LENOX

GUIDE TO BAND SAWING

INDEX

INTRODUCTION

The increased cost of manufacturing today is forcing manufacturers and machine operators to seek more economical ways to cut steel. Fortunately, sawing technology has improved greatly. Modern, high technology metals have generated new saw machine designs, and improved saw blades are helping keep manufacturing costs under control.

LENOX® is a leader in the field of band saw research. Over the years we have developed new techniques to improve the efficiency of cutting metal. This manual has been written to share that information with you.

The information contained here is not meant to answer all of your band sawing questions. Each job is likely to present its own set of unique circumstances. However, by following the suggestions outlined here, you will be able to find economical and practical solutions more quickly.

TECHNICAL SUPPORT BY PHONE

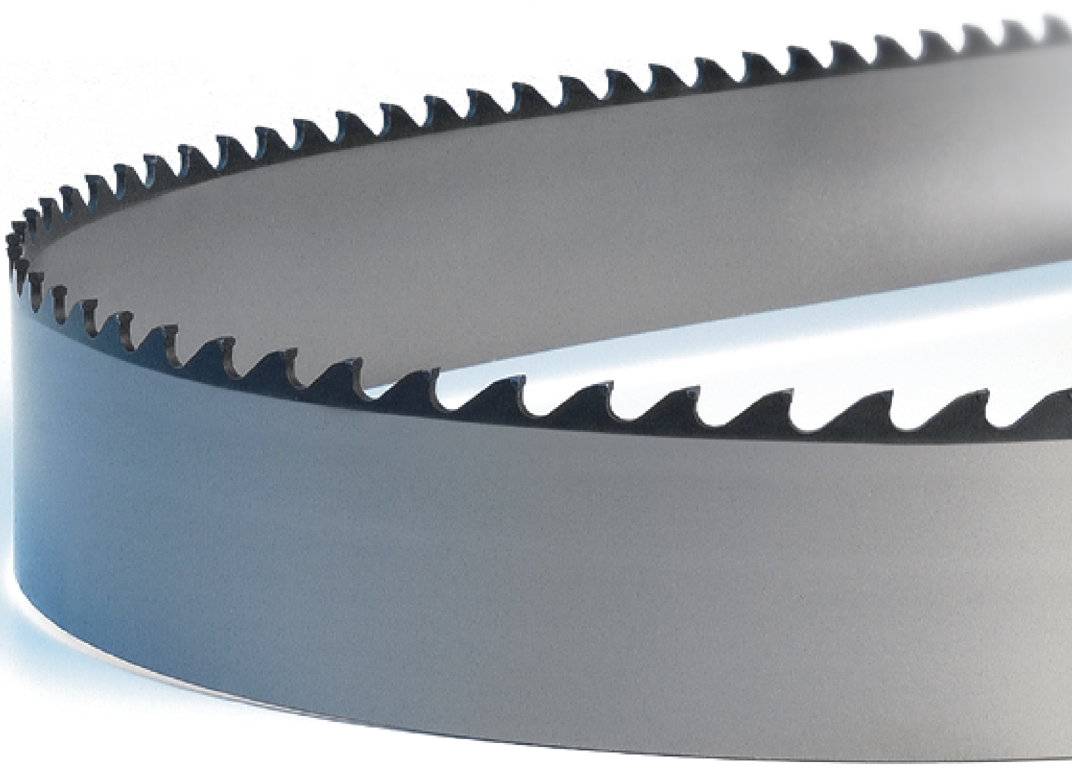
You can get technical assistance for solving your band sawing problems by phone. Our Technical Support staff is here to serve you and can be reached during normal working hours by calling our toll-free number.

413-526-6504

800-642-0010

FAX: 413-525-9611

800-265-9221



BLADE DESIGN

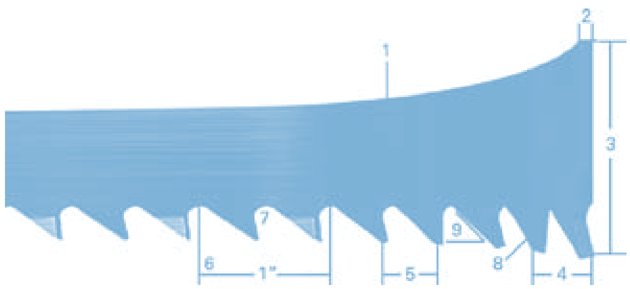
Choosing the right blade for the material to be cut plays an important role in cost effective band sawing. Here are some guidelines to help you make the right decision.

BLADE TERMINOLOGY

A clear understanding of blade terminology can help avoid confusion when discussing cutting problems.

1. **Blade Back:** The body of the blade not including tooth portion.
2. **Thickness:** The dimension from side to side on the blade.
3. **Width:** The nominal dimension of a saw blade as measured from the tip of the tooth to the back of the band.
4. **Set:** The bending of teeth to right or left to allow clearance of the back of the blade through the cut.

   Kerf: Amount of material removed by the cut of the blade.
5. **Tooth Pitch:** The distance from the tip of one tooth to the tip of the next tooth.
6. **TPI:** The number of teeth per inch as measured from gullet to gullet.
7. **Gullet:** The curved area at the base of the tooth. The tooth tip to the bottom of the gullet is the gullet depth.
8. **Tooth Face:** The surface of the tooth on which the chip is formed.
9. **Tooth Rake Angle:** The angle of the tooth face measured with respect to a line perpendicular to the cutting direction of the saw.



BLADE CONSTRUCTION

Blades can be made from one piece of steel, or built up of two pieces, depending on the performance and life expectancy required.

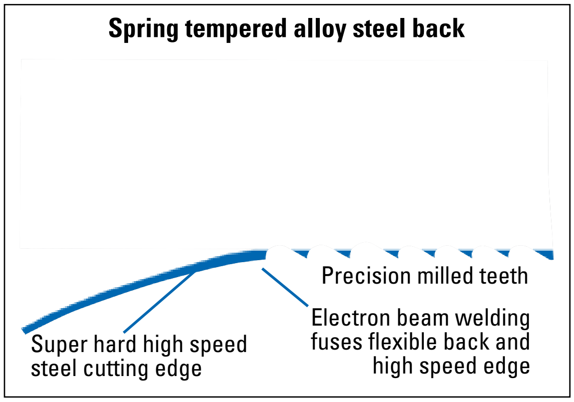
CARBON

Hard Back: A one-piece blade made of carbon steel with a hardened back and tooth edge.

Flex Back: A one-piece blade made of carbon steel with a hardened tooth edge and soft back.

BI-METAL

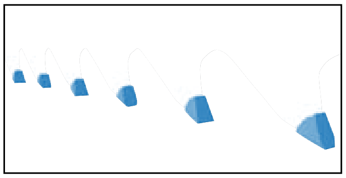
A high speed steel edge material is electron beam welded to fatigue resistant spring steel backing. Such a construction provides the best combination of cutting performance and fatigue life.



BLADE CONSTRUCTION (cont.)

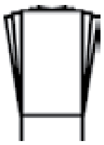
CARBIDE GROUND TOOTH

Teeth are formed in a high strength spring steel alloy backing material. Carbide is bonded to the tooth using a proprietary welding operation. Tips are then side, face and top ground to form the shape of the tooth.



SET STYLE CARBIDE TOOTH

Teeth are placed in a high strength spring alloy backing material. Carbide is bonded to the tooth and ground to form the shape of the tooth. The teeth are then set, providing for side clearance.



TOOTH CONSTRUCTION

As with a bi-metal blade design, there are advantages to differing tooth constructions. The carbide tipped tooth has carbide tips welded to a high strength alloy back. This results in a longer lasting, smoother cutting blade.

TOOTH FORM

The shape of the tooth's cutting edge affects how efficiently the blade can cut through a piece of material while considering such factors as blade life, noise level, smoothness of cut and chip carrying capacity.

Variable Positive: Variable tooth spacing and gullet capacity of this design reduces noise and vibration, while allowing faster cutting rates, long blade life and smooth cuts.

Variable: A design with benefits similar to the variable positive form for use at slower cutting rates.

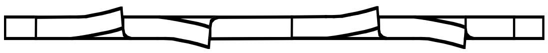
Standard: A good general purpose blade design for a wide range of applications.

Skip: The wide gullet design makes this blade suited for non-metallic applications such as wood, cork, plastics and composition materials.

Hook: Similar in design to the Skip form, this high raker blade can be used for materials which produce a discontinuous chip (such as cast iron), as well as for non-metallic materials.

TOOTH SET

The number of teeth and the angle at which they are offset is referred to as "tooth set." Tooth set affects cutting efficiency and chip carrying ability.

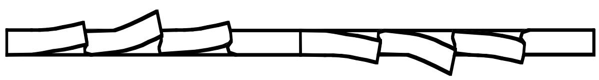


RAKER

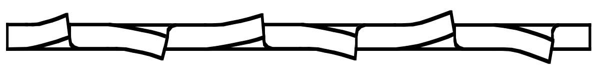
MODIFIED RAKER

Raker: 3 tooth sequence with a uniform set angle (Left, Right, Straight). **Modified Raker:** 5 or 7 tooth sequence with a uniform set angle for greater cutting efficiency and smoother surface finish (Left, Right, Left, Right, Straight). The order of set teeth can vary by product.

Vari-Raker: The tooth sequence is dependent on the tooth pitch and product family. Typically Vari-Raker set provides quiet, efficient cutting and a smooth finish with less burr.

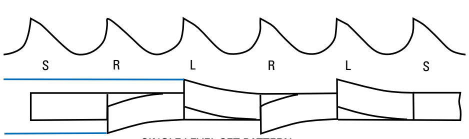


Alternate: Every tooth is set in an alternating sequence. Used for quick removal of material when finish is not critical.



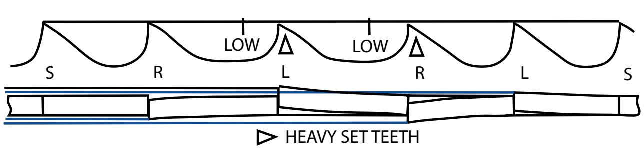
Wavy: Groups of teeth set to each side within the overall set pattern. The teeth have varying amounts of set in a controlled pattern. Wavy set is typically used with fine pitch products to reduce noise, vibration and burr when cutting thin, interrupted applications.

Vari-Set: The tooth height / set pattern varies with product family and pitch. The teeth have varying set magnitudes and set angles, providing for quieter operation with reduced vibration. Vari-Set is efficient for difficult-to-cut materials and larger cross sections.



SINGLE LEVEL SET PATTERN

Single Level Set: The blade geometry has a single tooth height dimension. Setting this geometry requires bending each tooth at the same position with the same amount of bend on each tooth.



Dual Level Set: This blade geometry has variable tooth height dimensions. Setting this product requires bending each tooth to variable heights and set magnitudes in order to achieve multiple cutting planes.

TPI

For maximum cutting efficiency and lowest cost per cut, it is important to select a blade with the right number of teeth per inch (TPI) for the material you are cutting. See Carbide Tooth Selection on page 18 or Bi-metal Tooth Selection on page 21.

The size and shape of the material to be cut dictates tooth selection. Placing odd-shaped pieces of material in the vise a certain way will also influence tooth pitch. See "Vise Loading" page 12.

FACTORS THAT AFFECT THE COST OF CUTTING

There are several factors that affect band sawing efficiency: tooth design, band speed, feed rates, vise loading, lubrication, the capacity and condition of the machine, and the material you are cutting.

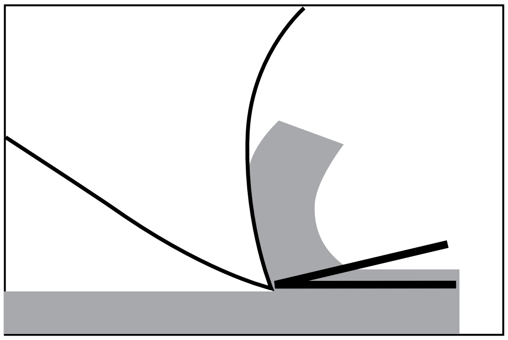
LENOX® has developed planning tools that help you make intelligent decisions about these many variables so that you can optimize your cutting operation. Ask your LENOX® Distributor or Sales Representative about the *SAWCALC®* computer program.

HOW CHIPS ARE MADE

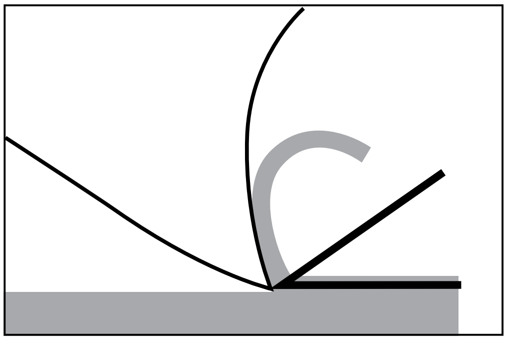
If you were to look at a blade cutting metal under a microscope, you would see the tooth tip penetrating the work and actually pushing, or shearing, a continuous chip of metal. The angle at which the material shears off is referred to as the "shear plane angle." This is perhaps the single most important factor in obtaining maximum cutting efficiency.

Generally, with a given depth of penetration, the lower the shear plane angle, the thicker the chip becomes and the lower the cutting efficiency. The higher the shear plane angle, the higher the efficiency, with thinner chips being formed.

Shear plane angle is affected by work material, band speed, feed, lubrication and blade design as shown in the following sections.



Low shear plane angle = low efficiency



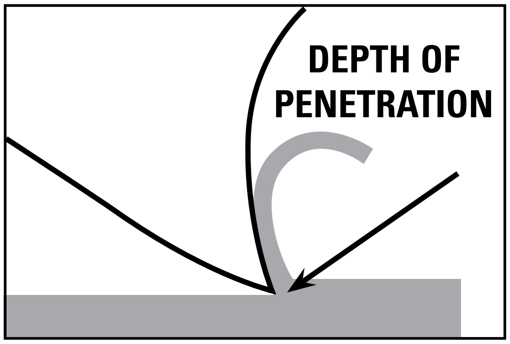
High shear plane angle = high efficiency

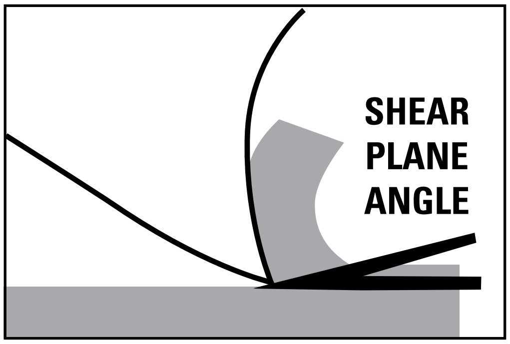
FEED

Feed refers to the depth of penetration of the tooth into the material being cut. For cost effective cutting, you want to remove as much material as possible as quickly as possible by using as high a feed rate/pressure as the machine can handle. However, feed will be limited by the machinability of the material being cut and blade life expectancy.

A deeper feed results in a lower shear plane angle. Cutting may be faster, but blade life will be reduced dramatically. Light feed will increase the shear plane angle, but increase cost per cut.

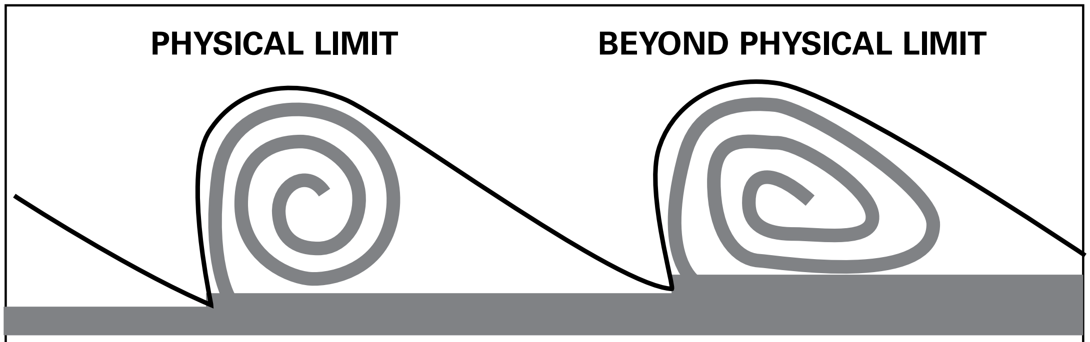
How can you tell if you are using the right feed rate? Examine the chips and evaluate their shape and color. See chip information on page 5.





GULLET CAPACITY

Gullet capacity is another factor that impacts cutting efficiency. The gullet is the space between the tooth tip and the inner surface of the blade. As the tooth scrapes away the material during a cut, the chip curls up into this area. A blade with the proper clearance for the cut allows the chip to curl up uniformly and fall away from the gullet. If too much material is scraped away, the chip will jam into the gullet area causing increased resistance. This loads down the machine, wastes energy and can cause damage to the blade.

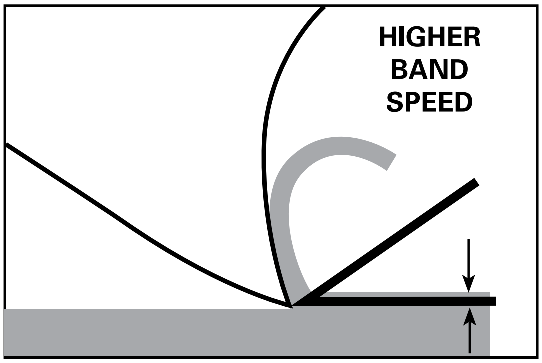


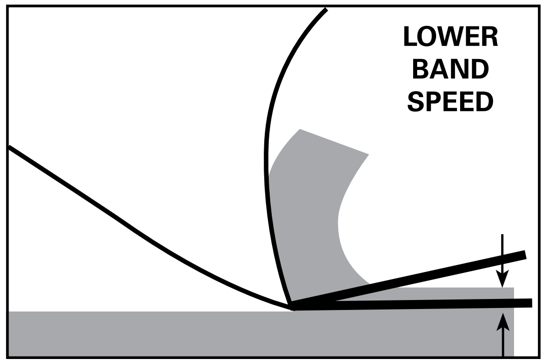
Physical limit of gullet capacity: uniform curl

Beyond physical limit of gullet capacity: distorted curl, jams, chokes machine

BAND SPEED

Band speed refers to the rate at which the blade cuts across the face of the material being worked. A faster band speed achieves a higher, more desirable shear plane angle and hence more efficient cutting. This is usually stated as FPM (feet per minute) or MPM (meters per minute).





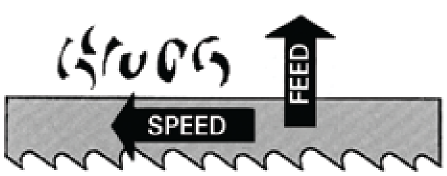
Band speed is restricted, however, by the machinability of the material and how much heat is produced by the cutting action. Too high a band speed or very hard metals produce excessive heat, resulting in reduced blade life.

How do you know if you are using the right band speed? Look at the chips; check their shape and color. The goal is to achieve chips that are thin, tightly curled and warm to the touch. If the chips have changed from silver to golden brown, you are forcing the cut and generating too much heat. Blue chips indicate extreme heat which will shorten blade life.

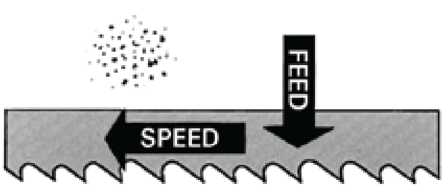
The new LENOX® *ARMOR®* family of products create some exceptions to this rule. These products use coatings to shield the teeth from heat. This *ARMOR®* – like shield pushes the heat into the chip. For more information see page 14.

Telltale Chips

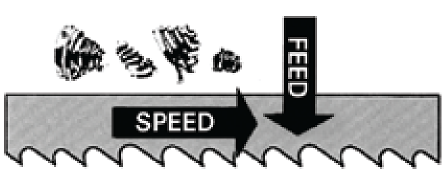
Chips are the best indicator of correct feed force. Monitor chip formation and adjust accordingly.



Burned heavy chips— reduce feed/speed.



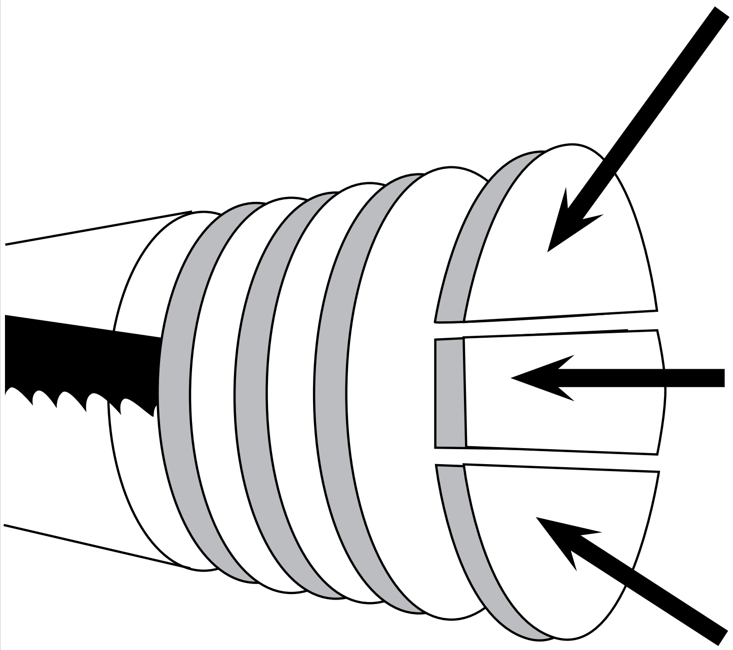
Thin or powdered chips—increase feed.



Curled silvery and warm chips—optimum feed.

GETTING AROUND BLADE LIMITATIONS

Once you understand how feed and gullet capacity limit cutting action, you will be able to choose the most effective feed rate for the material being cut. Here is an example. Assume you are cutting a piece of 4" round. There are actually three cutting areas to consider:



1. Entering the material, the blade encounters a small width and therefore meets minimum resistance. Feed rate is the limiting factor here, so you can use a feed setting that maximizes cutting without losing blade life.

2. As the blade moves through the material, the width increases, more material fills the gullet area and imposes limitations on feed and depth of penetration. For maximum sawing efficiency in this difficult midsection, the blade must have ample gullet capacity, otherwise the feed rate must be reduced accordingly.

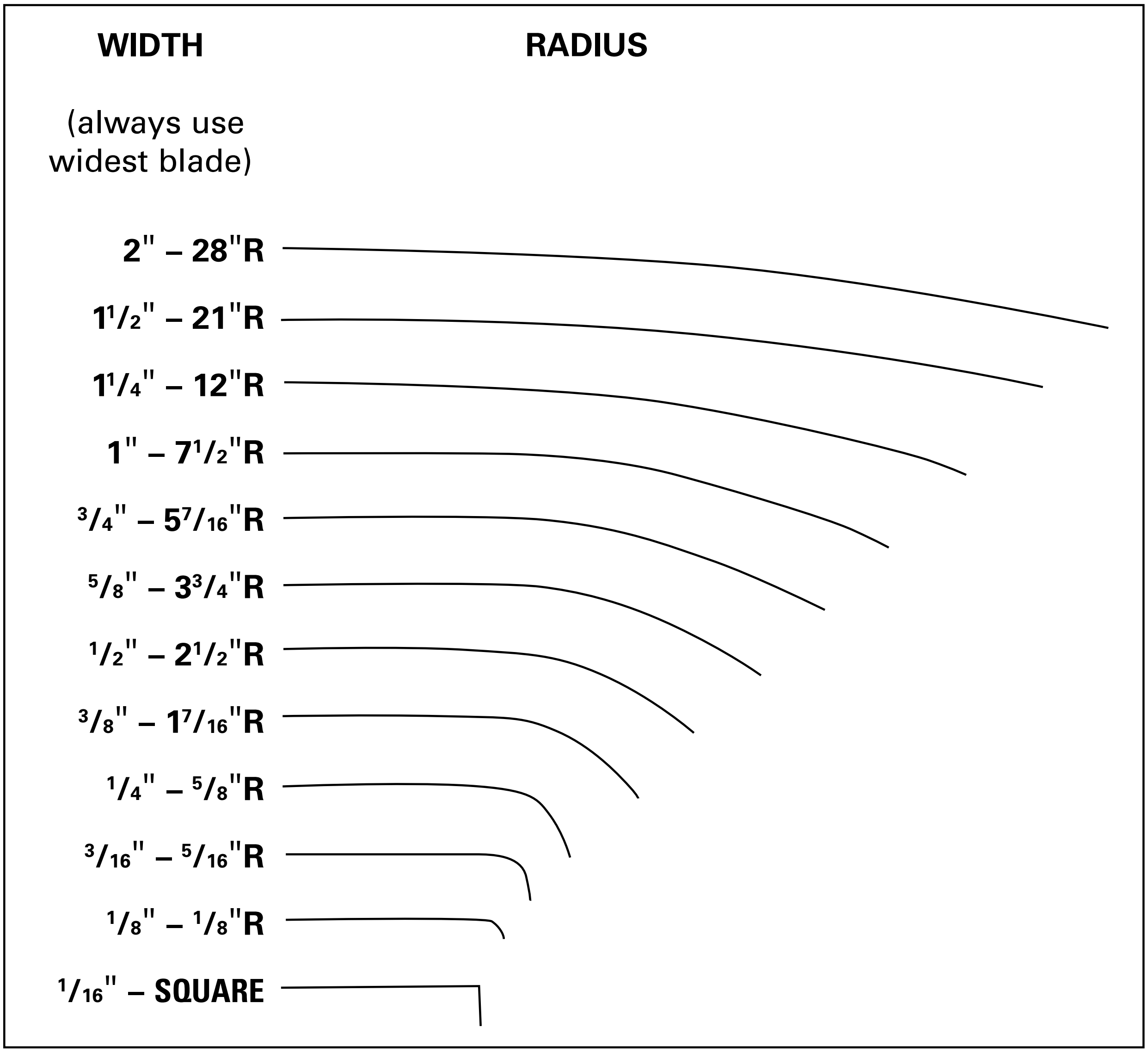
3. As the blade moves out of the difficult cutting area and into an area of decreasing width, the important limiting factor again becomes feed rate, and the feed setting can again be increased.

By knowing those portions of the cut which affect only feed rate, you can vary the rate accordingly in order to improve overall cutting efficiency.

BLADE WIDTH AND RADIUS OF CUT

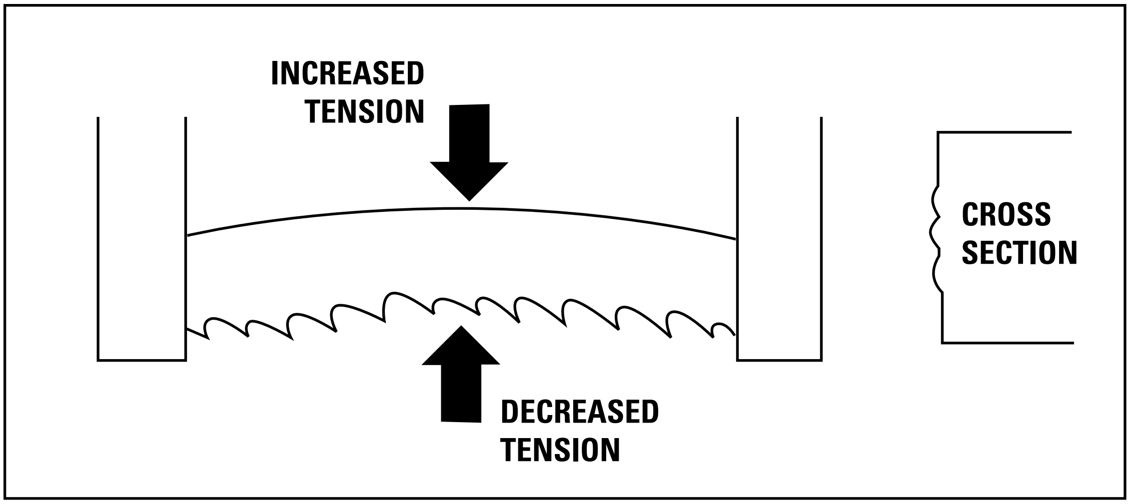
A blade must bend and flex when cutting a radius. Blade width will be the factor that limits how tight a radius can be cut with that particular blade. The following chart lists the recommended blade width for the radius to be cut.

MINIMUM RADIUS FOR WIDTH OF BLADE



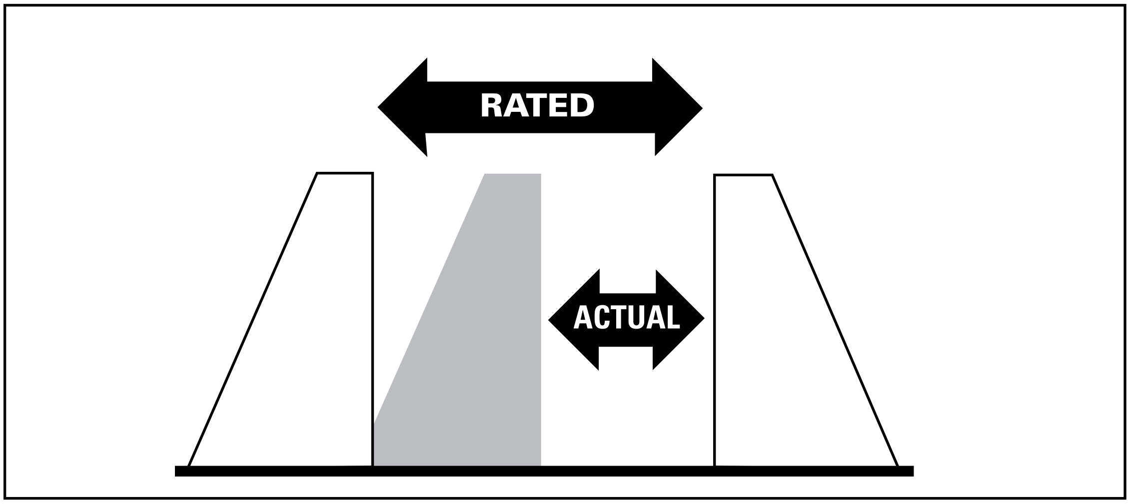
BEAM STRENGTH

When resistance grows due to increased feed rate or the varying cross section of the material being cut, tension increases on the back edge of the blade and decreases on the tooth edge. This results in compression, forcing the blade into an arc, producing cuts which are no longer square.



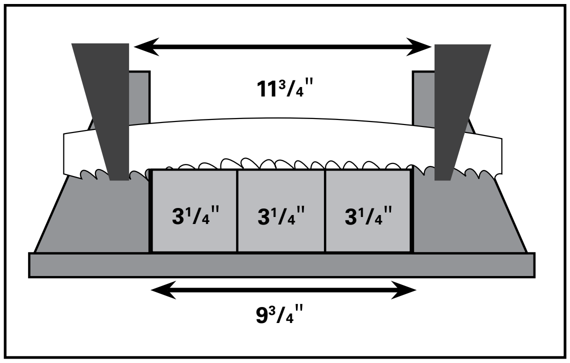
Beam strength is a blade's ability to counter this resistance during the cutting process. A blade with greater beam strength can withstand a higher feed rate, resulting in a smoother, more accurate cut.

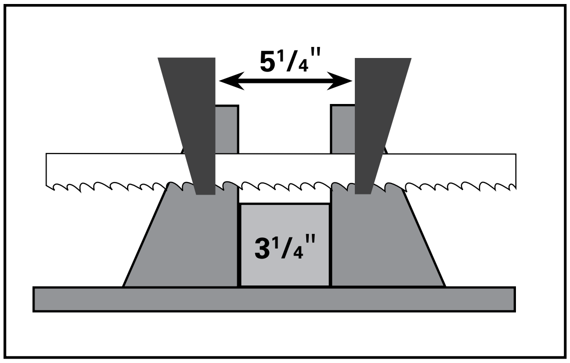
Beam strength depends on the width and gauge of the blade and the distance between guides, machine type, blade tension and the width of the material being cut. From a practical standpoint, use no more than 1/2 of the saw machine's stated capacity. For harder materials, it is safer to work closer to the 1/3 capacity.



INCREASE BEAM STRENGTH – REDUCE COST PER CUT

Here's an example of how increasing beam strength can improve cutting economy. A customer needed to cut 3¼" squares of 4150 steel on a 1¼" blade width machine. The operator, trying to cut efficiently, placed three pieces side by side. The three squares measured 9¼" wide - well within the 14" machine capacity.





With this arrangement, after only 40 cuts (120 pieces), the blade was still sharp, however, it would no longer cut square. The operator decided to call for help.

LENOX® Technical Support suggested cutting one piece at a time, which would decrease the guide distance to 5¼" (3¼" plus 1" on either side). Moving the guides closer together permitted higher feed rates.

BEAM STRENGTH – RULE OF THUMB

BLADE WIDTH		MAXIMUM CROSS SECTION	
1"	(27mm)	6"	(150mm)
1-1/4"	(34mm)	9"	(230mm)
1-1/2"	(41mm)	12"	(300mm)
2"	(54mm)	18"	(450mm)
2-5/8"	(67mm)	24"	(610mm)
3"	(80mm)	30"	(760mm)

SEVEN WAYS TO MAXIMIZE BEAM STRENGTH

1. **CALCULATE THE REAL CAPACITY** – A practical limit is 1/2 of the manufacturer's stated machine capacity. Restrict harder materials to 1/3 capacity.

2. **USE A WIDER BLADE** – A wider blade with a thicker gauge will withstand bowing, allowing for greater pressure and, therefore, higher feed rate.

3. **REPOSITION MACHINE GUIDES** – Bring guides in as close as possible. The farther apart the guides, the less support they provide to the blade.

4. **REDUCE STACK SIZE** – By cutting fewer pieces, you can increase speed and feed rates for an overall improved cutting rate.

5. **REPOSITION ODD-SHAPED MATERIAL** – Changing the position of odd-shaped material in the vise can reduce resistance and improve cutting rate Remember, the goal is to offer the blade as uniform a width as possible throughout the entire distance of cut.

6. **CHECK FOR BLADE WEAR** – Gradual normal wear dulls a blade. As a result, you cut slower, use more energy, and affect the accuracy of the cut.

7. **CHECK OTHER LIMITING FACTORS** – Use the *SAWCALC®* computer program to determine the correct feed, band speed, and tooth pitch for the work you are cutting.

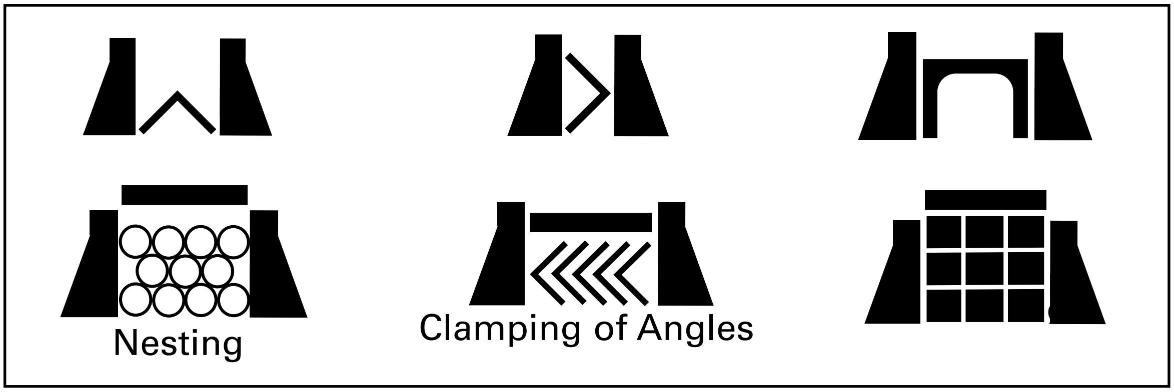
VISE LOADING

The position in which material is placed in the vise can have a significant impact on the cost per cut. Often, loading smaller bundles can mean greater sawing efficiency.

All machines have a stated loading capacity, but the practical level is usually lower, 1/2 to 1/3 as much, depending on the material being cut (harder materials are best cut at 1/3 rated capacity).

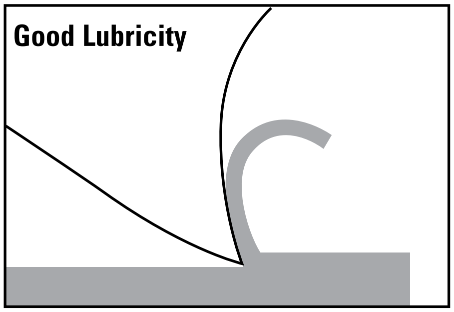
When it comes to cutting odd-shaped material, such as angles, I-beams, channel, and tubing, the main point is to arrange the materials in such a way that the blade cuts through as uniform a width as possible throughout the entire distance of cut.

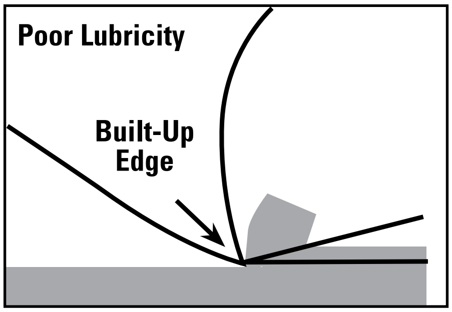
The following diagrams suggest some cost-effective ways of loading and fixturing. Be sure, regardless of the arrangement selected, that the work can be firmly secured to avoid damage to the machine or injury to the operator.

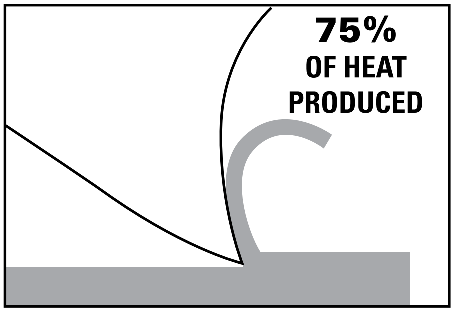


LUBRICATION

Lubrication is essential for long blade life and economical cutting. Properly applied to the shear zone, lubricant substantially reduces heat and produces good chip flow up the face of the tooth. Without lubrication, excessive friction can produce heat high enough to weld the chip to the tooth. This slows down the cutting action, requires more energy to shear the material and can cause tooth chipping or stripping which can destroy the blade.







Follow the lubrication manufacturer's instructions regarding mixing and dispensing of lubricant. Keep a properly mixed supply of replenishing fluid on hand. Never add water only to the machine sump. A fluid mixture with too high a water-to-fluid ratio will not lubricate properly and may cause rapid tooth wear and blade failure. Use a refractometer, and inspect the fluid visually to be sure it is clean.

Also, make sure the lubrication delivery system is properly aimed, so that the lubricant flows at exactly the right point.

For best results, we recommend LENOX® Sawing Fluids.

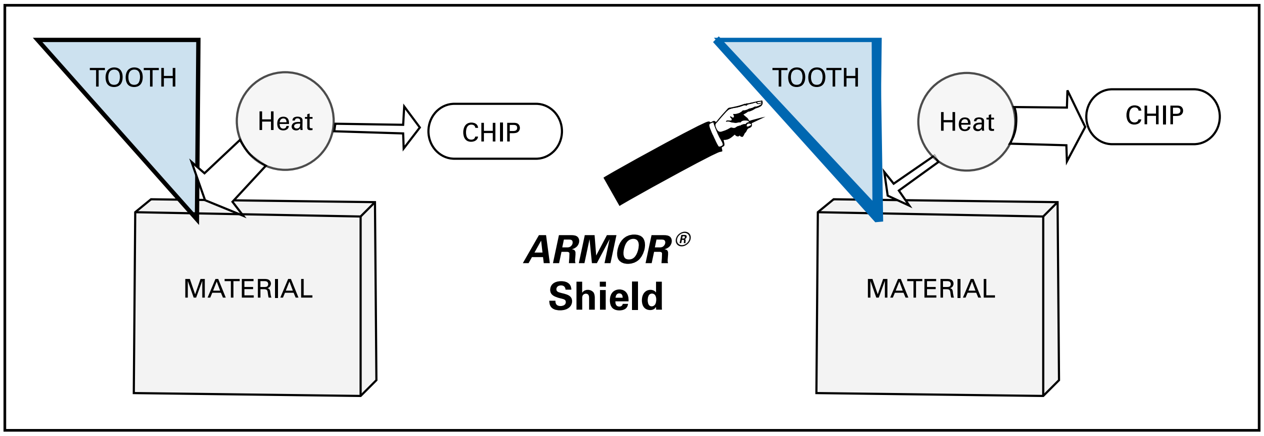
LENOX® *ARMOR®*

Heat is the primary enemy of any tool cutting edge. Excessive heat generated during chip formation can cause the cutting edge to wear rapidly. Traditionally, the band saw operator was forced to use decreased cutting rates to protect the life of the band saw blade. The tooling substrate could not handle aggressive rates or excessive heat. The introduction of LENOX® *ARMOR®* has changed this relationship.

LENOX® *ARMOR®* is not just a coating. At LENOX® we deploy extensive surface preparation and cleaning techniques to ensure the cutting edge is ready to be coated. Then we use an advanced coating process to ensure superior adhesion of the coating to the substrate.

Our AlTiN coated *ARMOR®* products shield the teeth from the devastating effect of heat. This *ARMOR®* – like shield pushes the heat away from the teeth and into the chip. Protecting the teeth from heat extends their life. Aluminum, Titanium, and Nitrogen combine to form a very hard coating on the tool surface. This coating also offers a low coefficient of friction reducing the tendency for chips to stick and weld to the cutting surface. We have combined this extremely hard cutting edge with our high performance backing steel to give the LENOX® *ARMOR®* family of products extraordinary performance.

The *ARMOR®* family of products break many of the conventional rules of sawing found in this guide. If you have an application which is abusive, aggressive or requires you to run with reduced fluids, then LENOX® *ARMOR®* may be the answer. We have both carbide and bi-metal blades in the family. The running parameters for each can vary by application. If you are considering LENOX® *ARMOR®* as a solution, then you should contact your LENOX® Sales Representative or LENOX® Technical Support for assistance.



HOW TO SELECT YOUR BAND SAW BLADES

The following information needs to be specified when a band saw blade is ordered:

For Example:	***Product Name***	***Length x Width x Thickness***	***Teeth Per Inch***
	CONTESTOR GT®	16' x 1-1/4" x .042" 4860mm x 34mm x 1.07mm	3/4 TPI

THESE STEPS ARE A GUIDE TO SELECTING THE APPROPRIATE PRODUCT FOR EACH APPLICATION:

STEP #1: ANALYZE THE SAWING APPLICATION

Machine: For most situations, knowing the blade dimensions (length x width x thickness) is all that is necessary.

Material: Find out the following characteristics of the material to be cut.
- Grade • Hardness (if heat treated or hardened)
- Shape • Size
- Is the material to be stacked (bundled) or cut one at a time?

Other Customer Needs: The specifics of the application should be considered.
- Production or utility/general purpose sawing operation?
- What is more important, fast cutting or tool life?
- Is material finish important?

STEP #2: DETERMINE WHICH PRODUCT TO USE

Use the charts on pages 16, 17, and 19.
- Find the material to be cut in the top row.
- Read down the chart to find which blade is recommended.
- For further assistance, contact LENOX® Technical Support at 800-642-0010.

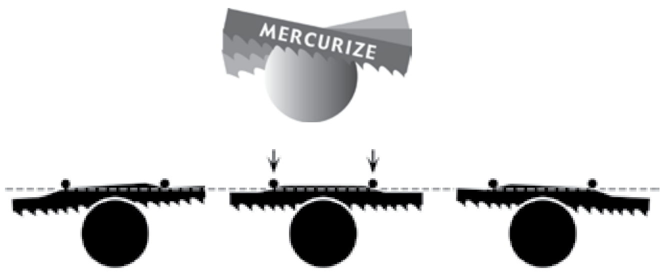
STEP #3: DETERMINE THE PROPER NUMBER OF TEETH PER INCH (TPI)

Use the tooth selection chart on page 18 or 21.
- If having difficulty choosing between two pitches, the finer of the two will generally give better performance.
- When compromise is necessary, choose the correct TPI first.

STEP #4: ORDER LENOX® SAWING FLUIDS AND LUBRICANTS for better performance and longer life on any blade.

STEP #5: DETERMINE THE NEED FOR MERCURIZATION

This patented, enhanced mechanical design promotes more efficient tooth penetration and chip formation, easily cutting through the work hardened zone. The MERCURIZE symbol denotes any product that can be *MERCURIZED™*. Consult your LENOX® Technical Representative to determine if MERCURIZATION will benefit your operation.



STEP #6: INSTALL THE BLADE AND FLUID

STEP #7: BREAK IN THE BLADE PROPERLY

For break-in recommendations, refer to *SAWCALC®* or contact LENOX® Technical Support at 800-642-0010.

STEP #8: RUN THE BLADE AT THE CORRECT SPEED AND FEED RATE

Refer to the Bi-metal and Carbide Speed Charts. For additional speed and feed recommendations, refer to *SAWCALC®* or contact LENOX® Technical Support at 800-642-0010.

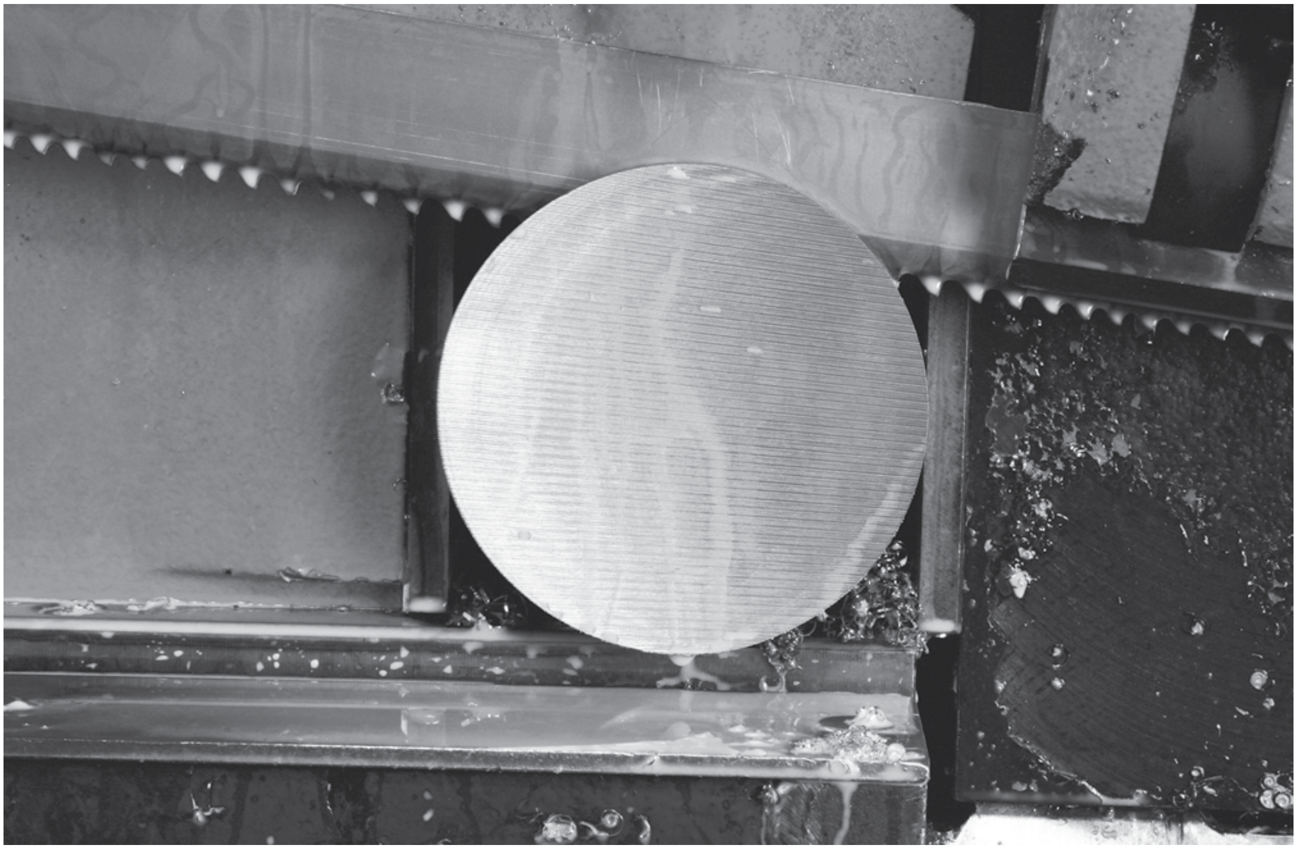
CARBIDE PRODUCT SELECTION CHART

HIGH PERFORMANCE

<table>
<tr><th>ALUMINUM/ NON-FERROUS</th><th>CARBON STEELS</th><th>STRUCTURAL STEELS</th><th>ALLOY STEELS</th><th>BEARING STEELS</th><th>MOLD STEELS</th><th>STAINLESS STEELS</th><th>TOOL STEELS</th><th>TITANIUM ALLOYS</th><th>NICKEL-BASED ALLOYS (INCONEL®)</th></tr>
<tr><td colspan="10">EASY ← MACHINABILITY → DIFFICULT</td></tr>
<tr><td></td><td colspan="6">ARMOR® CT BLACK for Extreme Cutting Rates</td><td colspan="3"></td></tr>
<tr><td></td><td>ARMOR® CT GOLD</td><td></td><td colspan="4">ARMOR® CT GOLD For Superior Life</td><td colspan="3"></td></tr>
<tr><td>TNT CT®</td><td colspan="5"></td><td colspan="4">TNT CT® Extreme Performance on Super Alloys</td></tr>
<tr><td colspan="2">TRI-TECH CT™</td><td></td><td colspan="7">TRI-TECH CT™ Set Style Blade for Difficult to Cut Metals</td></tr>
<tr><td colspan="2">TRI-MASTER®</td><td></td><td colspan="7">TRI-MASTER® Versatile Carbide Tipped Blade</td></tr>
</table>

SPECIAL APPLICATION

<table>
<tr><th>WOOD</th><th>COMPOSITES</th><th>ALUMINUM (Including Alum. Castings)</th><th>CASE HARDENED MATERIALS (Including IHCP Cylinder Shafts)</th><th>OTHER (Composites, Tires, etc.)</th></tr>
<tr><td colspan="5">EASY ← MACHINABILITY → DIFFICULT</td></tr>
<tr><td colspan="3">ALUMINUM MASTER™ CT Triple Chip Tooth Design</td><td colspan="2">HRc® Carbide Tipped Blade for Case and Through-Hardened Materials</td></tr>
<tr><td colspan="3">SST CARBIDE™ Set Style Tooth Design</td><td colspan="2"></td></tr>
<tr><td colspan="3">TRI-MASTER®</td><td colspan="2"></td></tr>
<tr><td></td><td>MASTER-GRIT®</td><td></td><td colspan="2">MASTER-GRIT® Carbide Grit Edge Blade for Cutting Abrasive and Hardened Materials</td></tr>
</table>



CARBIDE SPEED CHART

MATERIALS		*ARMOR® CT BLACK*		*ARMOR® CT GOLD*		*TNT CT®*		*ALUMINUM MASTER™ CT*		*SST CARBIDE™*		*HRc®*		*TRI-MASTER®*		*TRI-TECH CT™*	
TYPE	**GRADE**	**FPM**	**MPM**	**FPM**	**MPM**	**FPM**	**MPM**	**FPM**	**MPM**	**FPM**	**MPM**	**FPM**	**MPM**	**FPM**	**MPM**	**FPM**	**MPM**
Aluminum Alloys	2024, 5052, 6061, 7075					3,500–8,500*	1000–2600	3,500–8,500*	1000–2600	3,500–8,500*	1000–2600			3,500–8,500*	1000–2600	3,500–8,500*	1000–2600
Copper Alloys	CDA 220 CDA 360 Cu Ni (30%) Be Cu					240 300 220 180	75 90 65 55	210 295 200 160	65 90 60 50	210 295 200 160	65 90 60 50	280	85	210 295 200 160	65 90 60 50	240 300 220 180	75 90 65 55
Bronze Alloys	AMPCO 18 AMPCO 21 AMPCO 25 Leaded Tin Bronze Al Bronze 865 Mn Bronze 932 937					205 180 115 300 200 220 300 300	60 55 35 90 60 65 90 90	180 160 110 290 150 215 280 250	55 50 35 90 45 65 85 75	180 160 110 290 150 215 280 250	55 50 35 90 45 65 85 75			180 160 110 290 150 215 280 250	55 50 35 90 45 65 85 75	205 180 115 300 200 220 300 300	60 55 35 90 60 65 90 90
Brass Alloys	Cartridge Brass Red Brass (85%) Naval Brass					260 230	80 70					220 200	65 60	220 200	65 60	260 230	80 70
Leaded, Free Machining Low Carbon Steels	1145 1215 12L14	370 425 450	115 130 135	290 325 350	90 100 105									290 325 350	90 100 105	290 325 350	90 100 105
Structural Steel	A36	350	105														
Low Carbon Steels	1008, 1018 1030	310 290	95 90	250 240	75 75							270** 250**	80 75	250 240	75 75	250 240	75 75
Medium Carbon Steels	1035 1045	285 275	85 85	230 220	70 65							240** 230**	75 70	230 220	70 65	230 220	70 65
High Carbon Steels	1060 1080 1095	260 250 240	80 75 75									200** 195** 185**	60 60 55				
Mn Steels	1541 1524	260 240	80 75	220 200	65 60												
Cr-Mo Steels	4140 41L50 4150H	300 310 290	90 95 90	230 240 220	70 75 65												
Cr Alloy Steels	6150 52100 5160	315 300 315	95 90 95	220 295 230	65 90 70											190 190 190	60 60 60
Ni-Cr-Mo Steels	4340 8620 8640 E9310	300 310 305 315	90 95 95 95	230 280 240 295	70 85 75 90											190 190 190 190	60 60 60 60
Low Alloy Tool Steel	L-6	300	90			240	75							190	60	240	75
Water-Hardening Tool Steel	W-1	300	90			240	65							175	55	220	65
Cold-Work Tool Steel	D-2	240	75			210	65							170	50	210	65
Air-Hardening Tool Steels	A-2 A-6 A-10	270 240 190	80 75 60			230 220 160	70 65 50							185 175 130	55 55 40	230 220 160	70 65 50
Hot Work Tool Steels	H-13 H-25	240 180	75 55			220 150	55 45							175 120	55 35	220 150	55 45
Oil-Hardening Tool Steels	O-1 O-2	260 240	80 75			240 220	75 65							190 175	60 55	240 220	75 65
High Speed Tool Steels	M-2, M-10 M-4, M-42 T-1 T-15	140 130 120 100	45 40 35 30			110 105 100 80	35 30 30 25							90 85 80 65	25 25 25 20	110 105 100 80	35 30 30 25
Mold Steels	P-3 P-20	300 280	90 85			200 160	60 50							160 130	50 40	200 160	60 50
Shock Resistant Tool Steels	S-1 S-5, S-7	220 200	65 60														
Stainless Steels	304 316 410,420 440A 440C	260 240 290 250 240	80 75 90 75 75	235 225 240 210 200	70 70 75 65 60	220 180 250 200 200	65 55 75 60 60					220 180 250 200 200	65 55 75 60 60	155 125 175 140 140	45 40 55 45 45	190 180 250 200 200	60 55 75 60 60
Precipitation Hardening Stainless Steels	17-4 PH 15-5 PH	300 300	90 90	220 220	65 65	160 140	50 45					160 140	50 45	110 100	35 30	160 140	50 45
Free Machining Stainless Steels	420F 301	340 320	105 100	250 240	75 75	270 230	80 70					270 230	80 70	190 160	60 50	270 230	80 70
Nickel Alloys	Monel® K-500 Duranickel® 301					90 80	25 25							90 80	25 25	90 80	25 25
Iron-Based Super Alloys	A286, Incoloy® 825 Incoloy® 600 Pyromet® X-15					80 75 90	25 25 25							80 75 90	25 25 25	105 85 90	30 25 25
Nickel-Based Alloys	Inconel® 600, Inconel® 718 Nimonic® 90 NI-SPAN-C® 902, RENE® 41 Inconel® 625 Hastalloy B, Waspalloy Nimonic® 75, RENE® 88					85 85 115 75 75	25 25 35 25 25							85 85 115 75 75	25 25 35 25 25	100 100 105 105 100 105	30 30 30 30 30 30
Titanium Alloys	CP Titanium Ti-6A1-4V	230 230	70 70			180 180	55 55							150 150	45 45	180 180	55 55
Cast Irons	A536 (60-40-18) A536 (120-90-02) A48 (Class 20) A48 (Class 40) A48 (Class 60)	360 175 250 160 115	110 55 75 50 35														

FPM = Feet Per Minute | MPM = Meters Per Minute **For metal cutting saws run between 275 and 350 FPM. **Typically for hardened and case hardened carbon steels up to 61 Rc.*

CARBIDE TOOTH SELECTION

ARMOR® CT BLACK

<table>
<tr><th></th><th colspan="14">WIDTH OR DIAMETER OF CUT</th></tr>
<tr><td>INCHES</td><td>1</td><td>2.5</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>10</td><td>12</td><td>13</td><td>15</td><td>17</td><td>20+</td></tr>
<tr><td>MM</td><td>25</td><td>60</td><td>70</td><td>100</td><td>120</td><td>150</td><td>170</td><td>200</td><td>250</td><td>300</td><td>330</td><td>380</td><td>430</td><td>500+</td></tr>
<tr><td colspan="10"></td><td colspan="5">0.9/1.1 TPI</td></tr>
<tr><td colspan="8"></td><td colspan="7">1.4/1.6 TPI</td></tr>
<tr><td colspan="4"></td><td colspan="7">1.8/2.0 TPI</td><td colspan="4"></td></tr>
<tr><td colspan="8">2.5/3.4 TPI</td><td colspan="7"></td></tr>
</table>

ARMOR® CT GOLD

<table>
<tr><th></th><th colspan="14">WIDTH OR DIAMETER OF CUT</th></tr>
<tr><td>INCHES</td><td>1</td><td>2.5</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>10</td><td>12</td><td>13</td><td>15</td><td>17</td><td>20</td></tr>
<tr><td>MM</td><td>25</td><td>60</td><td>70</td><td>100</td><td>120</td><td>150</td><td>170</td><td>200</td><td>250</td><td>300</td><td>330</td><td>380</td><td>430</td><td>500</td></tr>
<tr><td colspan="10"></td><td colspan="5">0.9/1.1 TPI</td></tr>
<tr><td colspan="5"></td><td colspan="6">1.8/2.0 TPI</td><td colspan="4"></td></tr>
</table>

TNT CT®

<table>
<tr><th></th><th colspan="14">WIDTH OR DIAMETER OF CUT</th></tr>
<tr><td>INCHES</td><td>1</td><td>2.5</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>10</td><td>12</td><td>13</td><td>15</td><td>17</td><td>20</td></tr>
<tr><td>MM</td><td>25</td><td>60</td><td>70</td><td>100</td><td>120</td><td>150</td><td>170</td><td>200</td><td>250</td><td>300</td><td>330</td><td>380</td><td>430</td><td>500</td></tr>
<tr><td colspan="10"></td><td colspan="5">0.9/1.1 TPI</td></tr>
<tr><td colspan="5"></td><td colspan="6">1.8/2.0 TPI</td><td colspan="4"></td></tr>
<tr><td colspan="8">2.5/3.4 TPI</td><td colspan="7"></td></tr>
</table>

TRI-TECH CT™

<table>
<tr><th></th><th colspan="14">WIDTH OR DIAMETER OF CUT</th></tr>
<tr><td>INCHES</td><td>1</td><td>2.5</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>10</td><td>12</td><td>13</td><td>15</td><td>17</td><td>20+</td></tr>
<tr><td>MM</td><td>25</td><td>60</td><td>70</td><td>100</td><td>120</td><td>150</td><td>170</td><td>200</td><td>250</td><td>300</td><td>330</td><td>380</td><td>430</td><td>500+</td></tr>
<tr><td colspan="13"></td><td colspan="2">0.6/0.8 TPI</td></tr>
<tr><td colspan="12"></td><td colspan="2">0.9/1.1 TPI</td><td></td></tr>
<tr><td colspan="8"></td><td colspan="5">1.4/1.8 TPI</td><td colspan="2"></td></tr>
<tr><td colspan="4"></td><td colspan="7">1.8/2.0 TPI</td><td colspan="4"></td></tr>
<tr><td colspan="8">2.5/3.4 TPI</td><td colspan="7"></td></tr>
</table>

TRI-MASTER® • HRc® • ALUMINUM MASTER™ CT • SST CARBIDE™

<table>
<tr><th></th><th colspan="14">WIDTH OR DIAMETER OF CUT</th></tr>
<tr><td>INCHES</td><td>1</td><td>2.5</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>10</td><td>12</td><td>13</td><td>15</td><td>17</td><td>20</td></tr>
<tr><td>MM</td><td>25</td><td>60</td><td>70</td><td>100</td><td>120</td><td>150</td><td>170</td><td>200</td><td>250</td><td>300</td><td>330</td><td>380</td><td>430</td><td>500</td></tr>
<tr><td colspan="9"></td><td colspan="6">1.2/1.8 TPI</td></tr>
<tr><td colspan="6"></td><td colspan="8">1.5/2.3 TPI</td><td></td></tr>
<tr><td colspan="3"></td><td colspan="6">2/3 TPI</td><td colspan="6"></td></tr>
<tr><td colspan="2"></td><td colspan="6">3 TPI</td><td colspan="7"></td></tr>
<tr><td colspan="7">3/4 TPI</td><td colspan="8"></td></tr>
</table>

Note: Aluminum and other soft materials cut on machines with extremely high band speed may change your tooth selection.
Please call LENOX® *Technical Support at 800-642-0010 for more information or consult SAWCALC®.*

BI-METAL PRODUCT SELECTION CHART

PRODUCTION SAWING

<table>
<tr><th>ALUMINUM NON-FERROUS</th><th>CARBON STEELS</th><th>STRUCTURAL STEELS</th><th>ALLOY STEELS</th><th>BEARING STEELS</th><th>MOLD STEELS</th><th>TOOL STEELS</th><th>STAINLESS STEELS</th><th>TITANIUM ALLOYS</th><th>NICKEL-BASED ALLOYS (INCONEL®)</th></tr>
<tr><td colspan="10">EASY ← MACHINABILITY → DIFFICULT</td></tr>
<tr><td colspan="5"></td><td colspan="5">QGT™ Longest Life. Straight Cuts</td></tr>
<tr><td colspan="2">QXP™</td><td></td><td colspan="5">QXP™ Long Life. Fast Cutting</td><td colspan="2"></td></tr>
<tr><td colspan="5"></td><td colspan="5">CONTESTOR GT® Long Life. Straight Cuts</td></tr>
<tr><td colspan="2">LXP®</td><td></td><td colspan="5">LXP® Fast Cutting</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="2">ARMOR® Rx®+ Long Life. Structurals/Bundles</td><td colspan="7"></td></tr>
<tr><td></td><td colspan="2">Rx®+ Structurals/Bundles</td><td colspan="7"></td></tr>
</table>

GENERAL PURPOSE

<table>
<tr><td colspan="4">CLASSIC® 3/4” and Wider Blades</td><td colspan="2"></td><td colspan="2">CLASSIC®</td><td colspan="2"></td></tr>
<tr><td colspan="4">DIEMASTER 2® 1/2” and Narrower Blades</td><td colspan="2"></td><td colspan="2">DIEMASTER 2®</td><td colspan="2"></td></tr>
</table>

BI-METAL SPEED CHART PARAMETERS

The Speed Chart recommendations apply when cutting 4" wide (100mm), annealed material with a bi-metal blade and flood sawing fluid:

ADJUST BAND SPEED FOR DIFFERENT SIZED MATERIALS

MATERIAL	BAND SPEED
1/4" (6mm)	Chart Speed + 15%
3/4" (19mm)	Chart Speed + 12%
1-1/4" (32mm)	Chart Speed + 10%
2-1/2" (64mm)	Chart Speed + 5%
4" (100mm)	Chart Speed - 0%
8" (200mm)	Chart Speed - 12%

ADJUST BAND SPEED FOR DIFFERENT FLUID TYPES

FLUID TYPES	BAND SPEED
Spray lube	Chart Speed - 15%
No fluid	Chart Speed - 30–50%

ADJUST BAND SPEED FOR HEAT TREATED MATERIALS

ROCKWELL	BRINELL	DECREASE BAND SPEED
Up to 20	226	-0%
22	237	-5%
24	247	-10%
26	258	-15%
28	271	-20%
30	286	-25%
32	301	-30%
36	336	-35%
38	353	-40%
40	371	-45%

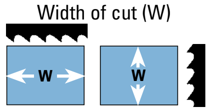
REDUCE BAND SPEED 50% WHEN SAWING WITH CARBON BLADES

BI-METAL SPEED CHART

	MATERIALS		BAND SPEED	
	TYPE	GRADE	FEET/MIN	METER/MIN
ALUMINUM / NON-FERROUS	Aluminum Alloys	2024, 5052, 6061, 7075	300+	85+
	Copper Alloys	CDA 220 CDA 360 Cu Ni (30%) Be Cu	210 295 200 160	65 90 60 50
	Bronze Alloys	AMPCO 18 AMPCO 21 AMPCO 25 Leaded Tin Bronze Al Bronze 865 Mn Bronze 932 937	180 160 110 290 150 215 280 250	55 50 35 90 45 65 85 75
	Brass Alloys	Cartridge Brass, Red Brass (85%) Naval Brass	220 200	65 60
CARBON STEELS	Leaded, Free Machining Low Carbon Steels	1145 1215 12L14	270 325 350	80 100 105
	Low Carbon Steels	1008, 1018 1030	270 250	80 75
	Medium Carbon Steels	1035 1045	240 230	75 70
	High Carbon Steels	1060 1080 1095	200 195 185	60 60 55
STRUCTURAL STEEL	Structural Steel	A36	250	75
ALLOY STEEL	Mn Steels	1541 1524	200 170	60 50
	Cr-Mo Steels	4140 41L50 4150H	225 235 200	70 70 60
	Cr Alloy Steels	6150 5160	190 195	60 60
	Ni-Cr-Mo Steels	4340 8620 8640 E9310	195 215 185 160	60 65 55 50
BEARING STEEL	Cr Alloy Steels	52100	160	50
MOLD STEEL	Mold Steels	P-3 P-20	180 165	55 50
STAINLESS STEEL	Stainless Steels	304 316 410, 420 440A 440C	115 90 135 80 70	35 25 40 25 20
	Precipitation Hardening Stainless Steels	17-4 PH 15-5 PH	70 70	20 20
	Free Machining Stainless Steels	420F 301	150 125	45 40
TOOL STEEL	Low Alloy Tool Steel	L-6	145	45
	Water-Hardening Tool Steel	W-1	145	45
	Cold-Work Tool Steel	D-2	90	25
	Air-Hardening Tool Steels	A-2 A-6 A-10	150 135 100	45 40 30
	Hot Work Tool Steels	H-13 H-25	140 90	40 25
	Oil-Hardening Tool Steels	O-1 O-2	140 135	40 40
	High Speed Tool Steels	M-2, M-10 M-4, M-42 T-1 T-15	105 95 90 60	30 30 25 20
	Shock Resistant Tool Steels	S-1 S-5, S-7	140 125	40 40
TITANIUM ALLOY	Titanium Alloys	CP Titanium Ti-6Al-4V	85 65	25 20
NICKEL BASED ALLOY	Nickel Alloys	Monel® K-500 Duranickel 301	70 55	20 15
	Iron-Based Super Alloys	A286, Incoloy® 825 Incoloy® 600 Pyromet X-15	80 55 70	25 15 20
	Nickel-Based Alloys	Inconel® 600, Inconel® 718, Nimonic 90 NI-SPAN-C 902, RENE 41 Inconel® 625 Hastalloy B, Waspalloy Nimonic 75, RENE 88	60 60 80 55 50	20 20 25 15 15
OTHER	Cast Irons	A536 (60-40-18) A536 (120-90-02) A48 (Class 20) A48 (Class 40) A48 (Class 60)	225 110 160 115 95	70 35 50 35 30

BI-METAL TOOTH SELECTION

1. Determine size and shape of material to be cut
2. Identify chart to be used (square solids, round solids, or tubing/structurals)
3. Read teeth per inch next to material size.

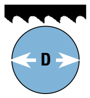


SQUARE/RECTANGLE SOLID Locate width of cut (W)

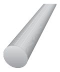
WIDTH OF CUT

IN	.1	.2	.3	.4	.5	.6	.7	.8	.9	1	2	5	10	15	20	25	30	35	40	45	50
MM	2.5	5	7.5	10	12.5	15	17.5	20	22.5	25	50	125	250	375	500	625	750	875	1000	1125	1250

TPI	14/18	10/14	8/12	6/10	6/8 5/8	4/6	3/4	2/3	1.5/2.0 1.4/2.0	1.0/1.3	.7/1.0



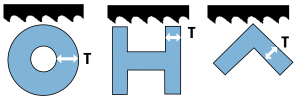
ROUND SOLID Locate diameter of cut (D)



DIAMETER OF CUT

IN	.1	.2	.3	.4	.5	.6	.7	.8	.9	1	2	5	10	15	20	25	30	35	40	45	50
MM	2.5	5	7.5	10	12.5	15	17.5	20	22.5	25	50	125	250	375	500	625	750	875	1000	1125	1250

TPI	14/18	10/14	8/12	6/10	6/8 5/8	4/6	3/4	2/3	1.5/2.0 1.4/2.0	1.0/1.3	.7/1.0



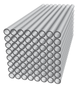
TUBING/PIPE/ STRUCTURALS Locate wall thickness (T)

WALL THICKNESS

IN	.05	.10	.15	.20	.25	.30	.40	.50	.60	.70	.80	.90	1	1.5	2
MM	1.25	2.5	3.75	5	6.25	7.5	10	12.5	15	17.5	20	22.5	25	37.5	50

TPI	14/18	10/14	8/12	6/10	6/8 5/8	4/6	3/4	2/3

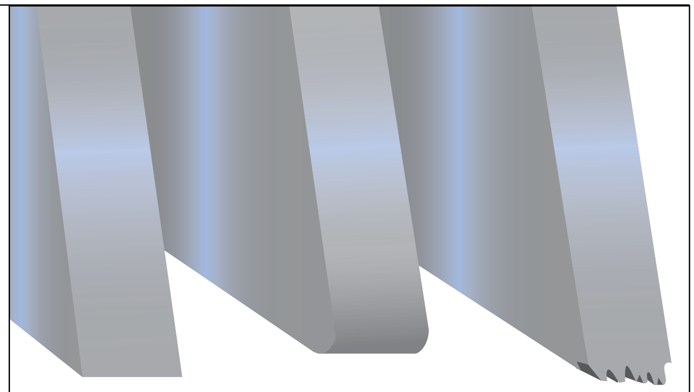
BUNDLED/STACKED MATERIALS:



To select the proper number of teeth per inch (TPI) for bundled or stacked materials, find the recommended TPI for a single piece and choose one pitch coarser to cut the bundle

BLADE BREAK-IN

Getting Long Life from a New Band Saw Blade



WHAT IS BLADE BREAK-IN?
A new band saw blade has razor sharp tooth tips. In order to withstand the cutting pressures used in band sawing, tooth tips should be honed to form a micro-fine radius. Failure to perform this honing will cause microscopic damage to the tips of the teeth, resulting in reduced blade life.

WHY BREAK-IN A BAND SAW BLADE?
Completing a proper break-in on a new band saw blade will dramatically increase its life.

HOW TO BREAK IN A BLADE

Select the proper band speed for the material to be cut (see charts on page 17 and 20).

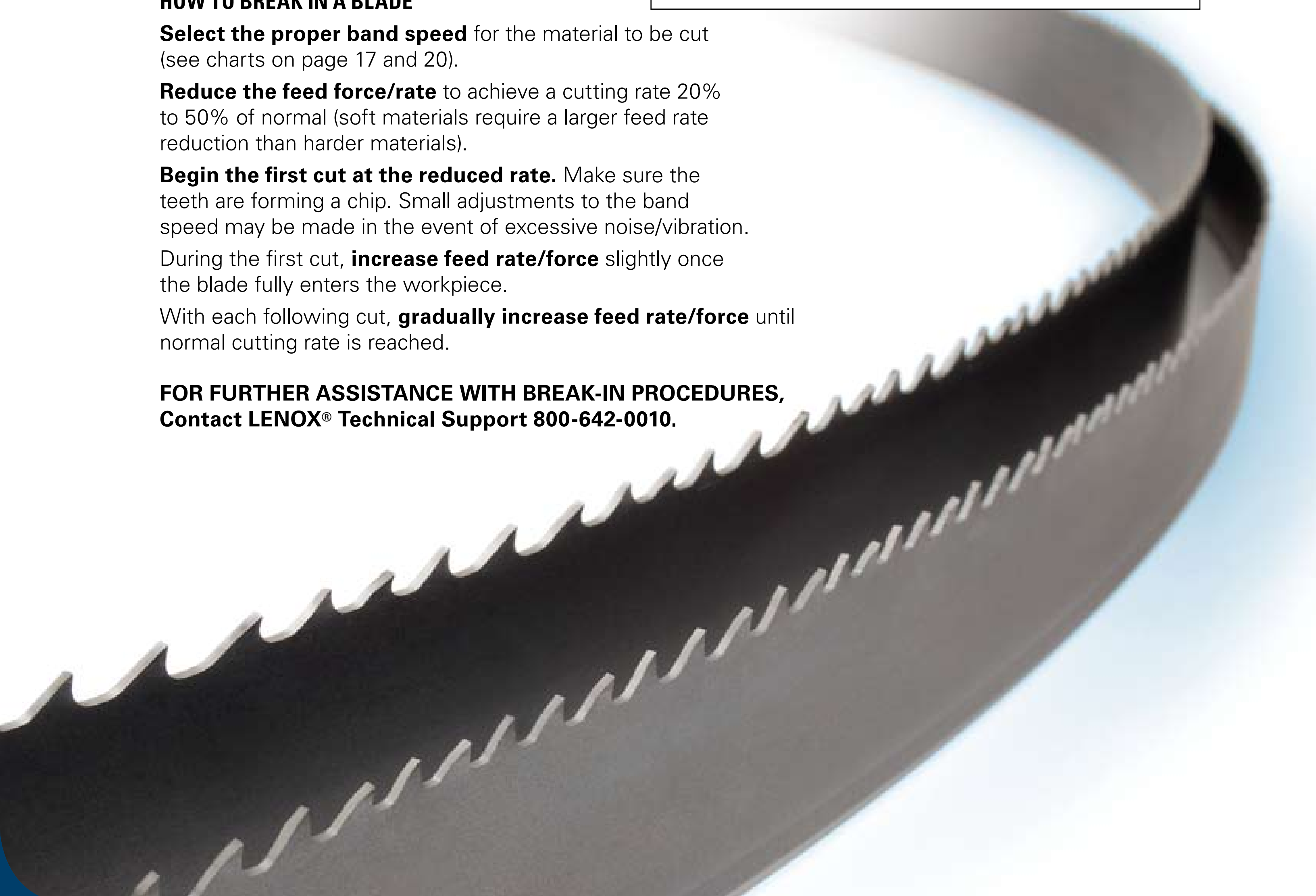
Reduce the feed force/rate to achieve a cutting rate 20% to 50% of normal (soft materials require a larger feed rate reduction than harder materials).

Begin the first cut at the reduced rate. Make sure the teeth are forming a chip. Small adjustments to the band speed may be made in the event of excessive noise/vibration.

During the first cut, **increase feed rate/force** slightly once the blade fully enters the workpiece.

With each following cut, **gradually increase feed rate/force** until normal cutting rate is reached.

FOR FURTHER ASSISTANCE WITH BREAK-IN PROCEDURES, Contact LENOX® Technical Support 800-642-0010.



BASIC MAINTENANCE PAYS OFF!

Scheduled maintenance of sawing machines has always been necessary for proper and efficient cutting, but for today's super alloys that requirement is more important than ever. Besides following the manufacturer's maintenance instructions, attending to these additional items will help ensure long life and efficient operation.

Band Wheels – Remove any chips. Make sure they turn freely.

Blade Tension – Use a tension meter to ensure accuracy.

Blade Tracking – Make sure the blade tracks true and rides correctly in the guides.

Chip Brush – Engage properly to keep chips from re-entering the cut.

Guides – Make sure guides are not chipped or cracked. Guides must hold the blade with the right pressure and be positioned as close as possible to the workpiece.

Guide Arm – For maximum support, move as close as possible to the workpiece.

Sawing Fluid – Be sure to use clean, properly mixed lubricant, such as *BAND-ADE®*, applied at the cutting point. Test for ratio with a refractometer and visually inspect to be sure. If new fluid is needed, mix properly, starting with water then adding lubricating fluid according to the manufacturer's recommendations.

TECHNICAL SUPPORT BY PHONE

You can get technical assistance for solving your band sawing problems by phone. Our Technical Support staff is here to serve you, and can be reached during normal working hours by calling our toll-free number.

800-642-0010
FAX: 800-265-9221

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BAND SAW TUNE-UP

BY LENOX® FIELD ENGINEERING, YOURS WITH QUALIFYING GUARANTEED TRIAL ORDER.

SOLUTIONS TO SAWING PROBLEMS

Table Of Contents

OBSERVATION #1

Heavy Even Wear On Tips and Corners Of Teeth

The wear on teeth is smooth across the tips and the corners of set teeth have become rounded.

PROBABLE CAUSE:

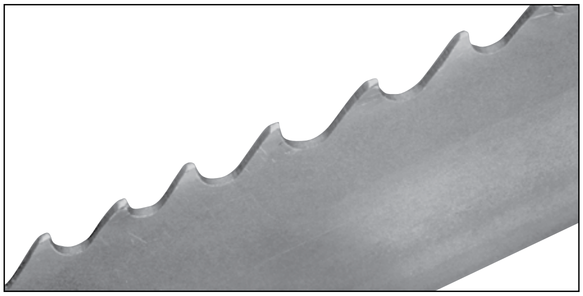
A. Improper break-in procedure.

B. Excessive band speed for the type of material being cut. This generates a high tooth tip temperature resulting in accelerated tooth wear.

C. Low feed rate causes teeth to rub instead of penetrate. This is most common on work hardened materials such as stainless and tool steels.

D. Hard materials being cut such as "Flame Cut Edge" or abrasive materials such as " Fiber Reinforced Composites".

E. Insufficient sawing fluid due to inadequate supply, improper ratio, and/or improper application.



OBSERVATION #2

Wear On Both Sides Of Teeth

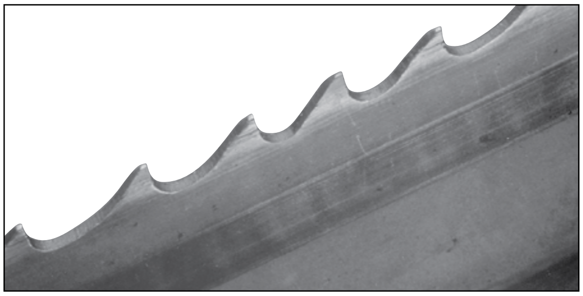
The side of teeth on both sides of band have heavy wear markings.

PROBABLE CAUSE:

A. Broken, worn or missing back-up guides allowing teeth to contact side guides.

B. Improper side guides for band width.

C. Backing the band out of an incomplete cut.



OBSERVATION #3

Wear On One Side Of Teeth

Only one side of teeth has heavy wear markings.

PROBABLE CAUSE:

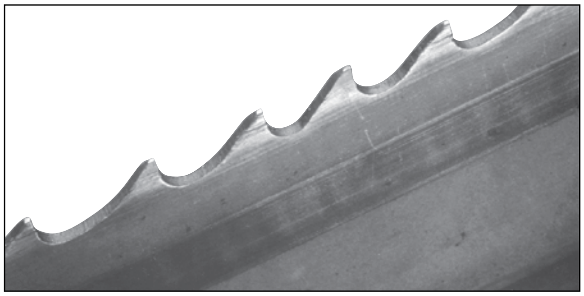
A. Worn wheel flange, allowing side of teeth to contact wheel surface or improper tracking on flangeless wheel.

B. Loose or improperly positioned side guides.

C. Blade not perpendicular to cut.

D. Blade rubbing against cut surface on return stroke of machine head.

E. The teeth rubbing against a part of machine such as chip brush assembly, guards, etc.



OBSERVATION #4

Chipped Or Broken Teeth

A scattered type of tooth breakage on tips and corners of the teeth.

PROBABLE CAUSE:

A. Improper break-in procedure.

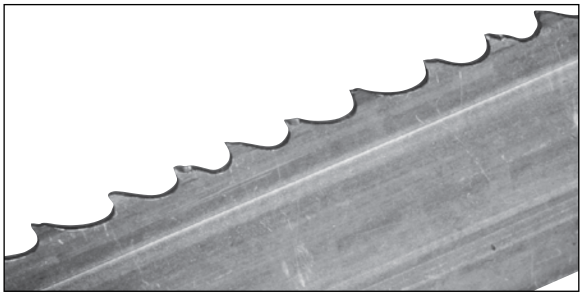
B. Improper blade selection for application.

C. Handling damage due to improper opening of folded band.

D. Improper positioning or clamping of material.

E. Excessive feeding rate or feed pressure.

F. Hitting hard spots or hard scale in material.



OBSERVATION #5

Body Breakage Or Cracks From Back Edge

The fracture originates from the back edge of band. The origin of the fracture is indicated by a flat area on the fracture surface.

PROBABLE CAUSE:

A. Excessive back-up guide "preload" will cause back edge to work harden which results in cracking.

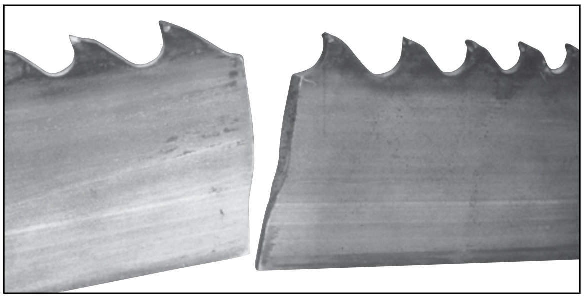
B. Excessive feed rate.

C. Improper band tracking – back edge rubbing heavy on wheel flange.

D. Worn or defective back-up guides.

E. Improper band tension.

F. Notches in back edge from handling damage.



OBSERVATION #6

Tooth Strippage

Section or sections of teeth which broke from the band backing.

PROBABLE CAUSE:

A. Improper or lack of break-in procedure.

B. Worn, missing or improperly positioned chip brush.

C. Excessive feeding rate or feed pressure.

D. Movement or vibration of material being cut.

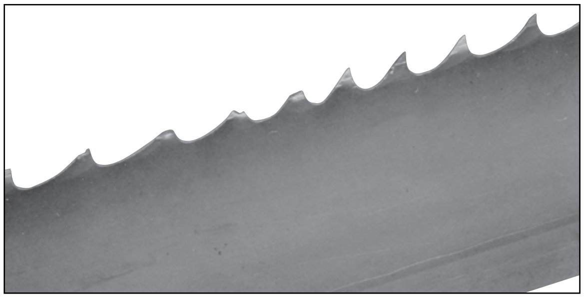
E. Improper tooth pitch for cross sectional size of material being cut.

F. Improper positioning of material being cut.

G. Insufficient sawing fluid due to inadequate supply, improper ratio and/or improper application.

H. Hard spots in material being cut.

I. Band speed too slow for grade of material being cut.



OBSERVATION #7

Chips Welded To Tooth Tips

High temperature or pressure generated during the cut bonding the chips to the tip and face of teeth.

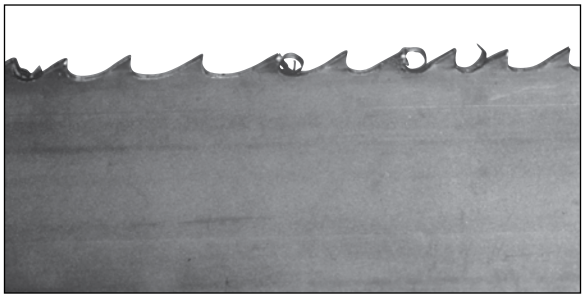
PROBABLE CAUSE:

A. Insufficient sawing fluid due to inadequate supply, improper ratio and/or improper application.

B. Worn, missing or improperly positioned chip brush.

C. Improper band speed.

D. Improper feeding rate.



OBSERVATION #8

Gullets Loading Up With Material

Gullet area has become filled with material being cut.

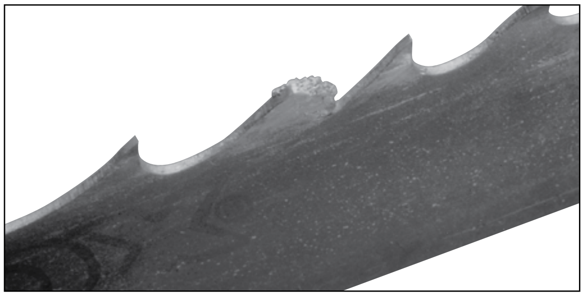
PROBABLE CAUSE:

A. Too fine of a tooth pitch – insufficient gullet capacity.

B. Excessive feeding rate producing too large of a chip.

C. Worn, missing or improperly positioned chip brush.

D. Insufficient sawing fluid due to inadequate supply, improper ratio and/or improper application.



OBSERVATION #9

Discolored Tips Of Teeth Due To Excessive Frictional Heat

The tooth tips show a discolored surface from generating an excessive amount of frictional heat during use.

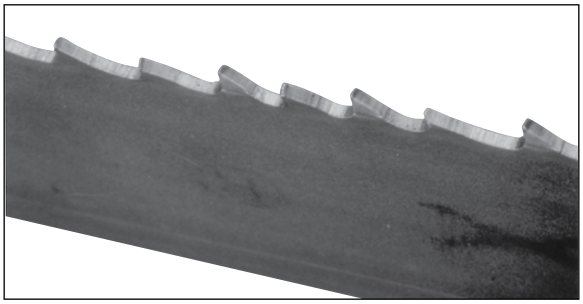
PROBABLE CAUSE:

A. Insufficient sawing fluid due to inadequate supply, improper ratio and/or improper application.

B. Excessive band speed.

C. Improper feeding rate.

D. Band installed backwards.



OBSERVATION #10

Heavy Wear On Both Sides Of Band

Both sides of band have heavy wear patterns.

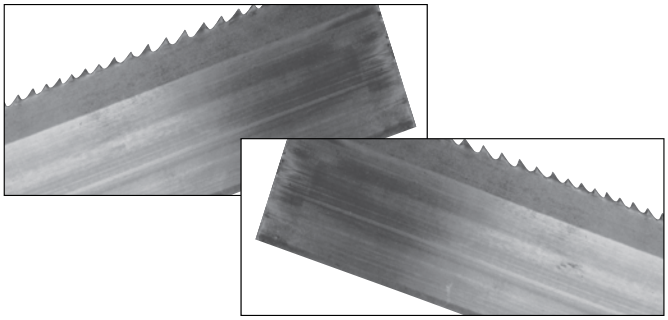
PROBABLE CAUSE:

A. Chipped or broken side guides.

B. Side guide adjustment may be too tight.

C. Insufficient flow of sawing fluid through the side guides.

D. Insufficient sawing fluid due to inadequate supply, improper ratio and/or improper application.



OBSERVATION #11

Uneven Wear Or Scoring On The Sides Of Band

Wear patterns are near gullet area on one side and near back edge on opposite side.

PROBABLE CAUSE:

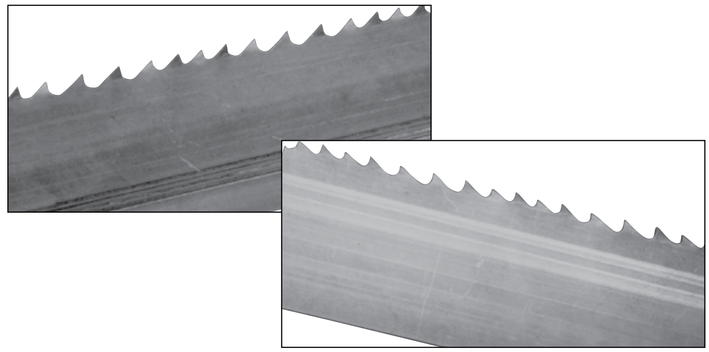
A. Loose side guides.

B. Chipped, worn or defective side guides.

C. Band is rubbing on part of the machine.

D. Guide arms spread to maximum capacity.

E. Accumulation of chips in side guides.



OBSERVATION #12

Heavy Wear And/Or Swagging On Back Edge

Heavy back edge wear will have a polished appearance or abnormal grooves worn into surface. Swaging of corners can also occur.

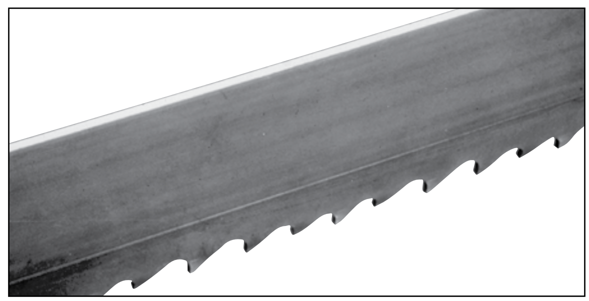
PROBABLE CAUSE:

A. Excessive feed rate.

B. Excessive back-up guide "preload".

C. Improper band tracking – back edge rubbing heavy on wheel flange.

D. Worn or defective back-up guides.



OBSERVATION #13

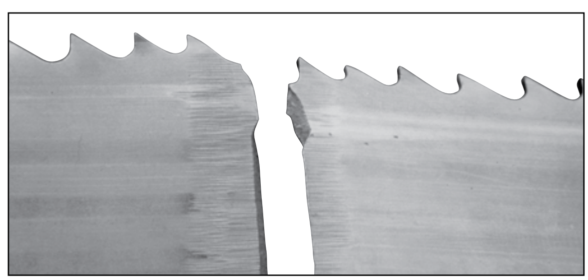
Butt Weld Breakage

To determine if the band broke at the weld, inspect the sides at the fracture to see if there are grind markings from the weld finishing process.

PROBABLE CAUSE:

A. Any of the factors that cause body breaks can also cause butt weld breaks.

(See Observations #5, #15 and #16)



OBSERVATION #14

Heavy Wear In Only The Smallest Gullets

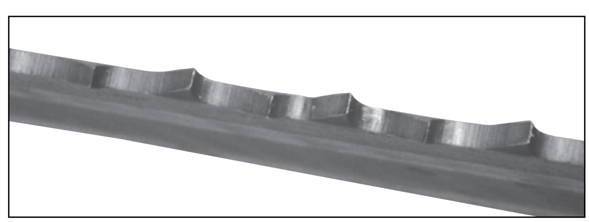
Heavy wear in only the smallest gullets is an indication that there is a lack of gullet capacity for the chips being produced.

PROBABLE CAUSE:

A. Excessive feeding rate.

B. Too slow of band speed.

C. Using too fine of a tooth pitch for the size of material being cut.



OBSERVATION #15

Body Breaking – Fracture Traveling In An Angular Direction

The fracture originates in the gullet and immediately travels in an angular direction into the backing of band.

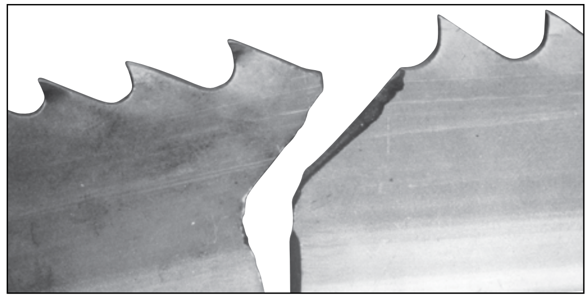
PROBABLE CAUSE:

A. An excessive twist type of stress existed.

B. Guide arms spread to capacity causing excessive twist from band wheel to guides.

C. Guide arms spread too wide while cutting small cross sections.

D. Excessive back-up guide "preload".



OBSERVATION #16

Body Breakage Or Cracks From Gullets

The origin of the fracture is indicated by a flat area on the fracture surface.

PROBABLE CAUSE:

A. Excessive back-up guide "preload".

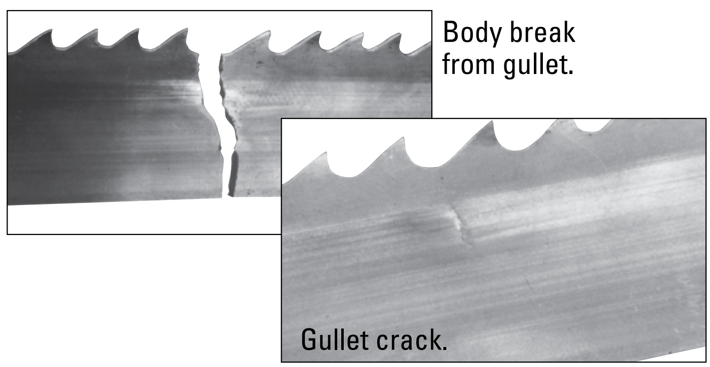
B. Improper band tension.

C. Guide arms spread to maximum capacity.

D. Improper beam bar alignment.

E. Side guide adjustment is too tight.

F. Excessively worn teeth.



Body break from gullet.

OBSERVATION #17

Band is Twisted Into A Figure "8" Configuration

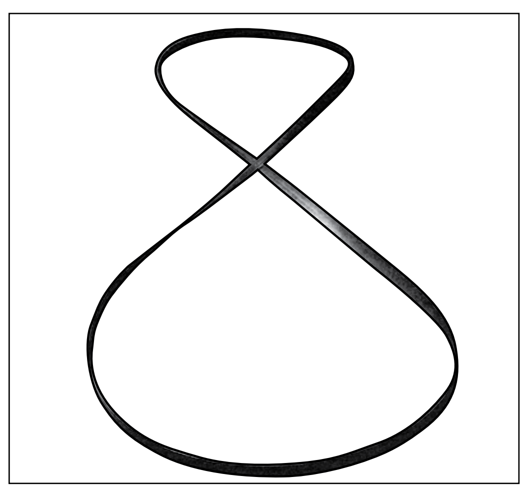
The band does not retain its normal shape while holding the sides of loop together. This indicates the flatness has been altered during use.

PROBABLE CAUSE:

A. Excessive band tension.

B. Any of the band conditions which cause the band to be long (#18) or short (#19) on tooth edge.

C. Cutting a tight radius.



OBSERVATION #18

Used Band Is "Long" On The Tooth Edge

"Long" on the tooth edge is a term used to describe the straightness of the band. The teeth are on the outside of the arc when the strip is lying on a flat surface.

PROBABLE CAUSE:

A. Side guides are too tight – rubbing near gullets.

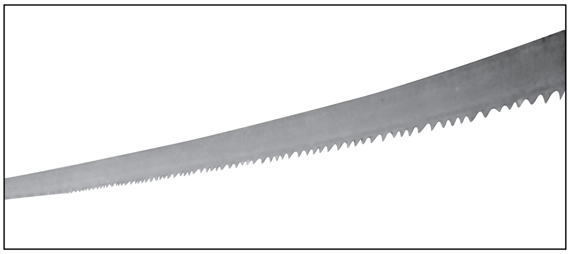
B. Excessive "preload" – band riding heavily against back-up guides.

C. Worn band wheels causing uneven tension.

D. Excessive feeding rate.

E. Guide arms are spread to maximum capacity.

F. Improper band tracking – back edge rubbing heavy on wheel flange.



OBSERVATION #19

Used Band Is "Short" On The Tooth Edge

"Short" on the tooth edge is a term used to describe the straightness of the band. The teeth are on the inside of the arc when the strip is lying on a flat surface.

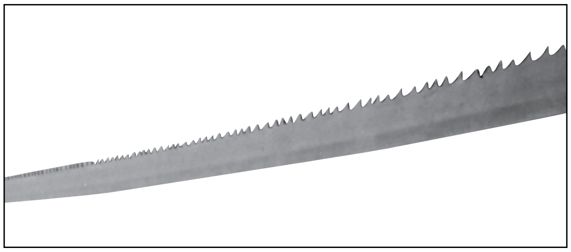
PROBABLE CAUSE:

A. Side guides are too tight – rubbing near back edge.

B. Worn band wheels causing uneven tension.

C. Guide arms are spread too far apart.

D. Excessive feeding rate.



OBSERVATION #20

Broken Band Shows A Twist In Band Length

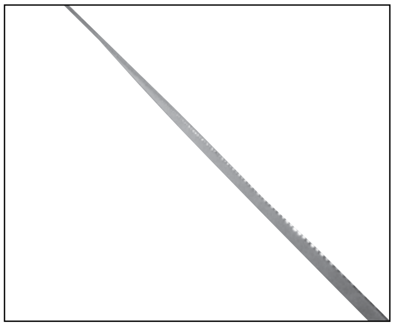
When a broken band lying on a flat surface displays a twist from one end to the other, this indicates the band flatness has been altered during use.

PROBABLE CAUSE:

A. Excessive band tension

B. Any of the band conditions which cause the band to be long (#18) or short (#19) on tooth edge.

C. Cutting a tight radius.



POSSIBLE CAUSES OF BLADE FAILURE

OBSERVATION	BAND SPEED	BAND WHEELS	BREAK-IN PROCEED	CHIP BRUSH	SAWING FLUID	FEEDING RATE	SIDE GUIDES	BACKUP GUIDES	PRELOAD CONDITION	BAND TENSION	BAND TRACKING	TOOTH PITCH
#1 Heavy even wear on tips and corners of teeth	•		•		•	•						
#2 Wear on both sides of teeth							•	•				
#3 Wear on one side of teeth		•					•					
#4 Chipped or broken teeth			•			•						•
#5 Discolored tips of teeth due to excessive frictional heat	•				•							
#6 Tooth strippage	•		•	•	•	•						•
#7 Chips welded to tooth tips	•			•	•	•						
#8 Gullets loading up with material				•	•	•						•
#9 Heavy wear on both sides of band					•		•					
#10 Uneven wear or scoring on sides of the band							•					
#11 Body breakage or cracks from gullets							•		•	•		
#12 Body breakage—fracture traveling in angular direction							•		•			
#13 Body breakage or cracks from back edge						•		•	•	•	•	
#14 Heavy wear and/or swaging on back edge						•		•	•		•	
#15 Butt weld breakage						•	•	•	•	•	•	
#16 Used band is "long" on the tooth edge		•				•	•		•		•	
#17 Used band is "short" on the tooth edge		•				•	•					
#18 Band is twisted into figure "8" configuration		•				•	•	•	•	•	•	
#19 Broken band shows a twist in band length		•				•	•	•	•	•	•	
#20 Heavy wear in only the smallest gullets	•					•						•

GLOSSARY OF BAND SAWING TERMS

BAND SPEED

The rate at which the band saw blade moves across the work to be cut.
The rate is usually measured in feet per minute (fpm) or meters per minute (MPM).

BASE BAND SPEED

List of recommended speeds for cutting various metals, based on a 4" wide piece of that stock.

BI-METAL

A high speed steel edge material electron beam welded to a spring steel back.
Such a construction provides the best combination of cutting performance and fatigue life.

BLADE WIDTH

The dimension of the band saw blade from tooth tip to blade back.

CARBIDE TIPPED BLADE

Carbide tips welded to a high-strength alloy back, resulting in a longer lasting, smoother cutting blade.

CARBON FLEX BACK

A solid one-piece blade of carbon steel with a soft back and a hardened tooth, providing longer blade life and generally lower cost per cut.

CARBON HARD BACK

A one-piece blade of carbon steel with a hardened back and tooth edge that can take heavier feed pressures, resulting in faster cutting rates and longer life.

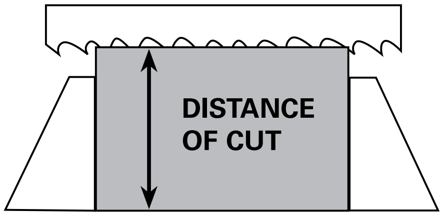
CUTTING RATE

The amount of material being removed over a period of time. Measured in square inches per minute.

DEPTH OF PENETRATION
The distance into the material the tooth tip penetrates for each cut.

GLOSSARY OF BAND SAWING TERMS

DISTANCE OF CUT
The distance the blade travels from the point it enters the work to the point where the material is completely cut through.



FEED RATE
The average speed (in inches per minute) the saw frame travels while cutting.

FEED TRAVERSE RATE
The speed (in inches per minute) the saw frame travels without cutting.

GULLET

The curved area at the base of the tooth.

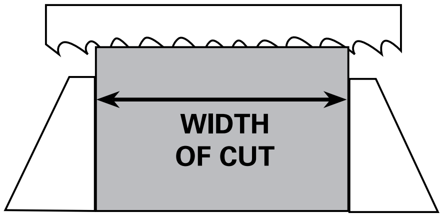
GULLET CAPACITY
The amount of chip that can curl up into the gullet area before the smooth curl becomes distorted.

TOOTH FORM
The shape of the tooth, which includes spacing, rake angle, and gullet capacity. Industry terms include variable, variable positive, standard, skip, and hook.

TOOTH PITCH
The distance (in inches) between tooth tips.

TOOTH SET
The pattern in which teeth are offset from the blade. Industry terms include raker, vari-raker, alternate, and wavy.

WIDTH OF CUT
The distance the saw tooth travels continuously "across the work." The point where a tooth enters the work to the point where that same tooth exits the work.



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