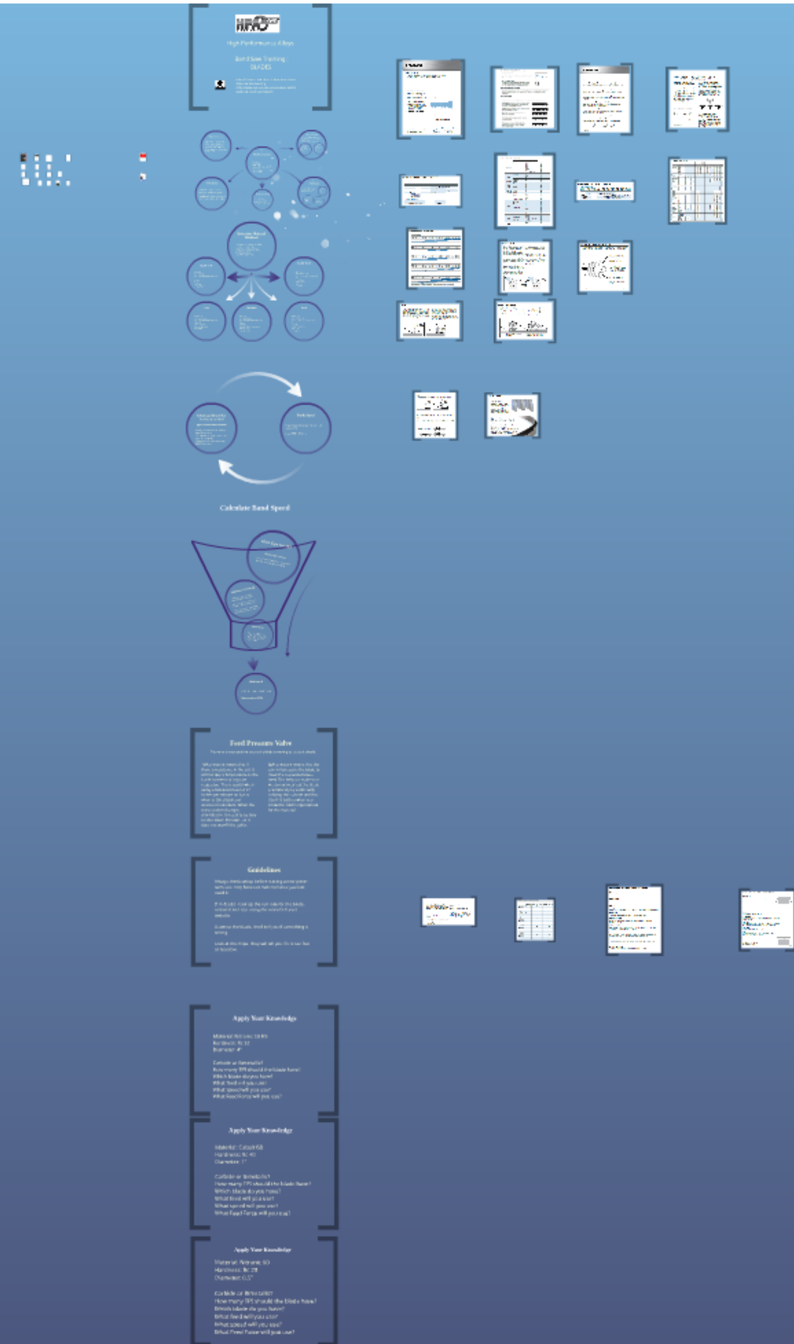

High Performance Alloys
Band Saw Training : BLADES
Calculate Band Speed
Feed Pressure Valve
Guidelines
Apply Your Knowledge
Apply Your Knowledge
Carbide or Bimetallic?
How many TPI should the blade have?
Which blade do you have?
What feed will you use?
What speed will you use?
What Feed Force will you use?
Apply Your Knowledge

High Performance Alloys

Band Saw Training : BLADES

Many Pictures and charts taken from Lenox Guide to Bandsawing (http://www.lenoxtools.com/Guides/LENOX Guide to Band Sawing.pdf)

Blade Components

Width and thickness
Angle of teeth
Offset of teeth
Cutting pattern (standard, triple chip or sinewave)
Type of teeth (carbide or bimetallic)
Teeth per inch (TPI)

BLADE DESIGN

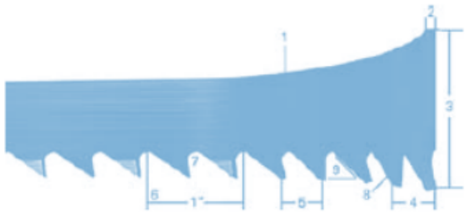
Choosing the right blade for the material to be cut plays an important role in cost effective band sawing. Here are some guidelines to help you make the right decision.

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.

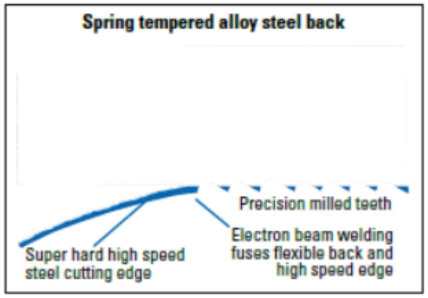
CARBON

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

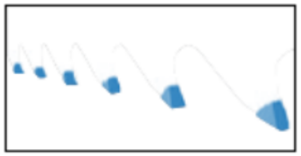
A high speed steel edge material is electron beam welded to fatigue resistant spring steel backing. Such a construction provides the best combination of cutting performance and fatigue life.



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.

Width and Thickness

Width, thickness and length of blade are determined by saw. The thicker and wider a blade is, the more durable it will be, less flex and greater cutting pressures can be achieved.

Tooth design

Angle of the tooth determines how the chip will be pulled up
Offset relates to a side to side variation of the tooth, or the grind of the tooth could be alternating.

Tooth Pattern

Pattern dictates the finish sound and how aggressive the cut can be made

Sinewave

Multi chip tooth
Gradual change of tooth engagement
Best finish
Best sound

Standard

No offset
Small uniform chips
Limited in feed
Harmonic issues

Offset

Multi chip tooth design
teeth have different angles
depth of cut varies
reduces work hardening

Standard

No offset
Small uniform chips
Limited in feed
Harmonic issues

Offset

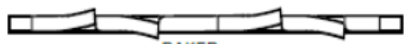
Multi chip tooth design
teeth have different angles
depth of cut varies
reduces work hardening

Sinewave

Multi chip tooth
Gradual change of tooth engagement
Best finish
Best sound

TOOTH SET

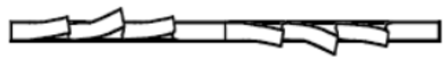
The number of teeth and the angle at which they are offset is referred to as "tooth set." Tooth set affects cutting efficiency and chip carrying ability.


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.

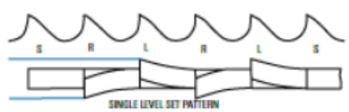
Vari-Raker: The tooth sequence is dependent on the tooth pitch and product family. Typically Vari-Raker set provides quiet, efficient cutting and a smooth finish with less burr.



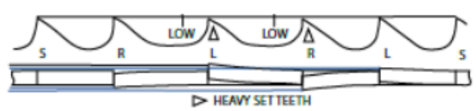
Alternate: Every tooth is set in an alternating sequence. Used for quick removal of material when finish is not critical.

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: 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.

Type of Teeth

Determines blade speed capable
Life can be good on either when properly set up
Large difference in blade cost

Bimetallic

Cannot handle heat
Slowest blade speed
Can handle some shock and vibration
Softer materials

Carbide

Handles heat well
Faster speed
No shock or vibration
Expensive

Bimetallic

Cannot handle heat
Slowest blade speed
Can handle some shock and vibration
Softer materials

BI-METAL PRODUCT SELECTION CHART

PRODUCTION SAWING

ALUMINUM NON-FERROUS	CARBON STEELS	STRUCTURAL STEELS	ALLOY STEELS	BEARING STEELS	MOLD STEELS	TOOL STEELS	STAINLESS STEELS	TITANIUM ALLOYS	NICKEL-BASED ALLOYS (INCONEL®)
EASY ←				MACHINABILITY					→ DIFFICULT
					QGT™ Longest Life, Straight Cuts	→	→	→	→
QXP™	→		***QXP™*** Long Life, Fast Cutting	→	→	→	→		
					CONTESTOR GT® Long Life, Straight Cuts	→	→	→	→
LXP®	→		***LXP®*** Fast Cutting	→	→	→	→		
	ARMOR® Rx+ Long Life, Structurals/Bundles	→							
	Rx+ Structurals/Bundles	→							

GENERAL PURPOSE

ALUMINUM NON-FERROUS	CARBON STEELS	STRUCTURAL STEELS	ALLOY STEELS	BEARING STEELS	MOLD STEELS	TOOL STEELS	STAINLESS STEELS	TITANIUM ALLOYS	NICKEL-BASED ALLOYS (INCONEL®)
CLASSIC® 3/4" and Wider Blades	→	→	→		***CLASSIC®***	→	→		
DIEMASTER 2® 1/2" and Narrower Blades	→	→	→		***DIEMASTER 2®***	→	→		

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

Carbide

Handles heat well

Faster speed

No shock or vibration

Expensive

CARBIDE PRODUCT SELECTION CHART

HIGH PERFORMANCE

ALUMINUM/ NON-FERROUS	CARBON STEELS	STRUCTURAL STEELS	ALLOY STEELS	BEARING STEELS	MOLD STEELS	STAINLESS STEELS	TOOL STEELS	TITANIUM ALLOYS	NICKEL-BASED ALLOYS (INCONEL®)
EASY ←				MACHINABILITY					→ DIFFICULT
	***ARMOR®* CT BLACK** for Extreme Cutting Rates								
	***ARMOR®* CT GOLD**		***ARMOR®* CT GOLD** For Superior Life						
TNT CT®						***TNT CT®*** Extreme Performance on Super Alloys			
TRI-TECH CT™			***TRI-TECH CT™*** Set Style Blade for Difficult to Cut Metals						
TRI-MASTER®			***TRI-MASTER®*** Versatile Carbide Tipped Blade						

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.*

Teeth Per Inch

TPI - Teeth per Inch
Determines cutting ability
Need 3 teeth minimum in cut
Optimum 6 - 12 teeth in cut
Adjust speed for the number of teeth

CARBIDE TOOTH SELECTION

ARMOR® CT BLACK

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

ARMOR® CT GOLD

WIDTH OR DIAMETER OF CUT														
INCHES	1	2.5	3	4	5	6	7	8	10	12	13	15	17	20
MM	25	60	70	100	120	150	170	200	250	300	330	380	430	500
0.9/1.1 TPI										x	x	x	x	x
1.8/2.0 TPI					x	x	x	x	x	x				

TNT CT®

WIDTH OR DIAMETER OF CUT														
INCHES	1	2.5	3	4	5	6	7	8	10	12	13	15	17	20
MM	25	60	70	100	120	150	170	200	250	300	330	380	430	500
0.9/1.1 TPI										x	x	x	x	x
1.8/2.0 TPI					x	x	x	x	x	x				
2.5/3.4 TPI	x	x	x	x	x	x	x							

TRI-TECH CT™

WIDTH OR DIAMETER OF CUT														
INCHES	1	2.5	3	4	5	6	7	8	10	12	13	15	17	20+
MM	25	60	70	100	120	150	170	200	250	300	330	380	430	500+
0.6/0.8 TPI													x	x
0.9/1.1 TPI												x	x	x
1.4/1.8 TPI								x	x	x	x	x		
1.8/2.0 TPI				x	x	x	x	x	x	x				
2.5/3.4 TPI	x	x	x	x	x	x	x							

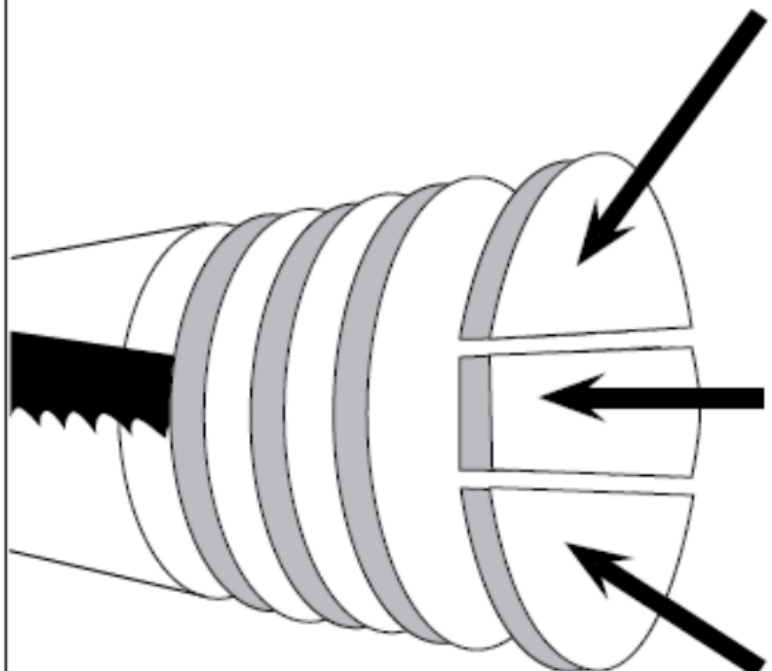
TRI-MASTER® • HRc® • ALUMINUM MASTER™ CT • SST CARBIDE™

WIDTH OR DIAMETER OF CUT														
INCHES	1	2.5	3	4	5	6	7	8	10	12	13	15	17	20
MM	25	60	70	100	120	150	170	200	250	300	330	380	430	500
1.2/1.8 TPI									x	x	x	x	x	x
1.5/2.3 TPI						x	x	x	x	x	x	x	x	
2/3 TPI			x	x	x	x	x	x						
3 TPI		x	x	x	x	x	x							
3/4 TPI	x	x	x	x	x	x								

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®.*

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:

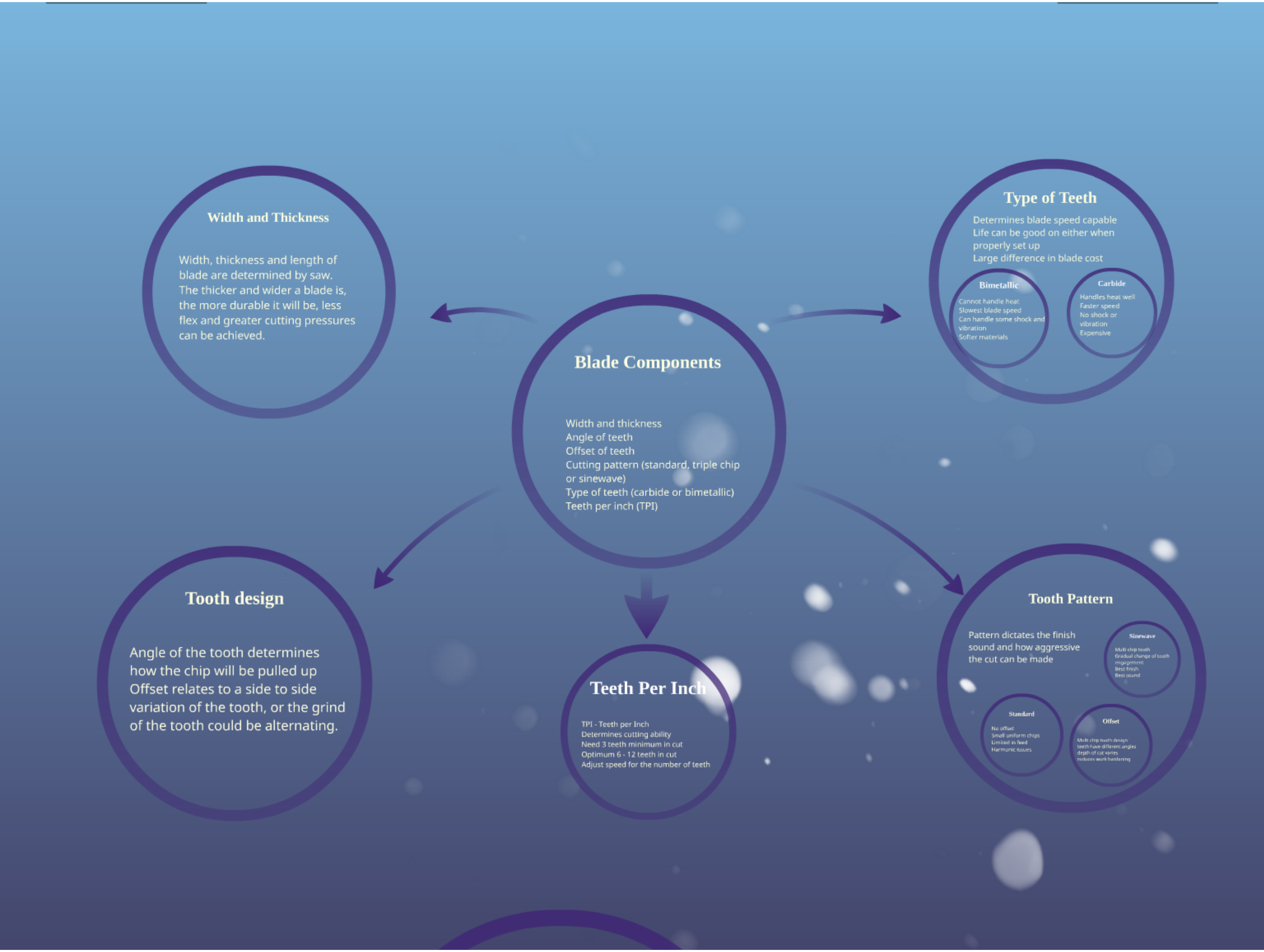


1. Entering the material, the blade encounters a small width and therefore meets minimum resistance. Feed rate is the limiting factor here, so you can use a feed setting that maximizes cutting without losing blade life.

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 Components
Width and thickness
Angle of teeth
Offset of teeth
Cutting pattern (standard, triple chip or sinewave)
Type of teeth (carbide or bimetallic)
Teeth per inch (TPI)
Width and Thickness
Width, thickness and length of blade are determined by saw. The thicker and wider a blade is, the more durable it will be, less flex and greater cutting pressures can be achieved.
Type of Teeth
Determines blade speed capable
Life can be good on either when properly set up
Large difference in blade cost
Bimetallic
Cannot handle heat
Slowest blade speed
Can handle some shock and vibration
Softer materials
Carbide
Handles heat well
Faster speed
No shock or vibration
Expensive
Tooth design
Angle of the tooth determines how the chip will be pulled up
Offset relates to a side to side variation of the tooth, or the grind of the tooth could be alternating.
Teeth Per Inch
TPI - Teeth per Inch
Determines cutting ability
Need 3 teeth minimum in cut
Optimum 6 - 12 teeth in cut
Adjust speed for the number of teeth
Tooth Pattern
Pattern dictates the finish sound and how aggressive the cut can be made
Sinewave
Multi chip tooth
Gradual change of tooth engagement
Best finish
Best sound
Standard
No offset
Small uniform chips
Limited in feed
Harmonic issues
Offset
Multi chip tooth design
teeth have different angles
depth of cut varies
reduces work hardening

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)

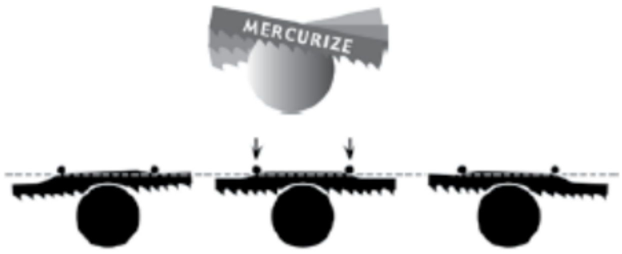
Use the tooth selection chart on page 18 or 21.

- 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.

Determine Material Hardness

Hardness is a measure of the tensile strength, which is important in machining or producing chips.
Harder = Slower cut

Really Soft

Rb 70-80
65 - 75 KSI UTS
0.8 inches per minute down feed

Ni 200
Ni 201
400 ANN
R405 ANN

Really Hard

Rc 41 - 45
181 - 210 KSI UTS
0.1 inch per minute down feed
6BH
718 CW+AH
L605 CW&AH
N50 Lvl 5
N60 Lvl 5

Soft

Rb 81 - 100
76 - 126 KSI UTS
0.6 inches per minute down feed
K500 Ann
400 / R405 CD
600 601 800 2205
N50 & N60

Medium

Rc 25 - 35
127 - 158 KSI UTS
0.4 inches per minute down feed
K500 AH
255 2507
625 825 718 Ann C-276 L605
N50 Lvl 1-2-3
N60 Lvl 1-2-3

Hard

Rc 36 - 40
159 - 180 KSI UTS
0.2 inches per minute down feed
6B
718 AH
C276 CW L605 CW
N50 Lvl 4
N60 Lvl 4

Determine Material Hardness

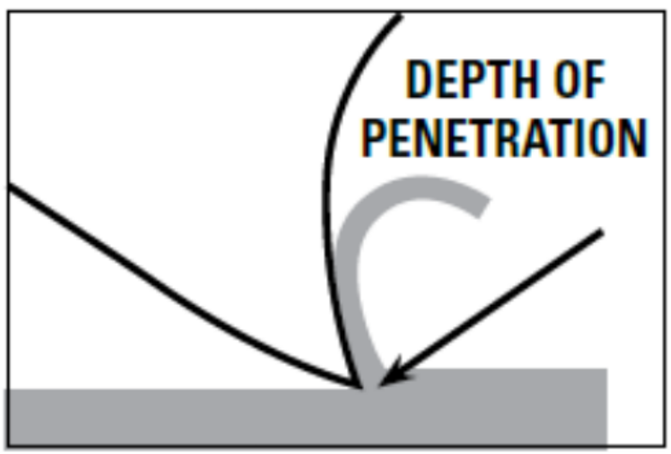
Hardness is a measure of the tensile strength, which is important in machining or producing chips.
Harder = Slower cut

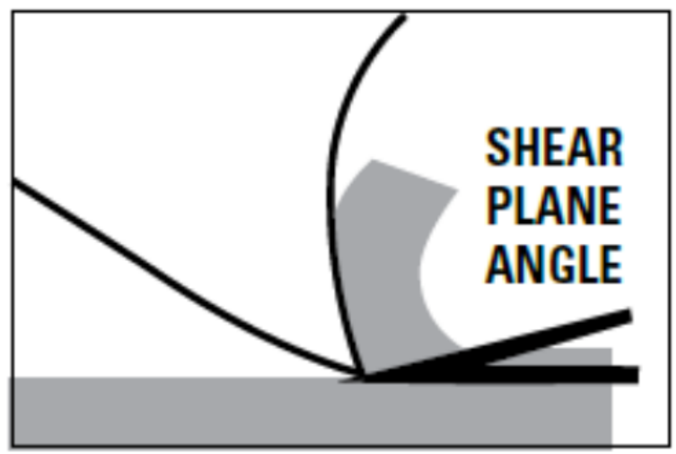
FEED

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.

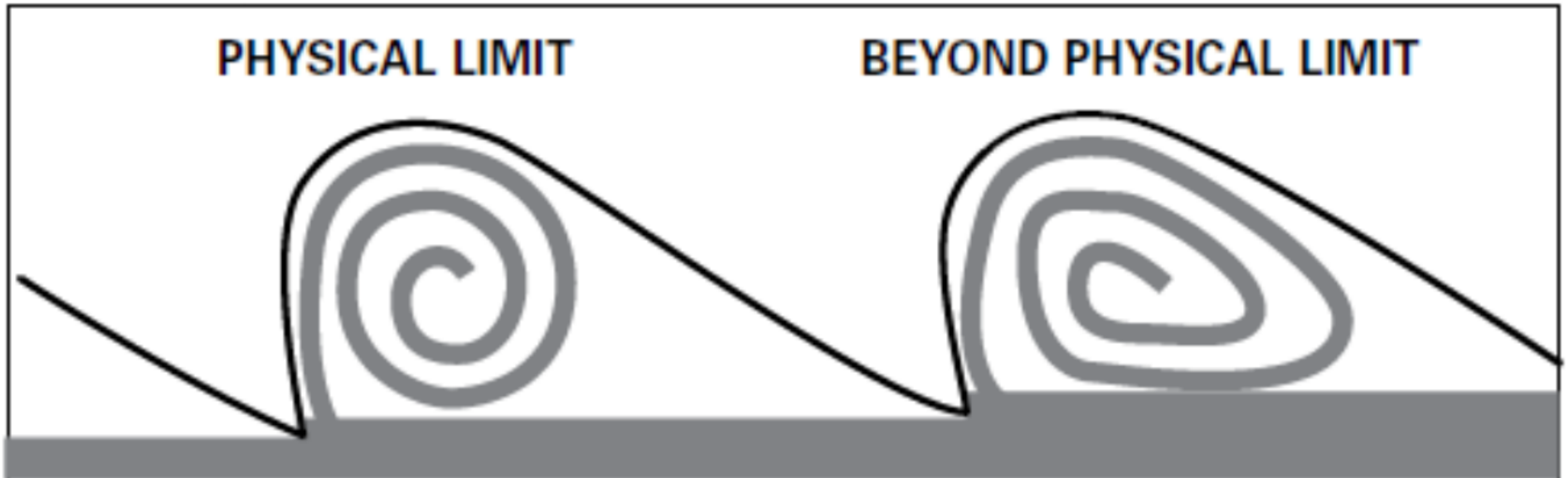
How can you tell if you are using the right feed rate? Examine the chips and evaluate their shape and color. See chip information on page 5.





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

Really Soft

Rb 70-80
65 - 75 KSI UTS
0.8 inches per minute down feed

Ni 200
Ni 201
400 ANN
R405 ANN

Soft

Rb 81 - 100
76 - 126 KSI UTS
0.6 inches per minute down feed
K500 Ann
400 / R405 CD
600 601 800 2205
N50 & N60

Medium

Rc 25 - 35
127 - 158 KSI UTS
0.4 inches per minute down feed
K500 AH
255 2507
625 825 718 Ann C-276 L605
N50 Lvl 1-2-3
N60 Lvl 1-2-3

Hard

Rc 36 - 40

159 - 180 KSI UTS

0.2 inches per minute down feed

6B

718 AH

C276 CW L605 CW

N50 Lvl 4

N60 Lvl 4

Really Hard

Rc 41 - 45
181 - 210 KSI UTS
0.1 inch per minute down feed
6BH
718 CW+AH
L605 CW&AH
N50 Lvl 5
N60 Lvl 5

Once you know the Feed rate needed

***Typical* Carbide Removal Rates**

Harder materials we can remove 0.0001" per tooth.
Medium materials we can remove 0.00015" per tooth.
Softer materials we can remove 0.0002" per tooth.

Blade Speed

Speed (IPM) = Down Feed * (1/TPI) * (1/Removal Rate)

Speed (FPM) = IPM / 12

Once you know the Feed rate needed

***Typical* Carbide Removal Rates**

Harder materials we can remove 0.0001" per tooth.
Medium materials we can remove 0.00015" per tooth.
Softer materials we can remove 0.0002" per tooth.

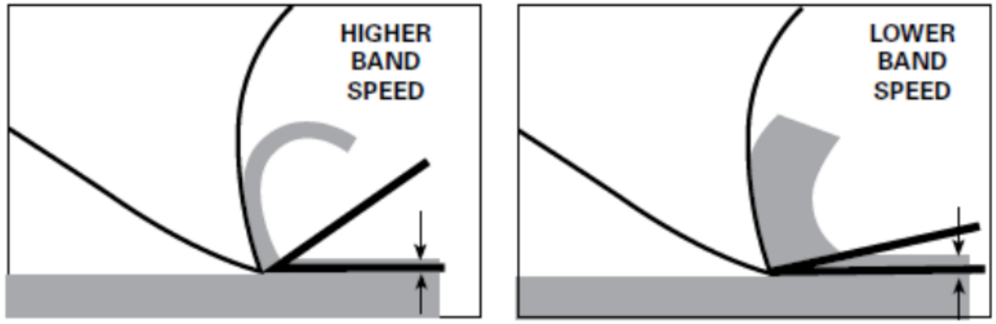
Blade Speed

Speed (IPM) = Down Feed * (1/TPI) * (1/ Removal Rate)

Speed (FPM) = IPM / 12

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

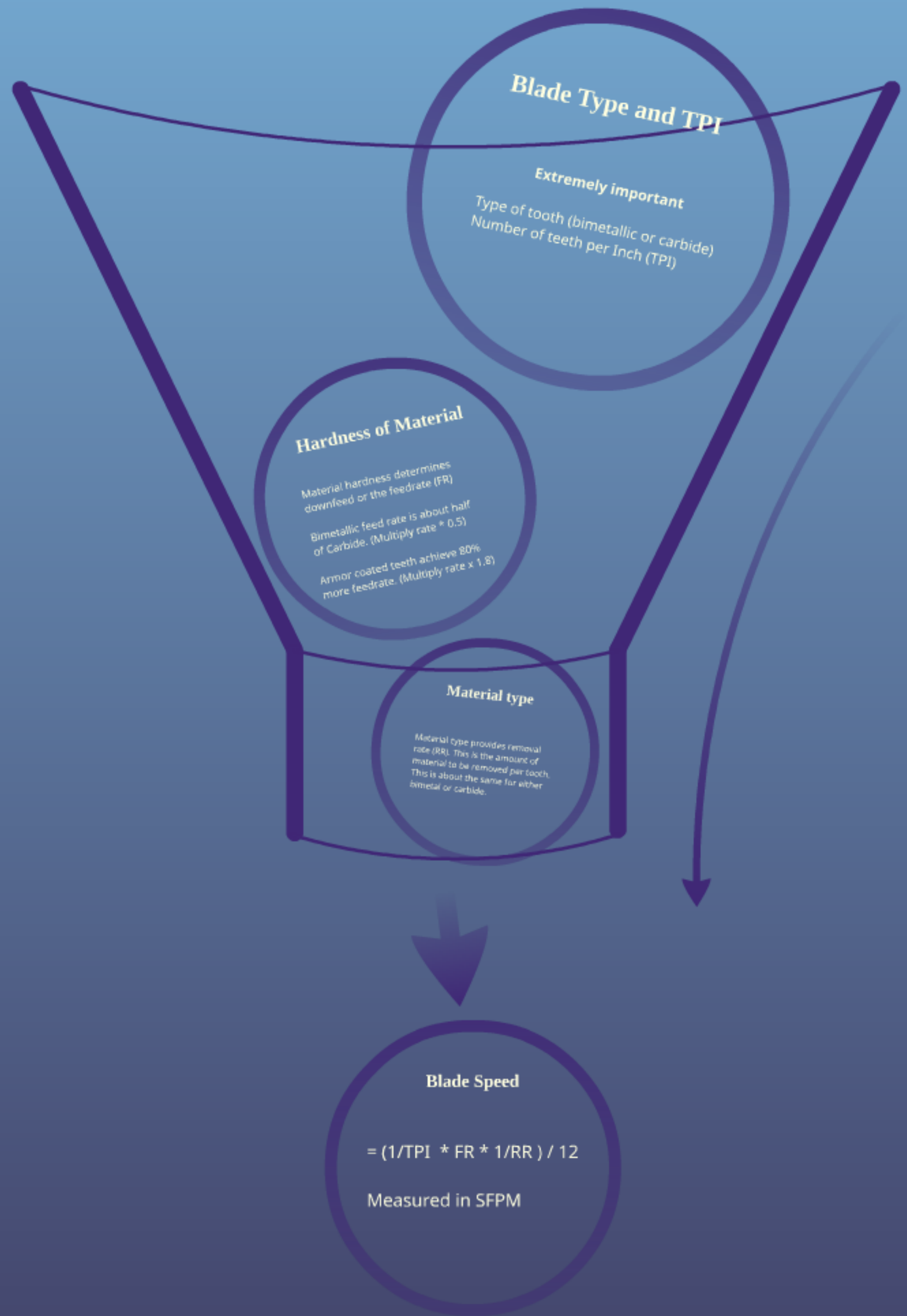
Chips are the best indicator of correct feed force. Monitor chip formation and adjust accordingly.

Burned heavy chips— reduce feed/speed.

Thin or powdered chips—increase feed.

Curled silvery and warm chips—optimum feed.

Calculate Band Speed



Blade Type and TPI

Extremely important

Type of tooth (bimetallic or carbide)
Number of teeth per Inch (TPI)

Hardness of Material

Material hardness determines downfeed or the feedrate (FR)

Bimetallic feed rate is about half of Carbide. (Multiply rate * 0.5)

Armor coated teeth achieve 80% more feedrate. (Multiply rate x 1.8)

Material type

Material type provides removal rate (RR). This is the amount of material to be removed per tooth. This is about the same for either bimetal or carbide.

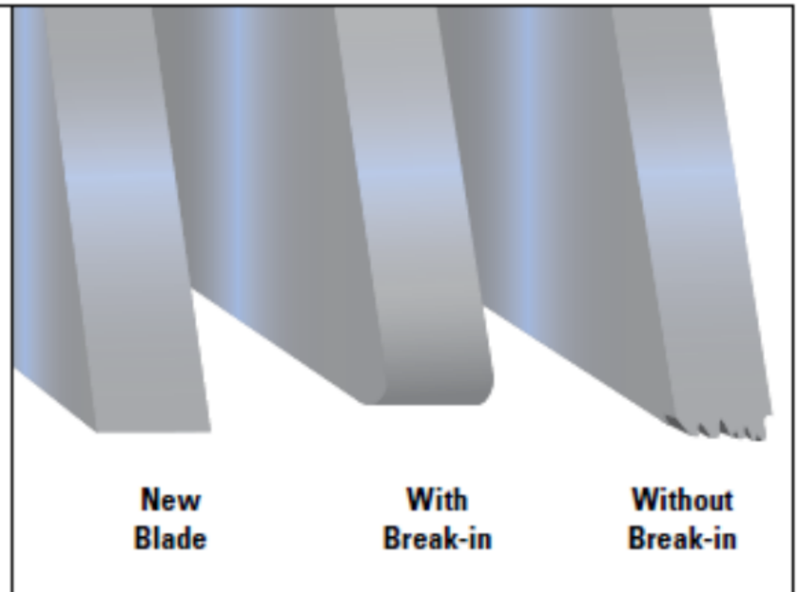
Blade Speed

= (1/TPI * FR * 1/RR) / 12

Measured in SFPM

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.

Feed Pressure Valve

This valve is very useful to ensure the blade is moving as fast as it should.

20% pressure means that if there is resistance in the cut, it will not apply full pressure to the blade to meet cutting rate requested. This is useful when using a fast down feed of 2+ inches per minute on bar or when cutting tubing or structural members. When the cross section changes dramatically, it needs to be able to slow down the feed - so it does not overfill the gullet.

80% pressure means that the saw will pressure the blade to meet the requested blade feed. This helps to make sure we do not wear out the blade prematurely by continually rubbing the carbide until hot. Use this setting when you know the feed is appropriate for the material.

Guidelines

Always check set up before cutting a new piece - someone may have cut material since you last used it.

If in doubt - look up the run rate for the blade, material and size using the manufacturers website.

Listen to the blade, it will tell you if something is wrong.

Look at the chips. They will tell you if it is too fast or too slow.

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.

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.

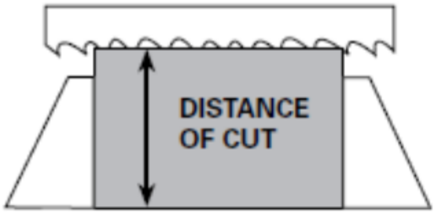
CUTTING RATE

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.

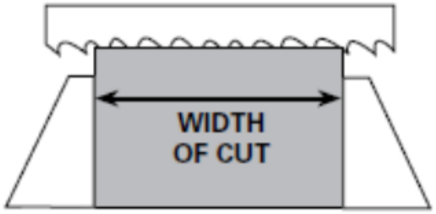
GULLET CAPACITY
The amount of chip that can curl up into the gullet area before the smooth curl becomes distorted.

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.



High Performance Alloys

Band Saw Training : BLADES

Many Pictures and charts taken from Lenox Guide to Bandsawing (http://www.lenoxtools.com/Guides/LENOX Guide to Band Sawing.pdf)

Apply Your Knowledge

Material: Nitronic 50 HS
Hardness: Rc 32
Diameter: 4"

Carbide or Bimetallic?
How many TPI should the blade have?
Which blade do you have?
What feed will you use?
What speed will you use?
What Feed Force will you use?

Apply Your Knowledge

Material: Cobalt 6B
Hardness: Rc 40
Diameter: 1"

Carbide or Bimetallic?
How many TPI should the blade have?
Which blade do you have?
What feed will you use?
What speed will you use?
What Feed Force will you use?

Apply Your Knowledge

Material: Nitronic 60
Hardness: Rc 20
Diameter: 0.5"

Carbide or Bimetallic?
How many TPI should the blade have?
Which blade do you have?
What feed will you use?
What speed will you use?
What Feed Force will you use?

SineWave® Technology

SIMONDS®

Engineered to your exact cutting needs!

Ride The Wave!

Turbocharge Saw Cutting Performance with SineWave®

MARKETS

- Production Cutting
- Steel Service Centers
- Job Shops

EXCELS IN SOLID MATERIALS

- Stainless Steel
- D2
- Inconnel, Hattalloy, Waspalloy
- High Nickel Alloys

Simonds Bi-metal and Carbide Tipped bandsaw blades with SineWave® technology are ideal for use on difficult to cut steels such as high chrome, tool, die, stainless and nickel base. Also suitable for cutting titanium and other exotic metals.

Special Applications Technology

Simonds' application engineered ***SineWave***® technology enhances cutting ability, reducing work time and increasing blade life. ***SineWave***® technology features a value-added broaching action by utilizing ramps on the back edge of the blade. This technology exerts more force into the cut without having to increase machine pressure. ***SineWave***® offers special ramp customization capabilities that optimize the cutting performance for specific alloy cross sections. ***Ride the Wave!***

SIMONDS® INTERNATIONAL

The Professionals' Edge™

www.simondsinternational.com

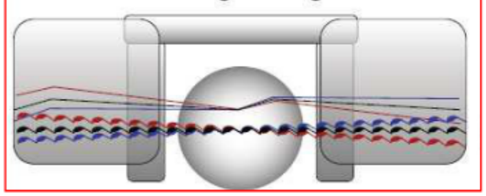
SineWave® Technology

SIMONDS®

SineWave's rocking motion ensures better tooth penetration for faster cutting rates while allowing the blade to cut with less pressure, extending blade life.

SineWave Advantages

- Cuts work hardened materials 30% to 40% faster
- Can double blade life
- Makes cutting rate more consistent

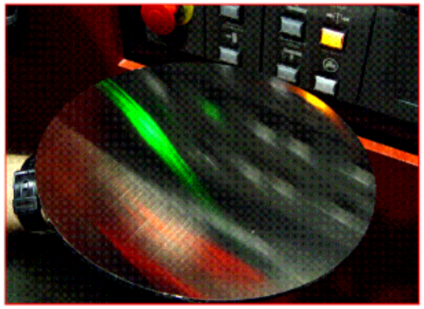


How Do I Order SineWave?

- Determine maximum cross-section dimension of all materials cut
- Select the aggressiveness of the cutting action – light, moderate or aggressive
- Call your Simonds sales person for applications assistance

Ride The Wave!

With self-feeding action, the band actually grows in width (see magnified back edge view of the SineWave® blade above), forcing each tooth to penetrate the work more efficiently.



Products displaying this icon are available with SineWave® technology. SineWave

SineWave® can be supplied on all M42 bim -metal and all carbide tipped bandsaw blades from 1" to 3-1/8". SineWave® is supplied only in welded-to-length bands.

SIMONDS® INTERNATIONAL

The Professionals' Edge™

SIMONDS INTERNATIONAL

135 Intervale Road, P.O. Box 500, Fitchburg, MA 01420
(978) 424-0100 (800) 343-1616 fax (800) 541-6224
www.simondsinternational.com

PROFESSIONAL GRADE SAW BLADES

SIMONDS®

Bandsawing Facts

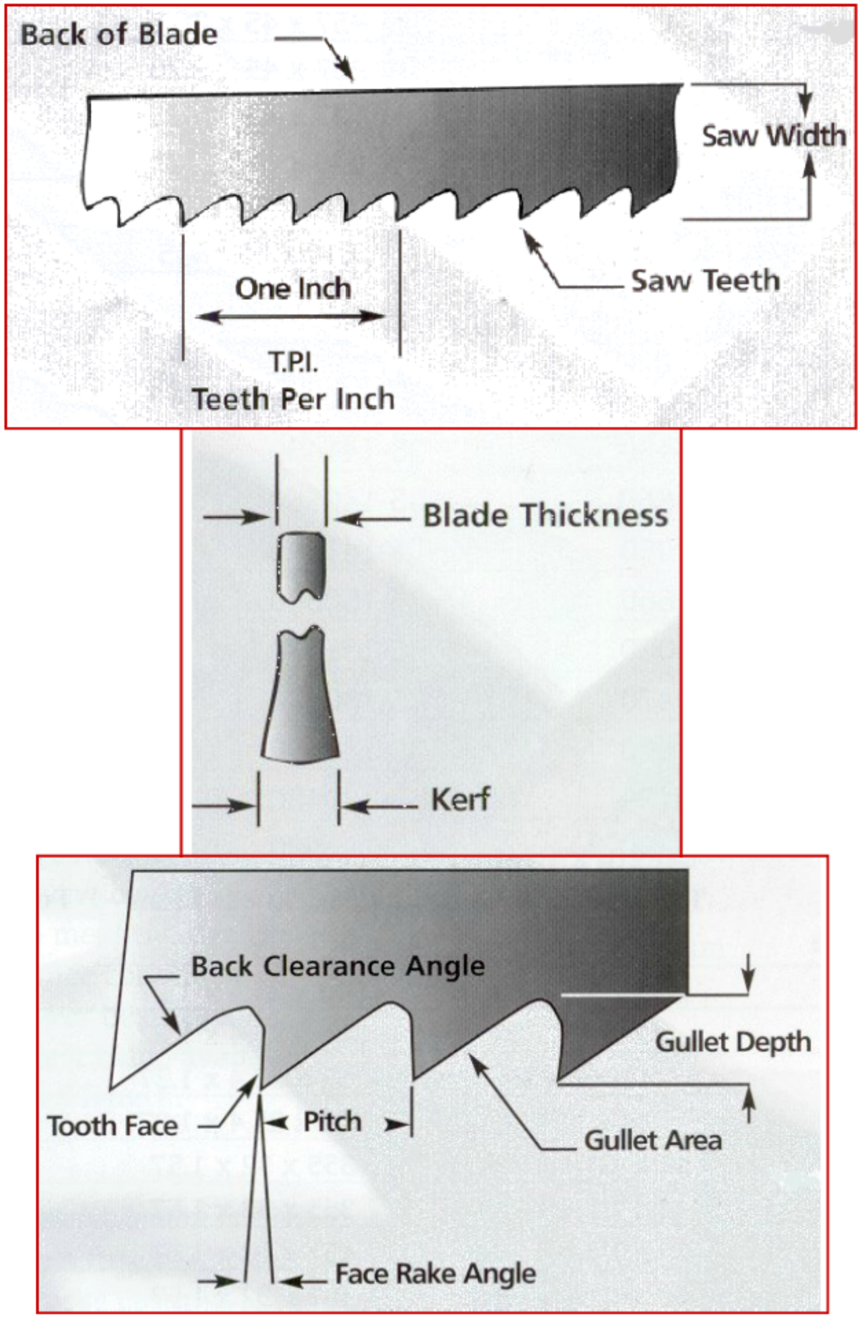
The Professionals' Edge™

CARBIDE

BI-METAL

CARBON

Basic Blade Terminology



Selecting the Correct Type of Blade

What is the best blade to use? Band quality varies widely depending upon the blade type - carbon, bi-metal, or carbide tipped. They differ in their ability to resist the heat generated while cutting and in their ability to resist the "shock" of entering and exiting the cut (a prime consideration when cutting structurals, pipe and tubing).

Carbide Tipped bandsaw blades - excel cutting the super alloys and in applications where high production rates and/or good surface finish is a requirement. Simonds offers four families of carbide tipped bandsaw blades in addition to carbide grit edge blades.

Bi-Metal bandsaw blades - are the "everyday workhorse", handling everything from simple metal cutting to production cutting of the super alloys. Simonds offers seven families of bi-metal bandsaw blades.

Carbon bandsaw blades - are good for maintenance shops, general purpose low volume cutting, or for cutting wood, plastics, and other non-ferrous materials. Simonds offers six families of carbon bandsaw blades.

Selecting the Correct Tooth Pitch

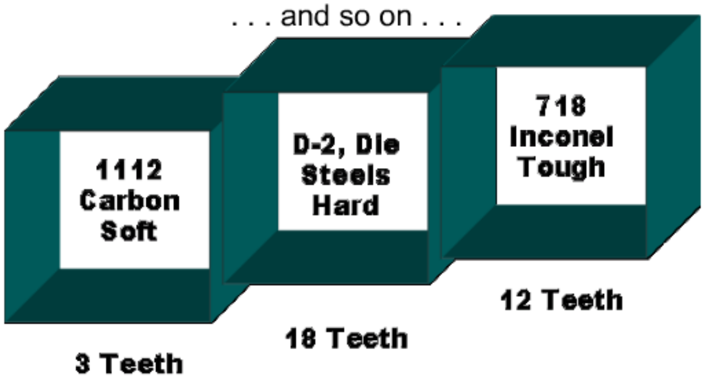
Do you cut mostly one dimension on a regular basis? Or a wide variety of dimensions? Choose your most common dimension is, then select the proper tooth pitch, or TPI (teeth per inch) for your bandsaw blade. Remember - "one blade fits all" is not always the case - sometimes it is optimal to use more than one blade to cut a wide range of materials and/or dimensions.

The general rule of thumb is to aim for a minimum of 3 teeth and a maximum of 24 teeth in the workpiece, with 6 to 12 teeth in the workpiece optimum for most applications. Some things to note:

- Too few teeth may straddle the work and break teeth.
- Too many teeth can cause gullet overload and strip teeth.
- Softer materials require fewer teeth and more gullet capacity to clear the larger chips they generate.
- Hard materials require more teeth to share in the work.

For Variable Pitch blades, use the average of the coarse and fine pitches to determine the "average" TPI, as follows:

3-4TPI averages 3.5 teeth per inch
4-6TPI averages 5 teeth per inch
5-8TPI averages 6.5 teeth per inch
6-10TPI averages 8 teeth per inch
. . . and so on . . .



Selecting the Proper Machine Feed and Speed

As with most machining operations, speed and feed, or pressure are closely interrelated. It is possible to select the optimum cutting speed and pressure for each different job.

In general terms:

- For softer materials - fast speed, light feed - 300SFPM (surface feet per minute) is a good rule of thumb.
- For harder materials - slower speed, heavier feed - 100SFPM is a good rule of thumb.

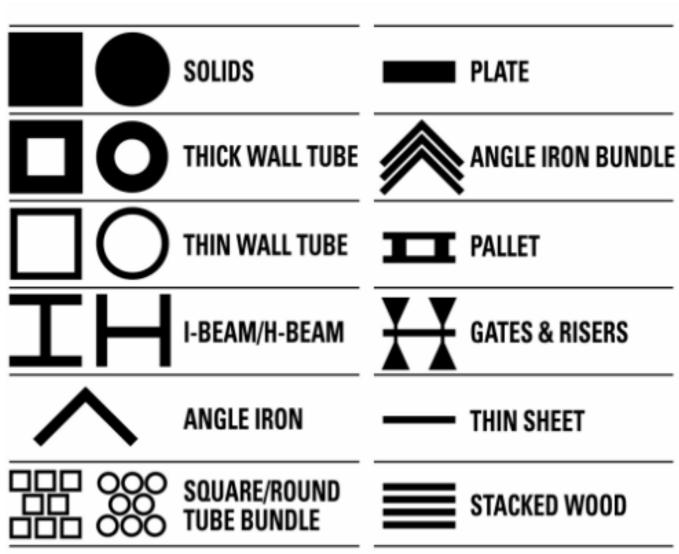
Avoid too high a cutting speed. If the speed is excessive, the teeth cannot bite into the material; they rub the surface, cause friction and dull the band. Bands run too slowly are uneconomical. The recommended speeds shown in the Speed & Feed Charts at the back of this booklet will generally give the best results.

The chips generated by the blade can give a good indication if the proper feed has been achieved:

- A free cut curly chip indicates ideal feed pressure with optimum cutting time and longest blade life.
- Discolored chips indicate too heavy a feed pressure, causing teeth to chip or break and the band to wear out rapidly, due to overheating. Overfeeding will cause the machine to chatter and vibrate, making a noisy cut.
- Fine powdery chips indicate that the feed is too light, resulting in the teeth rubbing the surface of the work instead of cutting.

What Shape is the Material?

Work piece shape can affect cutting performance - structural materials and small solids tend to be harder on a bandsaw blade. Work piece positioning on the saw is another variable - try to position the material so there is as little cross-section dimensional variance as possible across the blade's path.



The Use of Cutting Fluids

Cutting fluids or coolants are recommended for most materials - they help reduce the frictional heat generated at the cutting edge of the blade and they help wash chips from the blade. Don't use cutting fluids on materials that produce a powder, such as gray iron

Coolants can either be cutting oils, with a petroleum base, soluble oils, which are a suspension of natural oil droplets in water, and semi-synthetic or synthetic oils, which depend more heavily on chemicals for cooling and lubricating.

The following practices must be maintained to maximize performance:

- The specified concentration must be maintained - typically it is a higher concentration for band sawing than for drilling or turning operations.
- Proper application is essential - a flood of cutting fluid from several directions is desirable.
- Good housekeeping is important. Chip filters and sump oil separators should be cleaned and cutting fluid changed regularly.

Cutting fluids/lubricants can be applied to the cut by either a flood-type system or a spray-type system. We recommend flood-type systems for longest blade life.

Breaking In the Blade

Proper break-in of a bandsaw blade can extend blade life by up to 30%. Brand new, sharp teeth are more fragile than lightly honed teeth and, much like a freshly sharpened pencil, break-in helps condition the teeth for longer life.

To break in a new bandsaw blade:

- Set the band speed to the normal recommended SFPM for the material to be cut.
- Set the feed at 50% of the normal cutting rate (25% if you are using Simonds SineWave blades).
- Gradually increase the feed rate to normal over the total break-in period.

Caution: during break-in, it is very important that the band always produces chips, to avoid “rubbing’ the tooth tips dull. Increase the feed if needed to produce chips.

Problems & Solutions

Problem	Cause	Remedy
1. Premature Dulling of Teeth	Saw idling through cut	Increase tooth load by increasing feed or reducing speed
	Teeth too coarse	Select finer pitch
	Incorrect coolant or coolant improperly applied	Check amount, type and mixture of coolant
	Band teeth running in wrong direction	Reinstall band correctly
	Excessive speed for material being cut	Reduce speed accordingly
	Wrong type of blade	Select carbon, bi-metal or carbide tipped
2. Band Vibrating in the Cut	Unsuitable speed for material and thickness	Increase or decrease according to section, size and type of material
	Excessive feed/pressure	Decrease feed/pressure
	Work not held firmly	Reclamp work firmly
	Teeth too coarse	Select finer pitch
	Insufficient blade tension	Reset tension using a tensiometer
3. Tooth Strippage	Teeth too coarse	Select finer pitch
	Work not held firmly	Reclamp work firmly
	Sawing dry	Apply coolant
	Gullets of teeth loaded with chips/swarf	Use coarser pitch
	Excessive feed/pressure	Decrease feed/pressure
	Band teeth encountering sharp corner on material being cut	Reset a flat surface to the band when starting the cut
4. Band Cutting Out of Square	Band guides not properly adjusted	Realign band guides - replace if worn
	Excessive feed/pressure	Decrease feed/pressure
	Uneven wear of tooth set caused by hard inclusion in material being cut	Decrease tooth load by reducing feed pressure or using finer pitch
	Band nearing end of life	Replace with new band
	Work not held firmly	Reclamp work firmly

Problems & Solutions

Problem	Cause	Remedy
5. Slow Cutting Rate	Band speed too slow	Increase band speed
	Insufficient feed/pressure	Increase feed/pressure
	Teeth too fine	Select coarser pitch
	Lack of coolant	Increase supply of coolant
	Band nearing end of life	Replace with new band
	Wrong type of blade	Select carbon, bi-metal or carbide tipped
6. Premature Band Breakage	Cracking at the weld	Check welding technique
	Band guides not properly adjusted	Realign band guides - replace if worn
	Excessive blade tension	Reset tension using a tensiometer
	Wrong type of blade	Select carbon, bi-metal or carbide tipped
	In profile sawing band width too great for radius being cut	Select narrower band width
	Teeth too coarse	Select finer pitch
	Excessive feed/pressure	Decrease feed/pressure
	Excessive speed for material being cut	Reduce speed accordingly
	Band too thick for diameter of drive wheels, or wheels defective	Use thinner band and check periphery of drive wheels
7. Bad Surface Finish on Workpiece	Teeth too coarse	Select finer pitch
	Band speed too slow	Increase band speed
	Feed rate too great	Decrease feed rate
	Machine defect	Stop machine and examine functional components
	Lack of coolant	Increase supply of coolant
8. Premature Loss of Tooth Set	In profile sawing band width too great for radius being cut	Select narrower band width
	Excessive speed for material being cut	Reduce speed accordingly
	Band running too deep in guides	Adjust guides
	Lack of coolant	Increase supply of coolant
	Wrong type of blade	Select carbon, bi-metal or carbide tipped

Problems & Solutions

Problem	Cause	Remedy
9. Bandsaw Teeth Choked with Chips	Teeth too fine	Select coarser pitch
	Lack of coolant	Increase supply of coolant
	Feed rate too great	Decrease feed rate
10. Band Not Running True in Guides	Misaligned weld	Check welding equipment and reweld
	Drive wheels misaligned	Check alignment of drive wheels and adjust
	Band guide back support bearing worn	Adjust or replace
	Side guides misaligned	Adjust correctly
11. Saw Making Bow-Shaped Cut	Insufficient blade tension	Reset tension using a tensiometer
	Teeth too fine	Select coarser pitch
	Band guides worn or misaligned	Adjust or replace
	Feed rate too great	Decrease feed rate
12. Band Jamming in Cut	Back edge of band flattened by guides	Readjust guides and/or reduce feed rate
	Insufficient blade tension	Reset tension using a tensiometer
	Loss of tooth set on band	Examine under #8
	Movement of work piece	Reclamp work firmly
	In profile sawing band width too great for radius being cut	Select narrower band width
	Cutting out of square	Examine under #4

22 Variables - A Preview

- **The Operators** - The largest single variable.
- **The Number of Teeth in the Band** - 3 minimum, 6 - 12 optimum, 24 maximum.
- **Tooth Style** - Standard, Skip, Sabre, or Variable Pitch.
- **Tooth Set** - Regular, Wavy, ETS, or Variable Pitch.
- **Band Tension** - Measured with a tensiometer.
- **Band Speed** - Set using Speed & Feed charts.
- **Break-In Procedure** - Reduce normal feed rate by 50%.
- **Feed Rate** - Set using Speed & Feed charts.
- **Band Quality** - Carbon vs. Bimetal vs. Carbide Tipped.
- **Machine Type** - Different makes and models, horsepower of motor.
- **Wheels** - Check alignment, bearings, flanges.
- **Machine Condition** - Old, new, well-maintained.
- **Proper Vises** - Set to hold the work firmly.
- **Guides** - Should support the band, roller guides should barely turn by hand.
- **Guide Arms** - Set as close to the work as possible for support.
- **Brushes** - Aid in cleaning chips off the blade.
- **Coolant** - Should wash, cool and lubricate.
- **Material Machineability** - The toughness of a metal can reduce tool life.
- **Material Hardness** - An Rc of 40 has a machineability approaching 0.
- **Material Shape** - Structurals and small solids tend to be harder on the band.
- **Production Requirement** - Continuous use vs. intermittent use.
- **Room Temperature** - Affects hydraulic fluids in the machine.

Any one variable or any combination of the above variables can affect bandsaw life!

Uncoiling a Blade

To Uncoil

- Take the band in one hand and remove twist ties.
- With the band hanging vertically (Fig 1.1), rotate in both hands, separating the three loops to find the 'loose' middle loop (Fig 1.2).
- Using the hand holding only one loop, also grasp the 'loose' middle loop (Fig 1.3).
- Retain the hold on these two loops, and holding away from the body, remove the other hand (Fig 1.4).
- Separate the band by taking one loop in each hand and allow the band to spring open under controlled pressure.

Fig 1.1 Fig 1.2 Fig 1.3 Fig 1.4

Recoiling a Blade

To Recoil

- Hold the band firmly with both hands, and with the teeth facing away from the body (Fig 1.5).
- The lower part of the band should be placed forward of the operator and be pressing against a fixed object.
- The band should then be pushed forward while turning the hands inward.
- This operation will cause the band to overlap immediately in front of the hands (Fig 1.6).
- The band can be held at this point by one hand allowing the free hand to lift the lower part of the band (Fig 1.7).
- The spring nature of the bandsaw will cause it to form a coil (Fig 1.8).

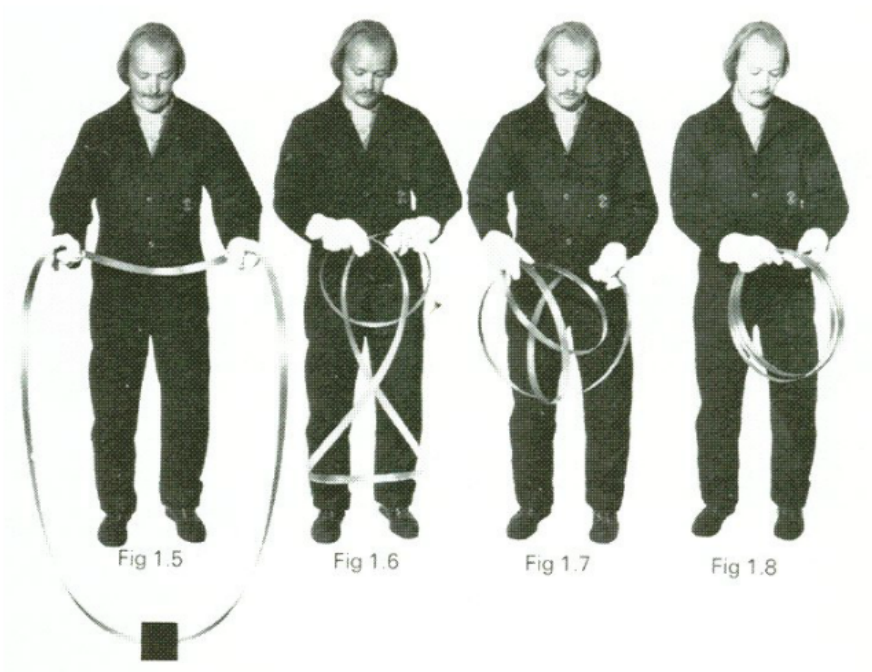


Fig 1.5 Fig 1.6 Fig 1.7 Fig 1.8

RECOMMENDED SPEEDS & CUTTING RATES **BI-METAL BANDSAW BLADES**

Stock Dimensions **Tooth Pitch**	**Up to 1"** **10-14, 8-12**		**From 1" - 3"** **6/10,8/12,5/8**		**From 3" - 6"** **5-8,4-6,3-4,2-3**		**Over 6"** **3-4,2-3,1.5-1.9,1.1-1.4** **3/4" T.S.**	
Material (Annealed)	**Speed (SFPM)**	**Cutting Rate (SIPM)**	**Speed (SFPM)**	**Cutting Rate (SIPM)**	**Speed (SFPM)**	**Cutting Rate (SIPM)**	**Speed (SFPM)**	**Cutting Rate (SIPM)**
Stainless Steels: (con't)								
416,430F	200	3 - 5	180	4 - 6	170	5 - 7	150	4 - 6
430, 446	100	1 - 3	90	2 - 4	80	2 - 4	80	1 - 3
440 A,B,C	120	1 - 3	10	1 - 3	90	2 - 4	70	1 - 3
440F, 443	150	1 - 3	130	1 - 3	120	2 - 4	100	1 - 3
17-4PH, 17-7PH	100	2 - 3	90	2 - 4	80	3 - 4	80	2 - 3
A-7	100	1 - 2	100	1 - 2	100	2 - 3	100	2 - 3
Beryllium Copper #25								
BHN 100-120	350	4 - 6	300	5 - 7	275	6 - 8	225	5 - 7
BHN 220-250	250	2 - 4	225	3 - 5	200	4 - 6	175	3 - 5
BHN 310-340	200	1 - 2	160	1 - 2	140	2 - 3	100	1 - 2
Nickel Base Alloys:								
Monel	100	1 - 2	100	1 - 2	80	1 - 2	60	1
R Monel	140	2 - 3	140	2 - 4	125	2 - 4	75	2 - 3
K Monel	100	1	80	1	60	1	60	1
KR Monel	100	1 - 3	90	1 - 3	80	1 - 3	60	1 - 2
Inconel	110	1 - 2	100	1 - 3	80	1 - 3	80	1 - 2
Inconel X	90	1	80	1	70	1	60	1
Nickel Base Alloys:								
Hastelloy A	120	1 - 2	100	1 - 2	85	2 - 3	75	1 - 2
Hastelloy B	110	0 - 1	100	1 - 2	90	1 - 2	75	0 - 1
Hastelloy C	100	0 - 1	90	0 - 1	70	0 - 1	60	0 - 1
Rene 41	90	1	90	1	90	1 - 2	90	1 - 2
Udimit	100	1	90	1 - 2	90	1 - 2	90	1 - 2
Waspalloy	90	1	90	1 - 2	90	1 - 2	90	1 - 2
Titanium	100	1 - 2	100	2 - 3	100	2 - 3	100	2 - 3
Titanium Alloys:								
TI-4AL-4MO Alpha Beta Alloy	100	0 - 1	90	0 - 1	80	0 - 1	70	0 - 1
TI-140A 2CR-2MO	100	0 - 1	90	0 - 1	80	0 - 1	60	0 - 1
TI-150A	100	0 - 1	90	0 - 1	80	0 - 1	60	0 - 1
MST-6AL-4V	100	0 - 1	90	0 - 1	80	0 - 1	60	0 - 1
99% Pure Titanium	100	0 - 1	90	0 - 1	80	0 - 1	60	0 - 1

Safety

- Always wear gloves and safety glasses when handling bandsaw blades.
- Keep hands safely away from a blade in motion.
- Maximum safe blade operating speeds are:
  - Carbon FlexBack - 10,000 SFPM
  - Carbon HardBack - 4,000 SFPM
  - Bimetal - 2,000 SFPM
  - Carbide Tipped - ???
- Be sure the blade is installed so the teeth are leading in the direction of the cut.
- Be sure guides are in good condition and are set properly.
- Be sure the material to be cut is securely clamped in the vising system.
- Be sure the blade is tensioned properly.
- Do not drop a stationary blade onto the work piece.
- Do not start a cut on a corner or sharp edge.
- Never stop or re-start a machine with the blade in a cut.
- Never use a new blade in a cut started with another blade; turn the work piece over and begin cutting with the new blade at the point opposite the unfinished cut.
- If ever in doubt concerning a bandsaw application, contact the Simonds Product Support Team.

Notes