height of the leading edge. High depth gauges are caused by not filing depth gauges down enough or by not filing depth gauges down at all. This is a common problem because many users do not know that depth gauges need to be lowered.




Cutter #1 has a proper depth gauge setting and will self feed into the wood efficiently. Cutter #2 has a high depth gauge. As you can see, the depth gauge is the same height as the leading edge of the cutter. This high depth gauge holds the cutting edge away from the wood and eliminates the cutter's ability to cut with a rocking motion and self feed into the wood. Cutter #3 shows what actually happens. The high depth gauge directs the cutter away from the wood as shown by the top row of arrows. When the chain stops cutting, the operator pushes down, adding more feed pressure, represented by the bottom row of arrows. The chain is forced into the wood in an attempt to make it cut as represented by the middle row of arrows into the gullet area. This operator-induced feed pressure causes the cutter bottoms to wear quickly and shows why it takes so much effort

to make a chain with high depth gauges cut wood.




The wear pattern on saw chain with high depth gauges is similar to that of backsloped cutters because of the excessive feed pressure necessary to force the chain into the wood. The dotted area in the drawings to the right shows this wear on the bottoms of the cutters and tie straps. This operator-induced feed pressure from high depth gauges breaks down the protective film of bar and chain oil. The friction created also causes the bar to wear and, if left uncorrected, will lead to chain and bar failure.

The operator notices that the chain stops cutting and will often try to fix things by repeatedly sharpening the cutters. Of course, this will only accelerate the problem unless the depth gauges are lowered when the cutter tooth is filed shorter in length and lower in height!

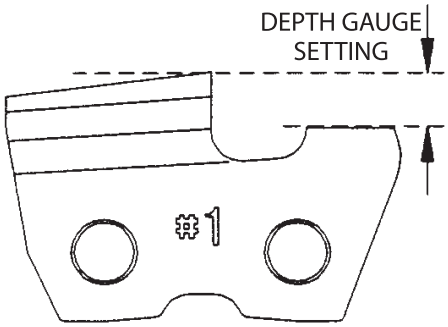
Uncorrected high depth gauges are directly responsible for a wide range of customer complaints. As the chain is filed back and high depth gauges occur, the chain will not cut as well as when new. This sometimes causes the operator to believe it to be "defective" or not made well enough to last for the life of the cutter. The chain will not stay sharp and requires constant filing to keep it cutting at all (see Carlton Technical Tip below). It wears out at the bottoms of the cutters and tie straps to further support the opinion that the chain must be "soft". Finally, this makes the job of cutting with a chain saw very difficult and frustrating!

High depth gauges are the major cause of saw chain failure. It is imperative to maintain depth gauges according to the saw chain manufacturer's specifications. A good rule of thumb is that the saw should cut without having to push down. If you have to apply force to make it cut, something is wrong! Saw chain with high depth gauges will not cut well, will not stay sharp and if uncorrected will ultimately lead to saw chain and guide bar failure.

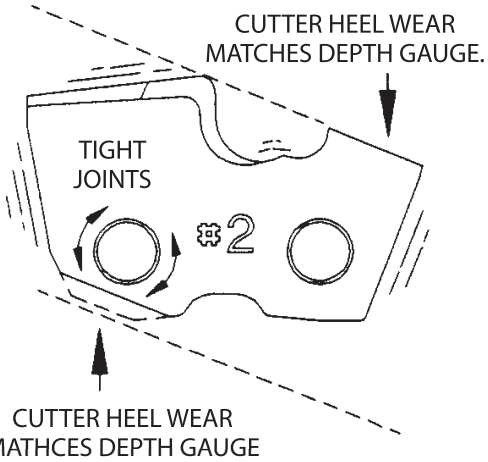
## Carlton Technical Tip

A unique thing happens when a sharpened cutter tries to cut with a high depth gauge. Rather than entering the wood straight on, the high depth gauge forces the wood to scrape at the leading edge of the cutter. You can re-create this by scraping at wood with a pocket knife instead of whittling with it. The blade will dull quickly - just like a

## Low Depth Gauges




Depth gauges determine the size of the bite that the cutter can take. Well maintained depth gauges (along with properly sharpened cutters) ensure a smooth and efficient rocking motion throughout the life of the chain. Low depth gauges exist when the depth gauges are filed down too far below the height of the leading edge of the cutter causing the cutter to take an excessive bite when cutting.




Low depth gauges cause the rocking motion to become very rough. A low depth gauge allows the cutter to take an oversized bite. This oversized bite causes the cutter heel to crash into the guide bar rails. Instead of a smooth transition into the wood the cutter grabs the wood and
can literally stall in the cut.
This happens because the saw motor often lacks the power to pull the cutter through the oversized bite it has taken.
The cutter eventually breaks out of the wood and crashes back onto the bar. This roughness in the rocking motion can be felt as a
vibration in the saw handles while cutting and the saw is almost pulled from the operators hands. An extreme low depth gauge situation can actually stall the engine!

Cutter #2 shows the wear pattern caused by extremely low depth gauges. The exaggerated rocking motion from low depth gauges causes the cutter bottoms to literally smash into the guide bar rails. This crashing leads to chipped cutter bottoms, tight joints where the chain is riveted together and eventual breakage. The guide bar rails bear the brunt of the pounding which results in chipped and cracked bar rails. These failures can lead to the mistaken conclusion that the chain and/or bar are made from "bad steel". A more costly by-product of uncorrected low depth gauges is chain saw engine problems, including broken crankshafts, clutches and main bearings.

Finally, as you will see in a later chapter, low depth gauges dramatically

increase the energy generated in a "kickback."

## The "Good Old Days."

Chain saws have changed. Older saws ran at chain speeds as slow as 600 feet per minute. There was enough raw power to allow the operator to almost ignore all of the chain maintenance problems in this chapter. If saw chain was misfiled, there was more than enough power to still make it cut. Chain speeds were so slow that bar and chain wear was much less of a problem. Also, the chains were physically larger (.404" and 1/2" pitch, for example) and could handle the abuse.

Today's saws are not as forgiving. These smaller powerheads have less than 1/2 the engine displacement of older saws and run much smaller chain (usually .325 and 3/8" pitch) at speeds of up to 3,000 to 4,000 feet per minute. If saw chain is not maintained properly, modern chain saws will not perform well; and the result will be chain and/or guide bar failures and operator frustration.

## There is a big difference between merely filing a chain and actually sharpening it!

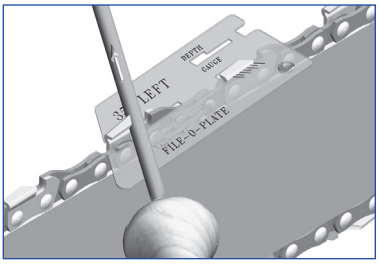
It's a fact that in most cases less than 1/2 of the life and cutting efficiency built into saw chain is ever realized. This is primarily due to poor and improper maintenance. And to be more specific, 90% of all saw chain failures are directly related to improperly maintained depth gauges. Some operators believe that they get full life from a saw chain when it's been used long enough to have the cutter teeth filed very short. Rather than using tooth length as a yardstick for chain life, a different and more practical approach might be to judge chain life in terms of production, performance, self feeding and stay sharp. Remember that improper maintenance often causes the cutter to be filed more frequently than necessary.

More to the point, it's important to employ a method of chain maintenance that is equal to the demands that modern chain saws place on saw chain. Understanding how saw chain cuts wood and knowing how backslope, hook, high depth gauges and low depth gauges can destroy a saw chain and guide bar are an important step to correcting any maintenance related problem.

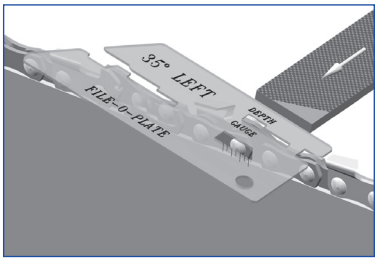
To this point we've discussed what these problems are. Now we are going to show you how to virtually eliminate all maintenance related chain problems.

CARLTON® SAW CHAIN

## The Carlton File-O-Plate®



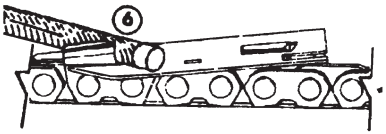

To help you get all of the life and cutting efficiency that was built into your Carlton Saw Chain, the simplest and most accurate tool you can use is the Carlton File-O-Plate®. Made from tempered steel, this patented tool takes all of the guesswork out of maintaining your Carlton Saw Chain. When used faithfully and properly, the Carlton File-O-Plate® will eliminate:




- Backslope
- Hook
- High Depth Gauges
- Low Depth Gauges

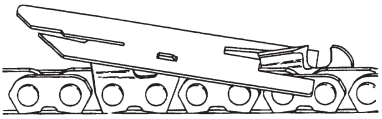
## Sharpening Cutters

The Carlton File-O-Plate® fits onto your chain and holds the file up, which forces you to sharpen the cutter properly. Using the front plate as a guide, the File-O-Plate® duplicates the cutter tooth angle originally ground into the chain at the factory. When used faithfully and properly, the Carlton File-O-Plate® eliminates backslope and hook.



## Maintaining Depth Gauges

In the depth gauge position, the Carlton File-O-Plate® rests over the leading edge of the cutter and allows you to lower the corresponding depth gauge more accurately than any other tool on the market.
When used faithfully and properly, the Carlton File-O-Plate® eliminates the possibility of high depth gauges or low depth gauges.



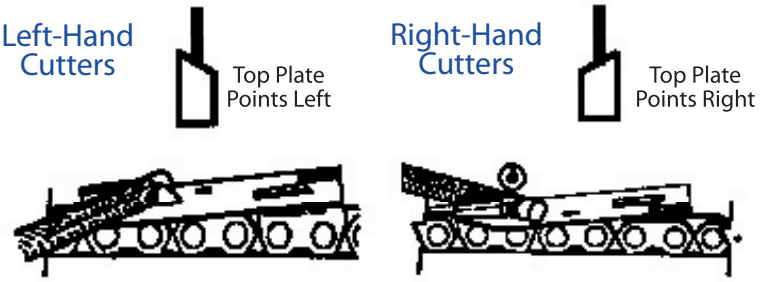
## Chain Tension

A properly tensioned saw chain should have a small amount of sag at the mid-point of a solid nose bar. The chain should snap back tight onto the rails of a sprocket nose bar.

# Using the Carlton File-O-Plate®

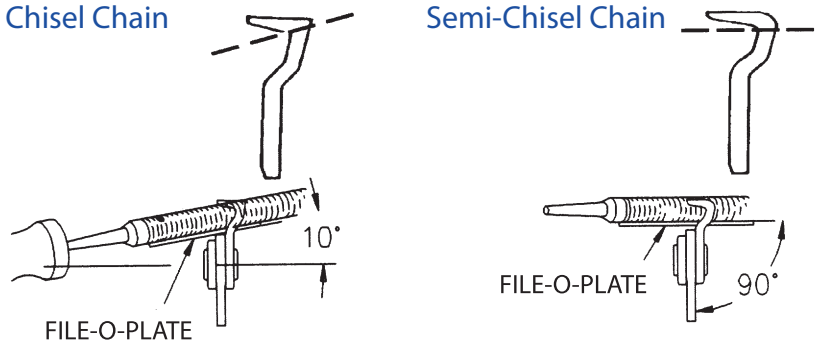
## Part 1. Sharpening Cutters

The Carlton File-O-Plate® slips into the cutter and holds the file up in




the proper position to eliminate backslope and hook.

The Carlton File-O-Plate® automatically compensates for Chisel or

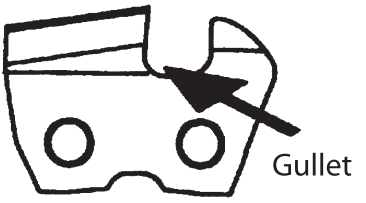



Semi-Chisel cutters. As you can see from the above drawings, Chisel chain has squared corners on both the outside and inside of the cutter. This chain must be filed 10 degrees up, to line up these two points.

Semi-Chisel chain does not require this 10 degree compensation.

## Gulleting

As a cutter gets shorter, it's important to make an occasional freehand stroke with the file to clear material out of the gullet that could get in the way of a good sharpening job.



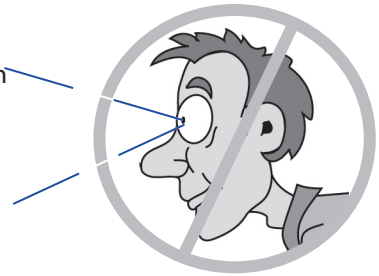
## Part 2. Maintaining Depth Gauges

Basically, there are three ways to set depth gauges:

- Guesswork (The Eyeball Method)
- Constant Method
- Progressive Method

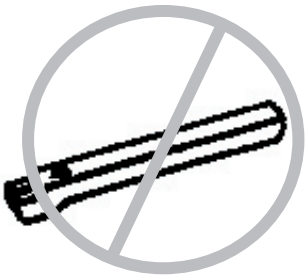
### Guesswork

Guessing at depth gauge settings may have worked on the old chain saws discussed earlier. But with today's high speed saws, accurate depth gauge maintenance is critical to overall cutting performance. Like ignition timing, depth gauges require precise adjustment.
The eyeball method isn't accurate enough and does not work!



### Constant Method

This method employs a tool similar to the one on the right. The number stamped onto the tool (.025",.030", etc.) is the depth gauge setting. Regardless of the overall tooth length, this tool will always give you the depth gauge setting stamped on it. Hence, we call this the constant method. THIS METHOD IS NOT RECOMMENDED.



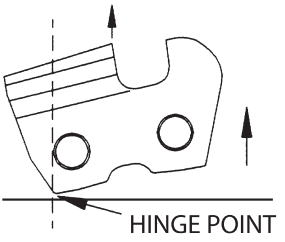
### Progressive Method

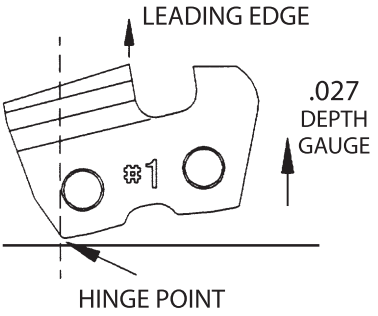
Progressive method means simply that the depth gauge setting changes with the length of the cutter. This is the only method we recommend, and is achieved by using the Carlton File-O-Plate®. It will be fully explained on the following pages. The basic difference between the progressive method and the constant method is in the way the File-O-Plate® adjusts the depth gauges to make the chain cut efficiently throughout the life of the cutter. This is high-tech depth gauge maintenance for high-tech saw chain!

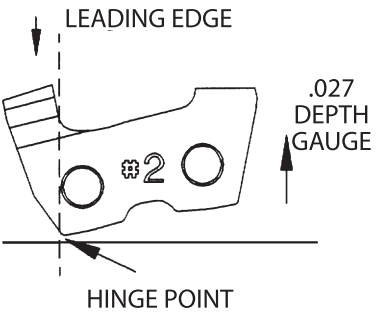
### Progressively Lowered Depth Gauges

An understanding of how saw chain cuts wood is essential to learning the concept of progressively lowered depth gauges. Reviewing page 5 of this manual shows that in a rocking motion, the cutter's leading edge tips as the cutter moves into the attack position.

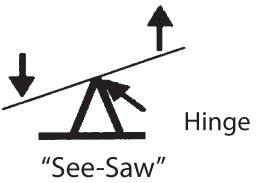
It's also important to note that the chain is held together by the rivets. This means that although the leading edge tips up, the entire cutter is actually pivoting at the "hinge point" which is behind the rear rivet of the cutter. The illustrations below show what happens as the cutter is filed shorter.



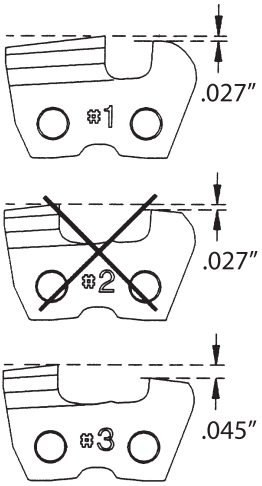

A good example of what happens here is a playground see-saw. Referring to the drawing of the "see-saw" shows the hinge point. As one end goes up the other goes down. Now apply this concept to cutters #1 and #2 above.




Each has a constant method .027" depth gauge setting. The leading edge in cutter #1 is to the right of the hinge point of the rear rivet and will tip up into the wood like the right hand arrow in the see-saw diagram. However, when the cutter is filed back to about 1/2 of its overall length as in cutter #2, the leading edge is now to the left of the hinge point. As a result, the leading edge in cutter #2 will tip down and away from the wood just like the left arrow in the see-saw diagram.

## Which will cut better —

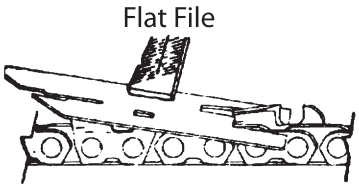
## Cutter #1 or Cutter #2?




Which will cut better? If the depth gauges are set at .027" the answer is cutter #1 because the leading edge tips up into the wood and not away from the wood. To make cutter #2 cut as well as cutter #1, a constant method .027" depth gauge setting is not enough. Cutter #2 needs approximately .045". The depth gauge setting on cutter #3 is what the progressive method is all about.

The theory behind the progressive method is to increase the depth gauge setting as the cutter is filed back to compensate for the fact that as the leading edge crosses the hinge point of the rear rivet it will tip up less than when new and eventually will tip away from the wood. Now that the concept has been explained the question is how to do it! The difference between .045" and .027" is only .018". That .018" has a positive effect on the performance of the chain.

## The Carlton File-O-Plate®




The patented Carlton File-O-Plate® allows depth gauges to be adjusted according to the progressive method. The File-O-Plate® rests on the leading edge of the cutter and allows you to accurately file depth gauge according to the height of the cutter. As the tooth gets shorter and lower in height, the File-O-Plate® sets farther down onto the cutter and more of the depth gauge protrudes through the slot. The Carlton File-O-Plate® compensates for the difference needed in depth gauge settings from approximately .027" to .045" depending on the height of the cutter. Faithfully maintaining depth gauges with a Carlton File-O-Plate® makes Carlton Saw Chain cut 100% efficiently throughout its life.

### Carlton Technical Tip

The three major causes of saw chain failures are high depth gauges, dull cutters and/or backsloped cutters. These are all eliminated when the Carlton File-O-Plate® is faithfully and properly used. Carlton recommends the File-O-Plate® as the only progressive depth gauge tool for Carlton Saw Chain. Do not attempt to use other depth gauge tools or feeler gauges.



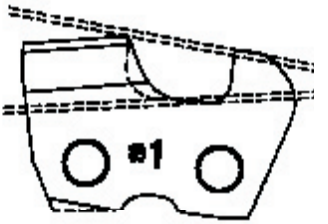
## Typical combinations of

## improper maintenance techniques.

### Backsloped Cutter — High Depth Gauge

This makes for a long day of woodcutting! The depth gauge will not allow the cutter to take a bite. Even if it could feed, the backsloped cutter guarantees poor performance.

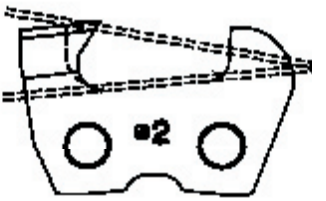
Remedy: This chain can be saved if the bottoms of the cutters are not too badly worn. Use the Carlton File-O-Plate to re-sharpen cutters and lower depth gauge.




### Hooked Cutter — High Depth Gauge

This is an attempt to make a high depth gauge chain cut better. The logic is to make the chain more aggressive. In fact, some manufacturers even suggest that you drop one file size (7/32 to 13/64 for example) as the tooth gets shorter. The depth gauge and the cutter tooth must work together to control the aggressiveness! This technique will not work and will yield all of the problems associated with hook.

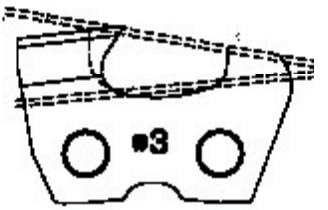
Remedy: This chain can also be saved by using the Carlton File-O-Plate® to eliminate the hook and properly lower the depth gauge.




### Hooked Cutter — Low Depth Gauge

This is the "Worst of Both Worlds" combining the most aggressive cutter with the most aggressive depth gauge. Do not attempt to use a saw chain that looks at all like this!

Remedy: Use the Carlton File-O-Plate® to remove the hook and shorten the tooth length. If after filing the cutter to about 3/16" in length, the depth gauge is still lower than the File-O-Plate® in the depth gauge position, discard the chain.

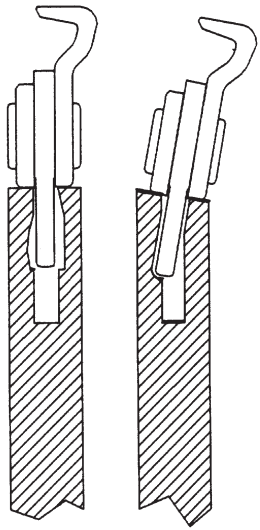



If you've tried everything and your chain still fails to cut properly, take it to your local Authorized Carlton Dealer. They will show you how to properly maintain your Carlton Saw Chain.

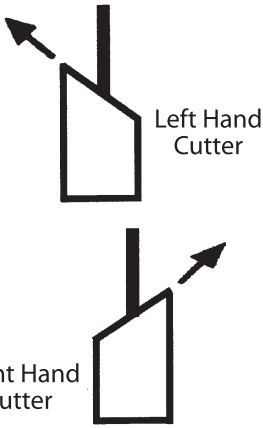
## Other Common Complaints

## Chain Cuts Crookedly

Saw chain will cut crookedly for several reasons. Obviously, the chain gauge must match the bar groove. When guide bar rails wear unevenly or the groove becomes worn, the saw chain will ride crookedly in the guide bar or sit in the bar crookedly; hence the crooked cut.
If the bar looks like the illustrations to the right, your Dealer might be able to recondition it. If not, the bar will need to be replaced. However, if the saw chain caused the bar to wear in that fashion, a new bar will eventually wear the same way! Correct the problem by filing the chain properly with a Carlton File-O-Plate®.



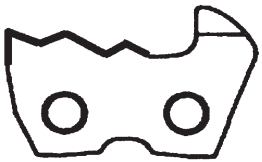

Another reason for chain to cut crookedly has to do with left and right hand cutters.
A saw chain cutting wood is like a pickup truck with a power angle snowplow. Angling the plow to the left pulls the truck to the left in a snowbank, and angling the plow to the right it pulls the truck to the right. When cutting wood, the left hand cutters pull the saw chain to the left and the right hand cutters pull it to the right. The chain cuts straight because the left and right forces balance each other. Whenever one side of the chain cuts more efficiently than the other the chain will pull in that direction. Re-sharpening the cutters and depth gauges with the Carlton File-O-Plate® will usually correct the problem.




## Broken Cutters

Cutters can break from too much hook or from hitting foreign objects such as nails, spikes, barbed wire, etc. It is important not to make the same cut once the chain has been repaired!

Extreme hook and frozen wood can also increase the potential for top plate breakage.



Guide bars are intended to serve as their name implies; to guide the saw chain. Unfortunately some guide bars end up being used as pry bars, anvils, and directional felling wedges. To understand what causes a guide bar to fail we will review just what guide bars are and how they are supposed to be maintained.

As with saw chain, many common guide bar complaints are a result of poor or improper maintenance. However, the fact that bars fail along with the chain in many cases only supports the often wrong conclusion that the parts are "defective."

Solid Nose

There are several types of guide bars available. Solid nose bars are made from a single piece of steel with a hardened surface (usually a form of Stellite®) welded to the nose area. Solid nose bars are not intended to be used in an application that requires a lot of bore-cutting or extensive cutting with the nose portion of the bar. Sprocket nose bars are designed for this application and have a series of needle bearings inside a sprocket laminated at the tip. In borecutting, this bearing assembly takes the friction from the chain away from the body of the bar. These sprocket noses are inserted into the main body of the bar or encased in a replaceable tip that can be changed as necessary.

Replaceable Sprocket

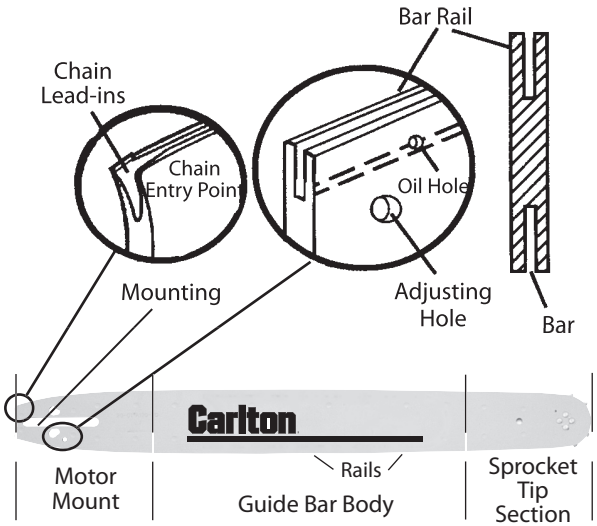
Laminated Sprocket

In addition, some sprocket nose bars are made from a single piece of steel like solid nose bars while others are "laminated bars" which means that they are made from three pieces of steel sandwiched together and spot welded. Laminated bars are usually the most economical to buy.

What type of bar should you use? Like with saw chain, it's best to match the bar to the job. Solid nose bars are best in gritty conditions. They have no bearing in the tip. Solid nose bars are expensive and will wear out quickly if the nose is used extensively. Sprocket nose bars are best for all around cutting: For occasional to semi-professional use, laminated sprocket bars are probably the best compromise for the money.

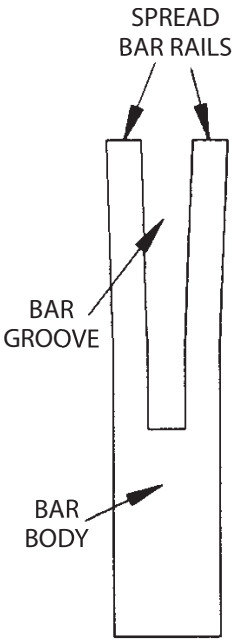
## Guide Bar Components

Guide bars are made of specially tempered steel. The rails of the guide bar on which the saw chain runs are hardened to specifications that have proven to offer the best durability in a variety of cutting conditions. Under normal use, when chains are properly maintained, a guide bar should last through the life of several chains. Usually, very little guide bar maintenance is required.




## Guide Bar Problems

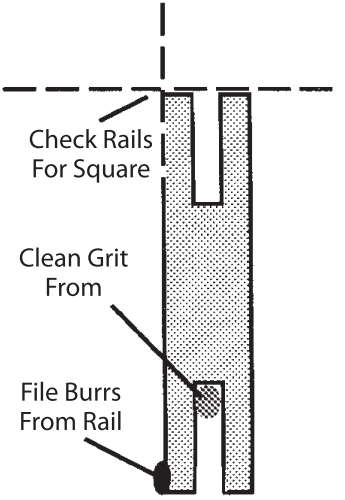
Guide bars generally fail from poor saw chain maintenance, poor chain tension, lack of lubrication on the rails and/or at the tip, or from abuse such as lifting on the saw handles to fell a tree. Using a guide bar as a felling wedge or getting pinched in the cut causes many bar failures. However, the leading cause of bar failures is improper saw chain maintenance.




Whenever a saw chain stops cutting (high depth gauges, dull cutters, etc.) the natural tendency is to push down and force the chain to cut. This turns the guide bar into a pry bar. The added friction and pressure causes the rails of the bar to wear unevenly and/or spread apart. As the chain heats up and expands or "stretches," there is an extra amount of pounding at the lead-ins where the chain enters the bar and at the bottom of the tip where the chain contacts. The drawing above shows that the bar rails will actually spread apart if run for an extended time under these conditions. The operator may think the bar is defective or soft, but the problem is usually in the way that the chain has been filed. If the chain problem is left uncorrected, bar failures will continue.

On the other hand, saw chain with low depth gauges will turn the guide bar into an anvil. The bottoms of the cutters crash into the bar and cause chips and cracks in the bar rails as well as in the bottoms of the cutters and tie straps. This may give the operator the false impression that the bar is defective or is brittle but the problem is in the way the chain has been filed. Once again, failure to correct the problem will ultimately lead to more chain and bar failures.

## Guide Bar Maintenance




Guide bars actually require very little maintenance. The main things to look for are burrs on the rails and to make sure the oil holes and grooves are free of sawdust and grit that can restrict lubrication. The Carlton File-O-Plate® is a handy bar groove cleaner.

Inspect the bar for cracks, twists and burrs. File burrs using a flat file and light strokes. Next, the bar rails must be even. This can be checked on a flat surface. If the bar won't stand on its rails, it needs to be trued up. Your Carlton Dealer can do this for you. Lastly, the groove must be straight and deep enough for the drive links. As the rails wear, the depth of the groove becomes shallower. Insert the chain into the bar and check for sloppiness.

IF YOU HAVE ANY DOUBTS ABOUT YOUR GUIDE BAR, ASK YOUR CARLTON DEALER BEFORE USING IT!

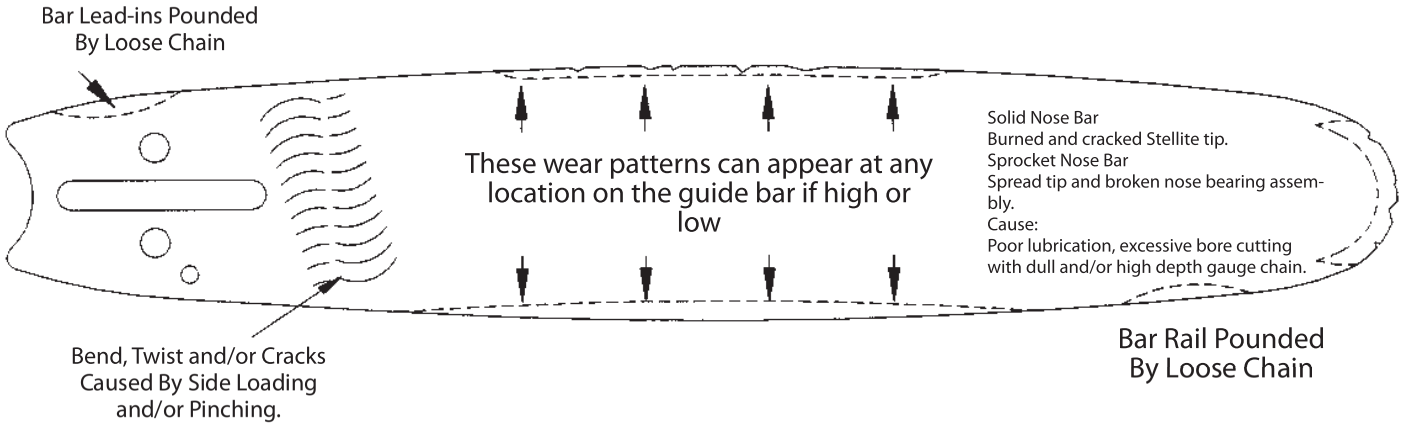
## Lubrication

Use good quality bar and chain oil. This oil is blended from a clean, fresh extreme pressure base oil with a "stay on" additive often called PARATAC. Waste engine oil contains grit and acids that can harm the saw oiler and increase bar and chain wear.

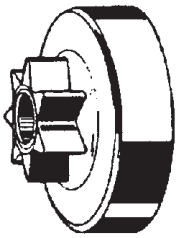
When operating properly, the saw oiler should pump enough oil to have some sling off the end of the bar. This flushes away grit that could ruin the bearings of the chain and accelerate bar rail wear. The oil that remains is to lubricate the bar and chain.

There's always the question about greasing sprocket bar tips and some manufacturers do not advise it. It really boils down to a matter of personal preference. If there's a problem, try to correct it. If not, it might be better to leave well enough alone!

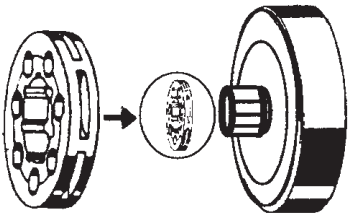
# SIDE VIEW OF BAR WEAR PATTERNS



The power from the chain saw's engine is transferred to the saw chain through a centrifugal clutch and drive sprocket. There are two types of drive sprockets used on chain saws; Spur Sprockets and Rim Sprockets. Spur sprockets incorporate the centrifugal clutch drum and drive sprocket into a single piece and must be changed as a complete unit. Rim sprockets are a two piece unit that allows you to replace the rim as it wears out. Originally, all saws used spur sprockets and the rim sprocket design came along in recent years. Both work well although some prefer one over the other.



Spur Sprocket



Replacement Sprocket Rim

Regardless of the design, there are two things that you need to know about drive sprockets:

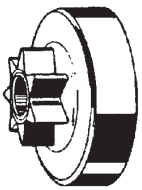
#1. The drive sprocket pitch must match the pitch of the saw chain and guide bar (sprocket nose bar).

#2. The drive sprocket must be replaced when worn out.

The saw chain and drive sprocket are a matched set—just like two gears working together. As the chain wears out, the drive sprocket wears out, too. If the drive sprocket is not replaced on a regular basis (preferably with every new chain), the new chain installed on a worn out drive sprocket will wear to match the amount of wear that is in the sprocket. The result is called "stretch."

For example, a common .325 pitch sprocket has 7 teeth on it. The .325 pitch sprocket matches a .325 pitch saw chain. If the sprocket has only .010" wear (about the thickness of a match) the effective wear on the sprocket is actually .070" when the sprocket is turning at 12,000 rpm engine speed. That makes the .325 sprocket with .070" wear effectively a .395 sprocket! A new .325 pitch chain on this sprocket will try to "stretch" to match the wear in the sprocket drive teeth.

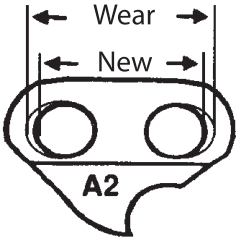
As mentioned before, what



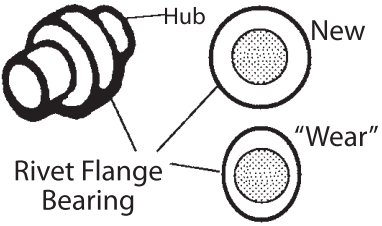
Typical
.325 Pitch Sprocket
Seven Teeth X .010" Wear
.070" Total Wear

.325"
+ .070"
.395"

usually appears to be chain "stretch" is actually wear. The diagrams to the right show this wear in the drive links and rivet flanges. What happens is that the new chain tries to mesh into the worn or improper pitch of the sprocket.



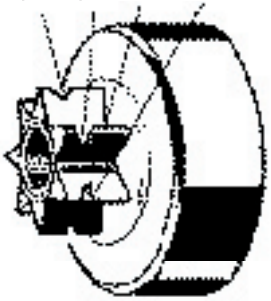
End View of Rivet



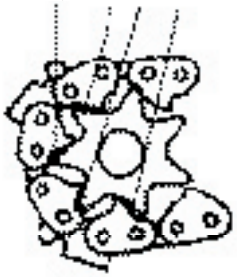

The flanges of the rivets are specially heat treated to be a bearing surface against the insides of the drive link holes. When the new chain tries to mesh into a worn or improper pitch drive sprocket, tremendous stresses occur in this area of the chain. This mismatch causes the chain to wear in an attempt to match the pitch of the sprocket. Aside from the wear shown above, worn or improper pitch sprockets also show wear patterns on other parts of the chain. Each type of sprocket leaves different marks because of the way the chain is driven. Spurs contact the chain in the notches below the cutters and tie straps. The wear from drive sprocket problems shows up in that area. Rims actually push the chain along from behind the drive links. This leaves less obvious marks but the same outcome - stretch and breakage.

## Spur Sprocket Wear

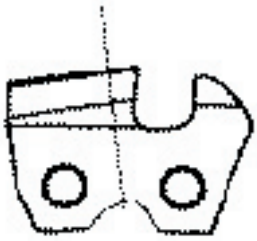
Notch Worn Into Spur Sprocket Teeth



Chain Cannot Mesh Cleanly With Sprocket



Marks On Cutter Bottoms

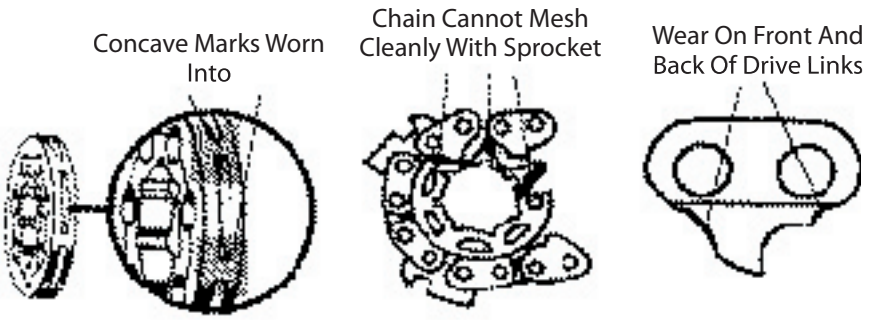


As a result of the wear patterns above, saw chain gives the appearance of "stretch". Sometimes the rivet bearings and drive link holes can wear to the point of the operator having to shorten the chain by removing drive links in order to maintain chain tension. Worn sprockets cause the joints of the chain to tighten up, and in extreme cases will literally tear the chain into pieces!

## A new drive sprocket is the best way to avoid the rivet bearing and drive link wear that appears as chain stretch!

It is a fact that at least 5 out of 10 saws in use today probably need new

### Rim Sprocket Wear




sprockets. It is a part of the chain saw that is out of sight and not given a lot of attention. However, the kinds of problems that worn or improper pitch sprockets create make it worth checking every time the chain is replaced.

A quick and easy way to test for a worn sprocket is to shut the saw off and pull the chain around the bar under proper tension. If it pulls rough or feels "ratchety" the sprocket is probably worn. Sometimes a worn sprocket makes it impossible to tension the chain without it binding up!

Another thing to remember is that when it comes to sprockets, what matters most is not how old it is but how worn it is. For example, a "new sprocket" can become a "worn sprocket" very quickly if the chain falls off and damages the sprocket due to improper installation. The sprocket would need to be changed even though it's still almost "new." Also, the sprocket must match the pitch of the chain and guide bar tip. As with saw chain and guide bar complaints, "stretch" and the problems associated with it can be avoided.

### Here are a few tips to remember:

1. Always install a new chain on a new sprocket of proper pitch.
2. Periodically check drive sprockets for wear.
3. Replace drive sprockets at the first visible sign of wear.

### Cold Weather Note:

Extreme cold weather can accelerate all forms of chain and bar failures, but particularly those from sprocket related problems. All steel parts become more brittle and less tolerant of shock loads and stress as the temperature drops below freezing.

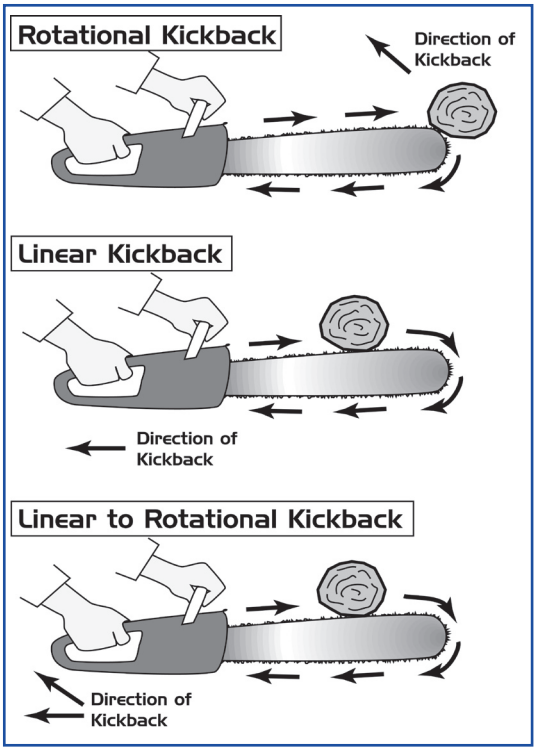
## The first step in avoiding kickback is to understand what causes it

### What is kickback?

There are two forms of kickback: (1) rotational kickback and (2) linear kickback (sometimes called pinch kickback).

Rotational kickback: The rapid upward and backward motion of the saw that can occur when the moving saw chain near the upper portion of the tip of the guide bar contacts an object such as a log or branch. (Source ANSI B175.1 1991)

Linear kickback: The rapid push back of the saw chain that can occur when the wood closes in and pinches the moving saw chain in the cut along the top of the guide bar. (Source ANSI B175.1 1991)




## What's the ANSI Standard all about?

### Saws 3.8 Cubic Inch (62 cc) and less

Effects of the ANSI standard on saw chain:

When replacing chain on saws 3.8 cubic inch (62cc) or less, any Carlton chain with proper pitch and gauge that is designated as low-kickback can be used.

Underwriters Laboratories Inc. classified low kickback saw chain in accordance with American National Standard low kickback safety requirements for gasoline powered chain saws (ANSI B175.1-1991), paragraphs 5, 12.2.3. (b) and 5.12.3.4. (b) 38N1 Type C: 38N1. Low kickback saw chain in accordance with CSA Z62.3 38N1.

Effects of ANSI standard on guide bars:

When replacing guide bars, a Carlton branded guide bar with the same bar length, nose radius (same number of sprocket teeth) and pitch can be used to maintain the low-kickback performace.

CAUTION: Chain not designated low-kickback should be used only by users experienced and trained in dealing with kickback.

### Saws larger than 3.8 cubic inch (62cc)

Saws 3.8 cubic inch (62cc) and larger are not required to meet the low-kickback acceptance criteria. Users should only use this class of saw with specialized training in dealing with kickback.

### Carlton Packaging & Labeling

Chains that comply with the ANSI B175.1-1991 are identified as low-kickback saw chain and carry the UL Classification marking.

### ISO 9001 Registered

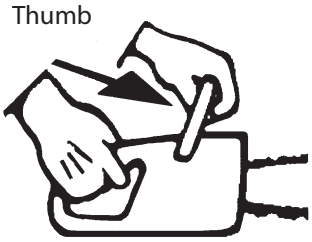
Carlton is a registered ISO 9001 manufacturer with the UL Laboratories, Inc.

## About Chain Maintenance

Saw chain maintenance affects kickback. An efficient, well sharpened chain will tend to snag less in a kickback situation. However, saw chain with low depth gauges and hooked cutters dramatically increases the severity of rotational kick-back because of its added aggressiveness. Do not run saw chain with low depth gauges and/or hooked cutters! Always maintain saw chain to the manufacturer's specifications. If you have any doubts about your saw chain ask your Carlton Dealer.

## Some Common Sense Advice

When used properly, a chain saw can be a versatile, efficient and fun tool to use, but like any power tool, it can also be very dangerous if operated or maintained improperly. Always read and fully understand the operator's manual. If you have any questions, please ask your Servicing Dealer. Here are just a few tips:




## Starting Chain Saws

Never attempt to "drop start" a chain saw. Always start the saw on the ground with your foot through the rear handle and your support arm fully extended.

## Operating Chain Saws

- Use "Low Kickback Saw Chain" in accordance with ANSI B175 which is available for almost every chain saw.
- Always use full throttle. A fast chain has less tendency to snag in the cut and reduces the possibility of a kickback.
- Always keep the bar tip in sight. If the tip contacts the wood there is a possibility of a kickback.
- Never run a dull chain, a hooked chain, or a chain with low depth gauges. The safest and most efficient chain is a sharp chain with properly maintained depth gauges. Use the Carlton File-O-Plate® faithfully for the sharpest chain possible.
- Always wrap your left thumb around the top handle of the saw (see diagram). This provides a sure grip in the event of a kickback.
- Never cut above chest height with a chain saw.
- Always wear eye, face, hand and leg protection.
- Take frequent rest breaks to reduce fatigue.
- Do not cut near powerlines or in close quarters without training.

### Sawing With Others

- Never just "walk up" to someone running a chain saw! Always establish a system to get each other's attention. A smart approach is to toss a baseball cap in front of the other person.
- Always approach a chain saw operator from the front - never approach from behind!

## Notes

CARLTON SAW CHAIN
THE PROFESSIONAL CHOICE