PRECISION, QUALITY, INNOVATION



# BAND SAW BLADES

BI-METAL

CARBIDE

HIGH CARBON

DIAMOND GRIT

WOOD CUTTING

FOOD PROCESSING

BAND SAW MACHINES

POWER
HACKSAWS

TECHNICAL SERVICES & SUPPORT





#### FACTORIES

Starrett has eight manufacturing facilities in four countries, distribution centres in a further ten countries, and partners in more than 120 countries.

#### TECHNICAL INFORMATION

Terminology, Tooth shapes, Band Saw Blade characteristics.

# CHOOSING THE CORRECT BLADE

#### POWERCALC

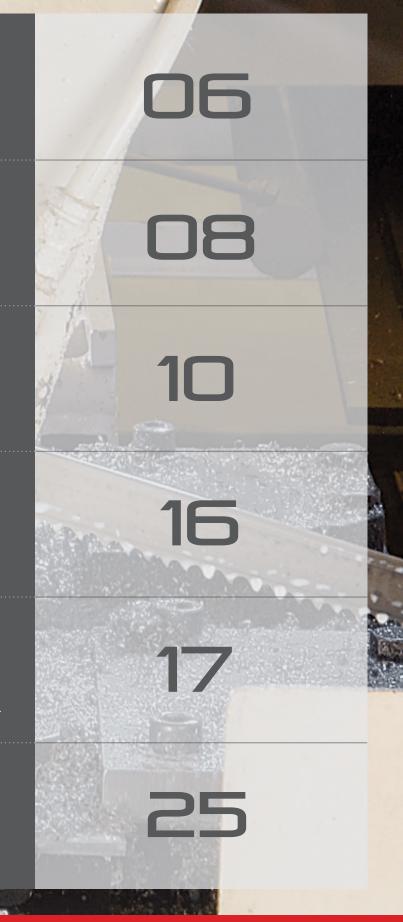
Online programme that assists in the correct choice of the band saw blade. Generates a cutting data report to improve performance in production.

#### BI-METAL SAW BLADES

The best solution for cutting metallic and non-metallic materials. A full range to suit all cutting needs whether economic or high production, for any model of machine.

#### CARBIDE / DIAMOND GRIT

Ideal for cutting extremely hard, abrasive materials. Withstands extreme cutting pressures and offers a high resistance to wear and fatigue.



BAND SAW BLADES

# 33 38 40 43 48

51

#### HIGH CARBON

Suitable for horizontal and vertical machines with manual or gravitational feed. A complete line with a wide range of widths, tooth pitches and shapes.

#### WOOD CUTTING

A selection of carbon and bi-metal blades ideal for a variety of wood cutting applications.

#### FOOD PROCESSING

Constructed of the best quality speciality steels, polished and hardened to resist corrosion and contamination. The ideal choice for accuracy and efficiency in food processing.

#### POWER HACK SAW BLADES

The Bi-Metal or Solid High-Speed Steel (HSS) Power Hacksaw blades are manufactured by Starrett, available in metric and inch lines.

#### BAND SAW MACHINES

List of Starrett band saw machines with cutting capacity, blade dimensions, cutting speeds etc.

#### TECHNICAL ASSISTANCE

Starrett Technical Assistance Channels.

#### **RECOMMENDATIONS**

Recommendations to ensure longer life and better blade performance. Running-in, installation and blade change instructions.

# 52

#### CUTTING TABLE

Table containing materials, dimensions of work piece and cutting speeds for Bi-Metal Blades.

# 54

#### CUTTING CALCULATION

Cutting calculation for different areas and materials.

# 56

#### **ACCESSORIES**

Tachometer, Pocket Laser Tachometer kit with case, Saw Tension Gauge and Band Saw Blade Alignment Gauge.

# 57

#### TROUBLESHOOTING

List of potential problems indicating the probable cause and solution.

# 58

BAND SAW BLADES

# FACTORIES AROUND THE WORLD



1 - Athol, Massachusetts, USA



2 - Laguna Hills, California, USA



3 - Waite Park, Minnesota, USA



4 - Cleveland, Ohio, USA









6 - Itu, São Paulo, Brazil



7 - Jedburgh, Scotland



8 - Suzhou, China



### TERMINOLOGY

#### A - WIDTH

Tip of the cutting edge to the back of the blade.

#### B - BLADE BODY

Distance between the back of the blade and the gullet.

#### C - LENGTH

Measurement along the back edge of the blade.

#### D - THICKNESS

Measurement of the body of the blade.

#### E - BACK EDGE

Opposite side of the blade from the teeth.

#### F - TOOTH PITCH

Distance from the tip of one tooth to the next tip.

#### G - TEETH PER INCH / 25MM

Number of teeth per inch (25.4mm).

#### H - GULLET

The curved area between two teeth, where the chips accumulate until being removed.

#### I - TOOTH FACE

Surface of the tooth where the chip is formed. The tooth can have a positive, negative or straight angle. (Rake)

#### J - TOOTH SET

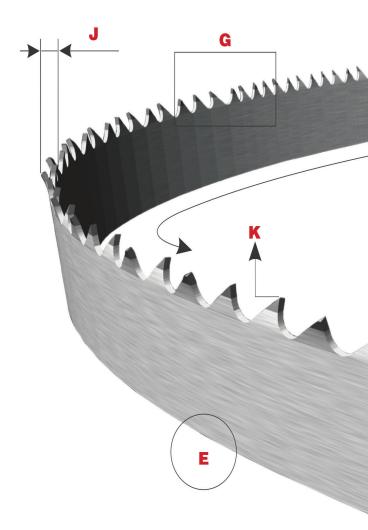
The bending of the teeth (right and left) to allow blade clearance through the cut.

#### K - BACK ANGLE

Angle formed by the back of the teeth and a parallel line to the tip of the same.







# Starrett® bi-metal unique® saw technology

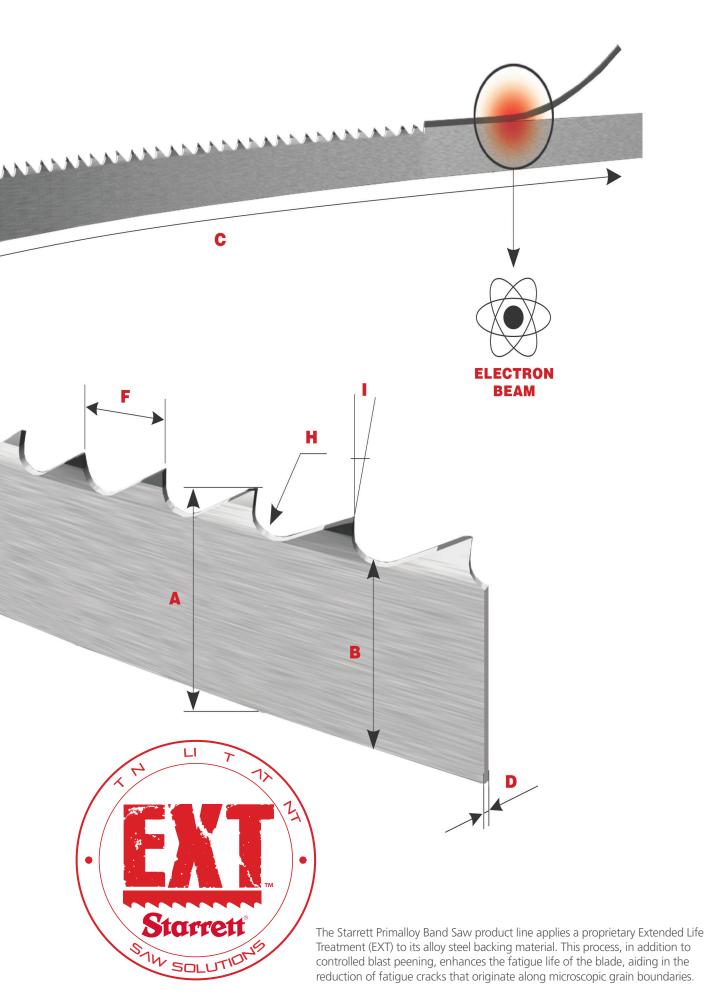
# MULTIPLE CUTTING EDGES



SPLIT CHIP







1	Quick Guide	_	_	META	LLICS	_	_
	***	Aluminium	Tubes and Profiles	Carbon Steel	Carbon Steel Alloys	Cast Iron	Copper Alloys
	PERFORMANCE						
	Primalloy <sup>™</sup> Page 18				***	***	***
	Intenss™ PRO-VTH Page 19				**		
	Intenss™ PRO Page 20	**	**	***	**	**	**
BI-METAL	Versatix™ MP Page 21	*	***	**			
B	Intenss™ Page 22	**	**	**	*	**	*
	Intenss™ PRO-DIE Page 23	**	**	**	**		*
	Univerz™ Page 24	*	**	*			
	Advanz™ MC7 <b>NEW -</b> Page 26			***	***		
	Advanz™ MC5 <b>NEW -</b> Page 27	***				***	***
CARBIDE	Advanz™ TS Page 28			***	***	*	
CARI	Advanz™ CS Page 29						
	Advanz™ FS Page 30	***				***	***
	Advanz™ CG Page 31						
DIAMOND	Advanz™ DG Page 32						
	Duratec™ Super FB Page 34	*	*	*			
HIGH CARBON	Duratec™ FC Page 36						
E E	Band Knives Page 37						
ОБ	Woodpecker™ Premium Page 39						
WOOD	Woodpecker™ Pro Page 39	***					
NG	Meatkutter™ Premium Page 41						
FOOD PROCESSING	Meatkutter™ Stainless Page 41						
DD PRO	Meatkutter™ Frozen Page 42						
Ğ	Carcasskutter™ Page 42						

	META	ALLICS			NON ME	ETALLICS	
HSS, Nickel & Titanium Alloys	Stainless Steel	Tool Steel - Hot & Cold Work	Steel with hardness	Composite materials and	Foam, Paper, Plastic &	Wood	Food
			above 45 HRC	abrasives	Rubber		0
***	***	***					
**	**	**					
**	**	**				*	
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#### **2** Tooth Shapes

# Intenss™ PRO-VTH

#### Intenss™ PRO-VTH

- Variable tooth height providing pulsating action
- Easy penetration
- Ideal for cutting hard and difficult to machine materials



#### Primalloy™ / Intenss™ PRO / Intenss™ PRO-DIE / Univerz™

- Positive Rake angle
- Double back angle
- Fast and efficient chip clearance
- Excellent choice for a wide range of cuts



#### Versatix<sup>™</sup> MP

- Extremely robust, shockproof
- Positive Rake angle
- Ideal for cutting tubes and profiles



#### Intenss<sup>™</sup> / Duratec<sup>™</sup> Super FB / Duratec<sup>™</sup> FC / Univerz<sup>™</sup>

- Standard 0° Rake
- Shock resistant
- Excellent choice for a wide range of cuts
- Suitable for all types of machines



#### Intenss<sup>™</sup> PRO

- Unique profile, patented by Starrett®
- Extremely robust
- Positive Rake angle
- Fast and efficient chip clearance

# Hook

#### Duratec<sup>™</sup> Super FB / Intenss<sup>™</sup> PRO-DIE

#### / Woodpecker<sup>™</sup> Premium

- Positive Rake angle, extremely aggressive
- Faster cuts
- Suitable for cutting non-ferrous and non-metallic metals



#### **Duratec™ Super FB / Woodpecker™ Premium**

- Standard 0° Rake
- Shock resistant
- Suitable for cutting non-ferrous and non-metallic metals



#### Advanz™ MC7 / Advanz™ MC5 / Advanz™ TS / Advanz™ CS / Advanz™ FS

- Differential tooth design, accurately ground
- Faster cuts
- Ideal for cutting hard and difficult to machine materials



#### Advanz™ CG / Advanz™ DG

- Cutting edge coated with grains, continuous or with gullet
- Suitable for cutting abrasive or hardened materials



#### TOOTH



#### Constant Pitch

All teeth on the blade have uniform spacing. The tooth is defined through the number of teeth per inch (25.4mm).

Example: 4 TPI.



#### **Variable Pitch**

Variable distance between the tips of the teeth on the blade. Size of tooth and depth of gullet varies to substantially reduce noise levels and vibrations.

Example: 4-6 TPI.

#### **SETS**



#### Raker

A recurring sequence of teeth set left and right, followed by one tooth unset.



#### **Progressive**

Groups of teeth set to each side of the blade, with progressive set followed by one tooth unset.



#### Wavy

Groups of teeth set to each side of the blade, with varying amounts of set in a controlled pattern.

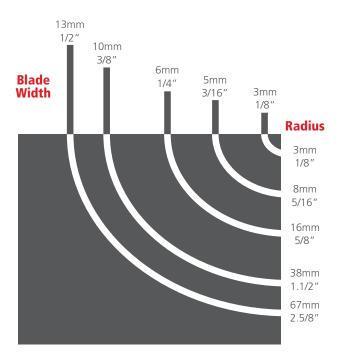


#### Trapezoidal

Special carbide cylinder welded in the tooth edge, being slightly thicker than the blade, and triple chip grind.

#### 3 Blade Width

Use the blade width recommended by the machine manufacturer, except for contour cutting in vertical machines when you should use the chart below.



#### 4 Pitch

Pitch is the number of teeth per inch or 25.4mm. Cutting thinner sections requires a finer pitch (more teeth per inch/25mm). Thick sections require coarser pitches (fewer teeth per inch/25mm).

The charts are good guidelines. Because the cross section limits in the chart are broad and overlap, choose a coarser pitch if the speed of cut is most important. Choose a finer pitch if finish is most important.

	MASSIVE	
Section to be cut (mm)	Constant Pitch (TPI)	Variable Pitch
4 to 10	32 or 24	14-18
6 to 13	18 or 14	10-14
13 to 19	14 or 10	8-12
19 to 25	10 or 8	6-10
25 to 38	8 or 6	5-8
38 to 88	6 or 4	4-6
88 to 180	4 or 3	3-4
180 to 250	3	2-3
250 to 400	_	1.4-2
350 to 500	1.3	1-2
400 to 800	1.3	1-1.2
Above 750	1	.8-1.3 / .9-1.1

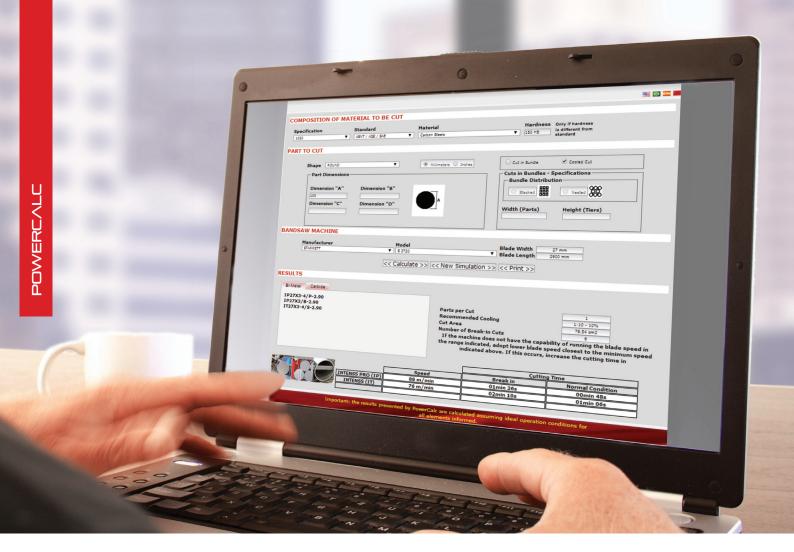
For cutting tubes and profiles, use the horizontal line to find the outside diameter (tube) or the largest section (profile). Find the thickness (tube/profile) using the vertical column. With that information, cross them to find the recommended pitch. (chart below).

					TU	IBES AND I	PROFILES						
Wall thickness				Outside	diameter	of tube or	maximun	n profile se	ction leng	th (mm)			
(mm)	10	20	40	60	80	100	120	150	200	300	400	500	600
2	14-18	14-18	10-14	10-14	10-14	10-14	8-12	8-12	8-12	8-12	6-10	6-10	5-8
3	10-14	10-14	10-14	10-14	10-14	8-12	8-12	8-12	6-10	6-10	6-10	5-8	5-8
4		8-12	8-12	8-12	8-12	6-10	6-10	6-10	5-8	5-8	4-6	4-6	4-6
5		6-10	6-10	6-10	6-10	5-8	5-8	5-8	5-8	4-6	4-6	4-6	4-6
6		5-8	5-8	5-8	5-8	5-8	5-8	5-8	4-6	4-6	4-6	4-6	3-4
8			4-6	4-6	4-6	4-6	4-6	4-6	4-6	4-6	3-4	3-4	3-4
10			4-6	4-6	3-4	3-4	3-4	3-4	3-4	3-4	3-4	2-3	2-3
12				4-6	3-4	3-4	3-4	3-4	3-4	3-4	2-3	2-3	2-3
15				4-6	3-4	3-4	3-4	3-4	3-4	2-3	2-3	2-3	2-3
20				4-6	3-4	3-4	3-4	3-4	3-4	2-3	2-3	2-3	2-3
25					3-4	3-4	3-4	3-4	2-3	2-3	2-3	1.4-2	1.4-2
30					3-4	3-4	3-4	3-4	2-3	2-3	2-3	1.4-2	1.4-2
40						3-4	3-4	3-4	2-3	2-3	2-3	1.4-2	1.4-2
50							3-4	3-4	2-3	2-3	1.4-2	1.4-2	1-1.2
60									2-3	2-3	1.4-2	1.4-2	1-1.2

# **5** Blade Length

The blade length varies according to the band saw machine type and specifications. Please find the correct blade length on your band saw machine user manual.





# **POWERCALC**

The online PowerCalc Software helps you to choose the correct Band Saw Blade:

- Assistance in choosing the correct Starrett Blade
- Calculating blade speed and cutting rate for a better performance
- Recommendations of the correct coolant ratio for longer life

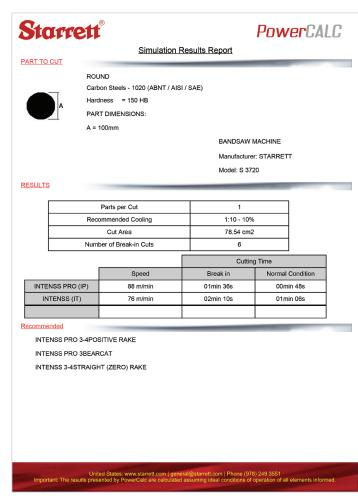
#### POWERCALC DIFFERENTIALS

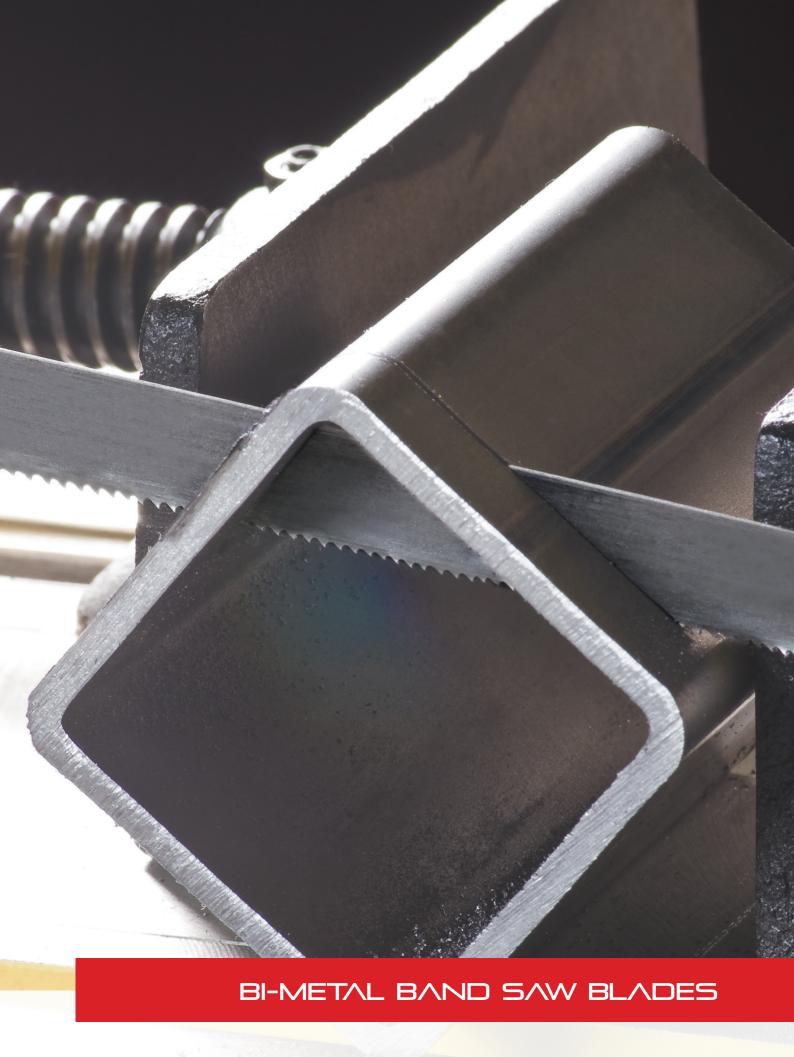
- The database includes the world's leading band saw machine manufacturers
- PowerCalc generates cutting data reports to improve production performance
- The simulations are recorded in the programme, and can be accessed at any time

#### HOW TO USE POWERCALC

- The online software is free.
- Access:

info.starrett.com/powercalc-download





#### PRIM∧LLOY™



# Starrett® Primalloy™

#### **FEATURES**

- Special high-speed steel edge
- Exclusive tooth geometry with positive rake angle
- Extended Life Treatment (EXT) functionality ensures maximum fatigue life
- Ground teeth

#### **BENEFITS**

High Cobalt and Vanadium content on teeth guarantees:

- Longer blade life with high quality surface finish
- Increased wear and heat resistance
- Easy penetration in hard and difficult to machine materials, increasing the blade performance
- Cost-effective over conventional bi-metal blades

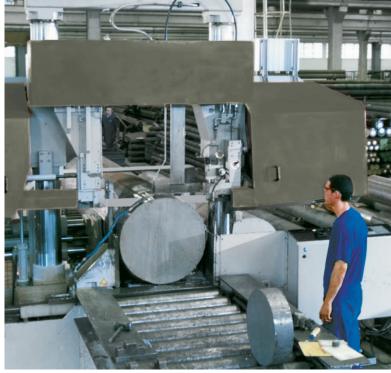
#### **APPLICATIONS**

- Tool steel and high speed steel
- Stainless steels
- Nickel and titanium alloys
- Hardened steel
- For machines with hydraulic feed control

Width x	Thickness	Dit als		
mm	inches	Pitch		
27 x 0.90	1 x .035	3 - 4		
34 x 1.10	1.1/4 x .042 —	2 - 3		
34 X 1.10	1.1/4 X .042	3 - 4		
		1.4 - 2		
41 x 1.30	1.1/2 x .050	2 - 3		
		3 - 4		
		1 - 1.2		
54 x 1.60	3 × 063	1.4 - 2		
54 X 1.60	2 x .063	2 - 3		
		3 - 4		
		1 - 1.2		
67 x 1.60	2.5/8 x .063	1.4 - 2		
		2 - 3		

Available as welded bands, random length coils and 45 metre coils. Note: Special products on request.





# INTENSS™ PRO-VTH



#### **FEATURES**

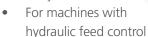
- Uniquely designed tooth edge with variable height and set
- Ground Teeth with positive rake angle

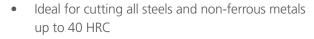
#### **BENEFITS**

- Easy penetration with faster cuts
- Excellent heat and wear resistance
- Pulsating action allows the teeth to cut in a fast action

#### **APPLICATIONS**

- Tool steel and high speed steel
- Stainless steels
- Hardened Copper and aluminium Bronze Alloys





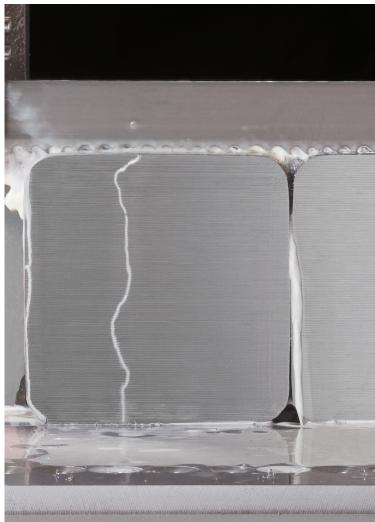
Width x Thickness				
inches	Pitch			
	2 - 3			
1 x .035	3 - 4			
	4 - 6			
1 1/4 × 042	2 - 3			
1.1/4 X .U4Z	3 - 4			
1 1/2 × 0E0	2 - 3			
1.1/2 X .050	3 - 4			
2 v. 062	1 - 1.2			
54 x 1.60 2 x .063	1.4 - 2			
2.5/8 x .063	1.4 - 2			
2.1/9 v. 062	1 - 1.2			
3. I/8 X .003	1.4 - 2			
	1 x .035  1.1/4 x .042  1.1/2 x .050  2 x .063			

Raker Tooth Set

Furnished in welded bands and in random length coils.

Note: Special products on request.





# INTENSS™ PRO

Starrett® Intenss™ PRO

#### **FEATURES**

- Complete line with a wide range of widths and pitches to suit a huge variety of cutting needs
- Unique tooth geometry provides intense production cutting in ferrous and non-ferrous metals

#### **BENEFITS**

- Faster and straighter cuts
- Improved fatigue and wear resistance



#### **APPLICATIONS**

- Ideal for production cutting across a wide range of metals
- For solids and thick wall tubes



Width x	Width x Thickness		
mm	inches	Pitch	
		3 - 4	
19 x 0.90	3/4 x .035	4 - 6	
19 X 0.90	3/4 X .035	5 - 8	
		6 - 10	
		2 - 3	
		3 - 4	
27 0 00	1 025	4 - 6	
27 x 0.90	1 x .035 -	5 - 8	
		6 - 10	
		3*	
		2 - 3	
		3 - 4	
34 x 1.10	1.1/4 x .042	4 - 6	
		5 - 8	
		6 - 10	
		1 - 1.2	
		1.4 - 2	
44 4 20	4.4/2 050	2 - 3	
41 x 1.30	1.1/2 x .050	3 - 4	
		4 - 6	
		5 - 8	
		.8 - 1.3	
		1 - 1.2	
54 x 1.60	2 x .063	1.4 - 2	
		2 - 3	
		3 - 4	
		.8 - 1.3	
67 x 1.60	2.5/8 x .063	1 - 1.2	
		1.4 - 2	
		.8 - 1.3	
80 x 1.60	3.1/8 x .063	1 - 1.2	
		1.4 - 2	

PS Tooth Shape \* = BR Tooth Shape

Raker Tooth Se

Furnished in welded bands, random length coils and 45 metre coils. Note: Special products on request.

# VERSATIX™ MP

Starrett® Versatix™ MP

#### **FEATURES**

- Special tooth geometry developed for cutting structural materials
- Increased tooth strength

#### **BENEFITS**

- Faster and straighter cuts
- Less tooth breakage

#### **APPLICATIONS**

- Tubes and structurals
- Small solids
- Bundles
- For all machines: manual, hydraulic, gravitational etc.





mm	inches	Pitch 4 - 6
		4 - 6
		5 - 8
19 x 0.90	3/4 x .035	6 - 10
		8 - 12
		10 - 14
		3 - 4
	4 - 6 5 - 8	4 - 6
27 x 0.90		5 - 8
27 X 0.30	1 7 .033	6 - 10
	8 - 12	8 - 12
		10 - 14
		2 - 3
	3	3 - 4
34 x 1.10 1	.1/4 x .042	4 - 6
		5 - 8
		6 - 10

Width x	Pitch	
mm	inches	FILCII
		2 - 3
41 x 1.30	1.1/2 x .050	3 - 4
41 X 1.30	1.1/2 X .030	4 - 6
		5 - 8
		2 - 3
54 x 1.30	2 x .050 3 - 4 4 - 6	3 - 4
		4 - 6
		2 - 3
54 x 1.60	2 x .063	3 - 4
		4 - 6
67. 460	2.5/2052	2 - 3
67 x 1.60	2.5/8 x .063	3 - 4
Raker Tooth Set		

Furnished in welded bands, random length coils and 45 metre coils.

Note: Special products on request.

# **INTENSS™**

# Starrett® Intenss™

#### **FEATURES**

- Strong tooth geometry
- M42 high speed steel teeth combined with a wear resistant alloy backing material

#### **BENEFITS**

- Ideal for using with manual feed and vertical band saw machines, as well as conventional machines with gravitational feed
- Ideal for tool rooms, service and maintenance and small machine shops

#### $\Lambda$ PPLICATIONS

- Cut steel sheets, carbon steel solids and structurals, aluminium, copper, brass, cast iron, alloy steel, stainless steel etc.
- Cut small and medium solids

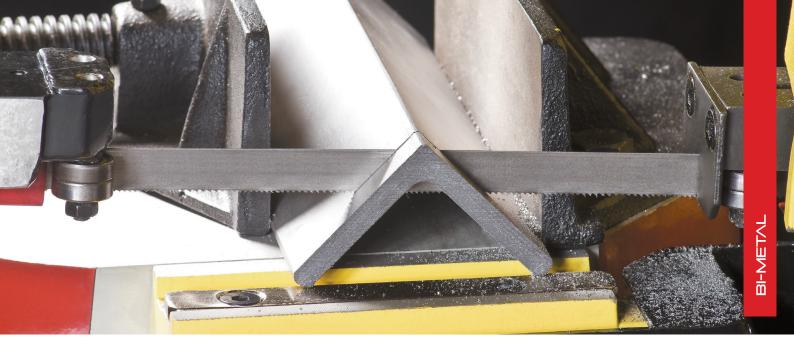


Width x	Width x Thickness			
mm	inches	Pitch		
13 x 0.65	1/2 x .025 -	14		
13 X U.05	1/2 X .U25	18		
13 x 0.90	1/2 x .035 —	10		
13 X 0.90	1/2 A .033	14		
		4 - 6		
19 x 0.90	3/4 x .035	5 - 8		
		14		
		3 - 4		
27 x 0.90	1 x .035	4 - 6		
27 x 0.50	5 - 8			
		14		
		2 - 3		
34 x 1.10	1.1/4 x .042	3 - 4		
J4 A 1.10	1.1/4 \(\Lambda\).042	4 - 6		
		5 - 8		
41 x 1.30	1.1/2 x .050	3 - 4		

Furnished in welded bands and random length coils. Note: Special products on request.







# INTENS5™ PRO-DIE

Starrett® Intenss™ PRO-DIE

#### **FEATURES**

- Split Chip Advantage Technology
- Multiple cutting edges Multi Edge Performance

#### **BENEFITS**

- Technology that allows faster cutting rates for longer blade life
- Cost-effective over conventional carbon steel blades
- Excellent fatigue, abrasion and shock resistance

#### $\Lambda$ PPLICATIONS

- Ideal for contour cutting on vertical machines
- Carbon steel and low alloy steels
- Sheet metal
- Die and Mould steel
- Stainless steel



Width x 1	Width x Thickness					
mm	inches	Pitch				
6 x 0.65	1/4 x .025	10 - 14				
	1/4 X .025	14 - 18				
6 x 0.90	1/4 x .035	10 - 14				
		8 - 12				
10 x 0.65	3/8 x .025	10 - 14				
		14 - 18				
		6 - 10				
12 - 0 65	1/2 × 035	8 - 12				
13 x 0.65	1/2 x .025	10 - 14				
		14 - 18				

Width x	Width x Thickness		
mm	inches	- Pitch	
13 x 0.65	13 x 0.65 1/2 x .025		
13 X 0.03	1/2 X .023	6*	
		6 - 10 8 - 12	
13 x 0.90	1/2 x .035		
15 X 0.90	1/2 X .033	10 - 14	
		4*	

PS Tooth (Variable Pitch)

\* = HK Tooth (Constant Pitch

All Raker Tooth Set apart from 14-18 TPI (Wavy Tooth Set)
Furnished in welded bands, random length coils and 30 metre (100') coils
Note: Special products on request

# UNIVERZ™

Starrett® Univerz™

#### **FEATURES**

- Split Chip Advantage Technology
- Multiple cutting edges Multiple Edge Performance
- Blade thickness: 0.50mm (0.020")

#### **BENEFITS**

- Technology that allows faster cutting rates, increasing the blade life
- Cost-effective over conventional carbon steel blades
- Excellent fatigue, abrasion and shock resistance
- For contour cuts

#### APPLICATIONS

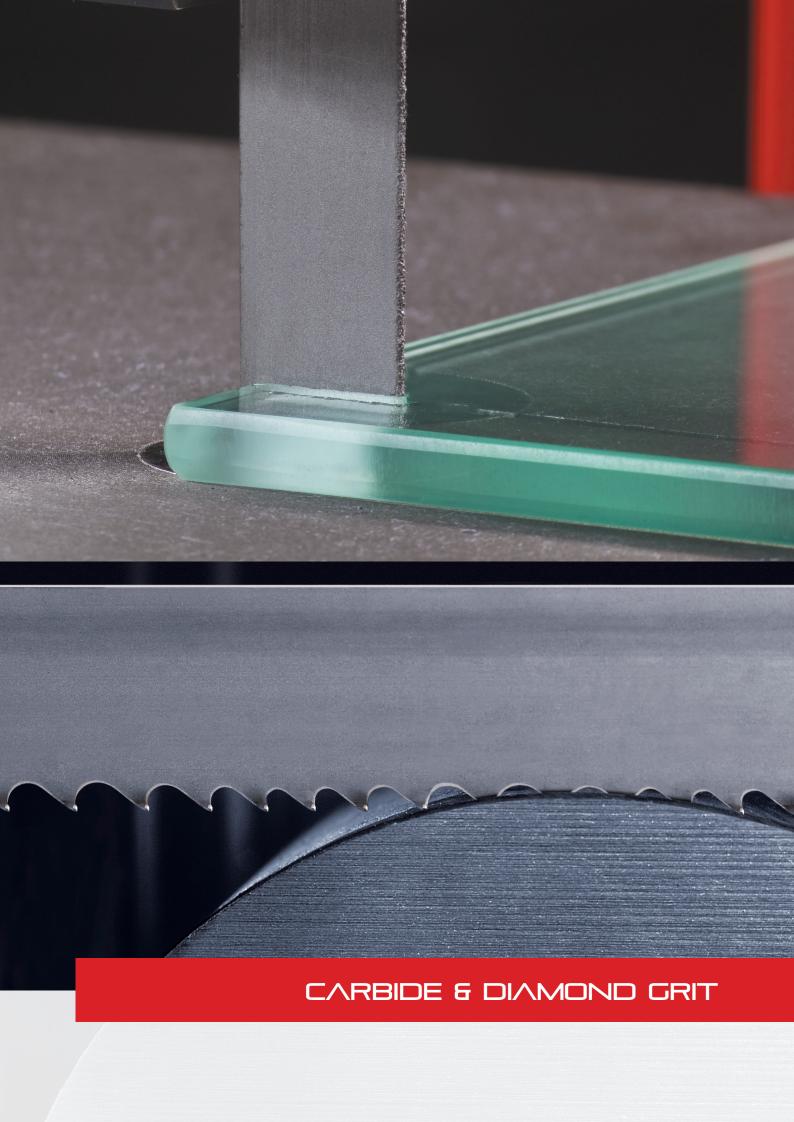
- Portable machines
- Vertical machines with reduced wheel diameter
- Ideal for metal work shops, construction and hobbyists
- Steel, iron, aluminium, metalon





Width x Thickness		Pitch
mm	inches	PILCII
	- - 13 x 0.50 1/2 x .020 -	10 - 14*
13 x 0.50		14 - 18*
		10
		14
		18
		24

Regular Tooth Shape \* = PS Tooth Shape Furnished in welded bands and random length coils. Note: Special products on request.



NEW!

# **^DV^NZ™MC7**

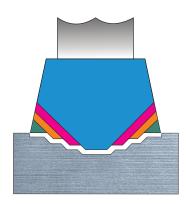
Starrett® Advanz™ MC7

#### **FEATURES**

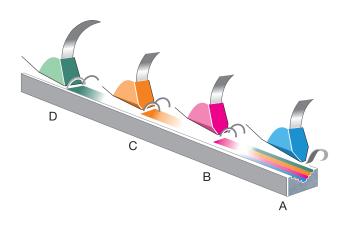
- Carbide tipped teeth
- Trapezoidal teeth with progressive grinding
- Ground Teeth forming 7 chips
- Positive Rake angle
- Dedicated geometry

#### **BENEFITS**

- Ideal for cutting ferrous metals
- Reduced cutting time
- Higher productivity
- Precise cuts and excellent finish
- Excellent cost-benefit ratio for production cutting



MC7 (Seven Multiple Chips)



#### **APPLICATIONS**

- Mechanical construction steels
- Tool steels, stainless steels
- Inconel
- Titanium
- For machines with hydraulic feed control



Width x	Pitch	
mm	inches	PILCII
34 x 1.10	1.1/4 x .042	2 - 3
41 x 1.30	1.1/2 x .050	1.4 - 2
41 X 1.30	1.1/2 X .U5U	2 - 3
F4 v 1 CO	2 x .063	1.4 - 2
54 x 1.60	Z X .003	2 - 3
671.60	2.5/0062	.9 - 1.1
67 x 1.60	2.5/8 x .063	1.4 - 2

All blades are Trapezoidal Tooth Set Furnished in welded bands and random length coils. Note: Special products on request.



NEW!

# **^DV**^NZ™ MC5

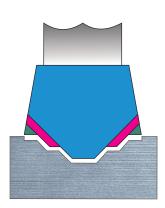
Starrett® Advanz™ MC5

#### **FEATURES**

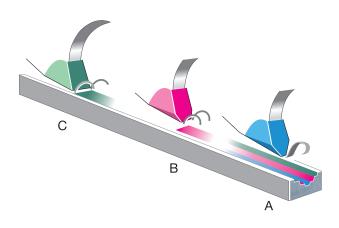
- Carbide tipped teeth
- Ground Teeth forming 5 chips
- Positive Rake angle
- Dedicated geometry

#### **BENEFITS**

- Ideal for cutting ferrous metals
- Reduced cutting time
- Higher productivity
- Precise cuts and excellent finishing
- Excellent cost-benefit ratio for production cutting



MC5 (Five Multiple Chips)



#### **APPLICATIONS**

- Automotive aluminium casting blocks
- Cast iron
- Bronze
- Copper
- For machines with hydraulic feed control



Width x	Width x Thickness	
mm	inches	Pitch
34 x 1.10	1.1/4 x .042	2 - 3
41 x 1.30	1.1/2 x .050	1.4 - 2
41 X 1.50	1.1/2 X .050	2 - 3
54 x 1 60		1.4 - 2
54 X 1.00	2 x .063	2 - 3

All blades are Trapezoidal Tooth Set Furnished in welded bands and random length coils. Note: Special products on request.



# **^DV**^NZ™ TS

Starrett® Advanz™ TS

mmmm

#### **FEATURES**

- Carbide tipped teeth
- Triple chip tooth geometry
- Aggressive Rake angle

#### **BENEFITS**

- Ideal for cutting hard materials that bi-metal blades cannot cut
- Extreme resistance to wear when cutting difficult to machine steels
- Reduced cutting time-higher productivity
- Precise cuts and excellent finish

#### **APPLICATIONS**

- High-alloy metals
- Aerospace alloys
- Stainless steel
- Nickel alloys
- Hard and abrasive materials
- For machines with hydraulic feed control





Width x Thickness		Pitch	
mm	inches	riccii	
19 x 0.90	3/4 x .035	3 - 4	
19 X 0.90	3/4 X .033	3	
19 x 1.30	3/4 x .050	3	
27 x 0.90	1 035	3 - 4	
27 X 0.90	1 x .035	3	
34 x 1.10	1.1/4 x .042	2 - 3	
34 X 1.10		3 - 4	
34 x 1.30	1.1/4 x .050	2 - 3	
34 X 1.30	1.1/4 X .050	3	
		1.4 - 2	
		2 - 3	
41 x 1.30	1.1/2 x .050	3 - 4	
		1	
		1.3	

Width x Thickness		Pitch	
mm	inches	FICH	
41 x 1.30	1.1/2 x .050	3	
		1.4 - 2	
54 x 1.60	2 x .063	2 - 3	
34 X 1.00	2 X .003	1	
		1.3	
		.9 - 1.1	
67 x 1.60	2.5/8 x .063	1.4 - 2	
		2 - 3	
80 × 1 60	3.1/0 063	1.4 - 2	
80 x 1.60	3.1/8 x .063	2 - 3	
		1	

Furnished in welded bands, random length coils, 40 metre coils (54mm - 80mm width blades only) and 45 metre coils (19mm - 41mm width blades only).

Note: Special products on request.

# **NDVNNZ™ CS**

# Starrett® Advanz™ CS

#### **FEATURES**

- Carbide tipped teeth
- Triple chip tooth geometry
- Negative Rake angle

#### **BENEFITS**

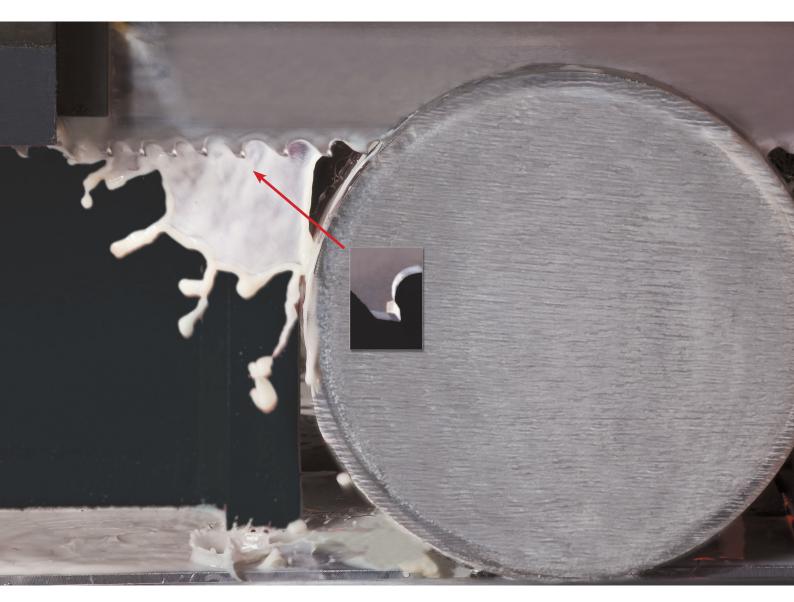
- Ideal for cutting hardened materials
- High resistance to abrasion
- Reduced cutting time-higher productivity
- Precise cuts and excellent finish

#### **APPLICATIONS**

- Case hardened steel
- Steel for shafts and linear guides
- Case hardened materials up to 60 HRC
- For machines with hydraulic feed control

Width x	Width x Thickness	
mm	inches	Pitch
27 x 0.90	1 x .035	3 - 4
34 x 1.10	1.1/4 x .042	3 - 4
44 4 30	1.1/2050	2 - 3
41 x 1.30	1.1/2 x .050 -	3 - 4

All blades are Trapezoidal Tooth Set
Furnished in welded bands, random length coils and 45 metre coils.
Note: Special products on request.







# **^DV**^NZ™ FS

**Starrett®** Advanz™ FS

#### **FEATURES**

- Carbide tipped teeth
- Triple chip tooth geometry
- Positive Rake angle

#### **BENEFITS**

- Ideal for cutting abrasive materials that bi-metal blades cannot cut
- Exceptional resistance to fatigue, abrasion and shocks
- Reduced cutting time Higher productivity
- Precise cuts and excellent finish

#### $\Lambda$ PPLICATIONS

- Abrasive non-ferrous metals
- Cast materials and risers
- Composite materials
- Fibreglass
- Graphite
- Abrasive hard woods
- Suitable for robust vertical machines and horizontal machines with hydraulic feed control



Width x Thickness	
inches	Pitch
3/4 x .035	3
1 v 02E	2 - 3
1 X .035	3
1 × 050	2 - 3
1 X .USU	3
1.1/4 x .042	3
1.1/4 x .050	3
1.1/2 x .050	2 - 3
	inches 3/4 x .035  1 x .035

All blades are Trapezoidal Tooth Set Furnished in welded bands, random length coils and 45 metre coils. Note: Special products on request.

# **NDVNNZ™ CG**

Starrett® Advanz™ CG

Starrett® Advanz™ CG

#### **FEATURES**

- With continuous or gulleted cutting edge
- Excellent blade life with high fatigue resistance

#### **BENEFITS**

- Ideal for cutting hard and or abrasive materials
- Excellent finish and cut accuracy
- Superior durability

Width x Thickness		Edua	
mm	inches	Edge	Grain
6 x 0.50	4.44 020	Gulleted	Medium Grain
6 X U.5U	1/4 x .020	Gulleted	Fine Grain
		Gulleted	Medium/Thick Grain
10 x 0.65	3/8 x .025	Gulleted	Medium Grain
		Continuous	Medium Grain
		Gulleted	Medium/Thick Grain
13 x 0.50	1/2 x .020	Gulleted	Medium Grain
		Continuous	Medium Grain
		Gulleted	Medium/Thick Grain
13 x 0.65	1/2 x .025	Gulleted	Medium Grain
		Continuous	Medium Grain
	Gulleted	Gulleted	Thick Grain
		Gulleted	Medium/Thick Grain
19 x 0.80	3/4 x .032	Gulleted	Medium Grain
		Continuous	Thick Grain
		Continuous	Medium Grain
		Gulleted	Thick Grain
25 x 0.90	1 x .035	Gulleted	Medium/Thick Grain
		Continuous	Medium Grain
25 x 1.10	1 x .042	Gulleted	Medium/Thick Grain
32 x 0.90	1.1/4 x .035	Gulleted	Thick Grain
J2 A 0.50	1.1/4 A .033	Continuous	Thick Grain
32 x 1.10	1.1/4 x .042	Gulleted	Medium/Thick Grain

Furnished in welded bands and 30 metre (100') coils.

Note: Special products on request.

#### **APPLICATIONS**

- Steel-belted tires
- Composite materials
- Reinforced plastics
- Composite Graphite
- Case-Hardened steels
- Fibreglass





# DIAMOND GRIT

# ^DV/NZ™ DG

Starrett® Advanz™ DG

#### **FEATURES**

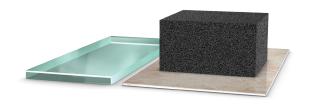
- Cutting edge coated with diamond grains
- Continuous cutting edge
- High strength body

#### **BENEFITS**

- Ideal for cutting abrasive materials that conventional blades cannot cut
- Precise cuts and excellent finish
- Exceptional durability and fatigue resistance

#### APPLICATIONS

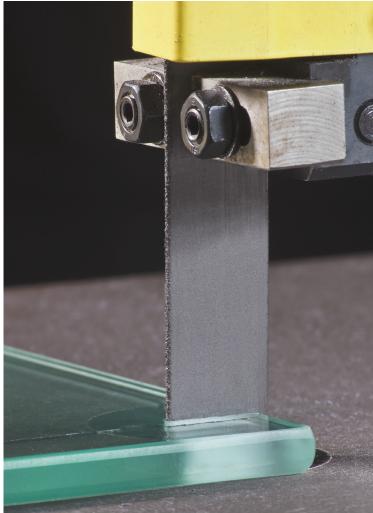
- Glass
- Glazed ceramic
- Silicon
- Graphite
- Fibreglass
- Stones
- Pyrex
- Ideal for machines with high cutting speed

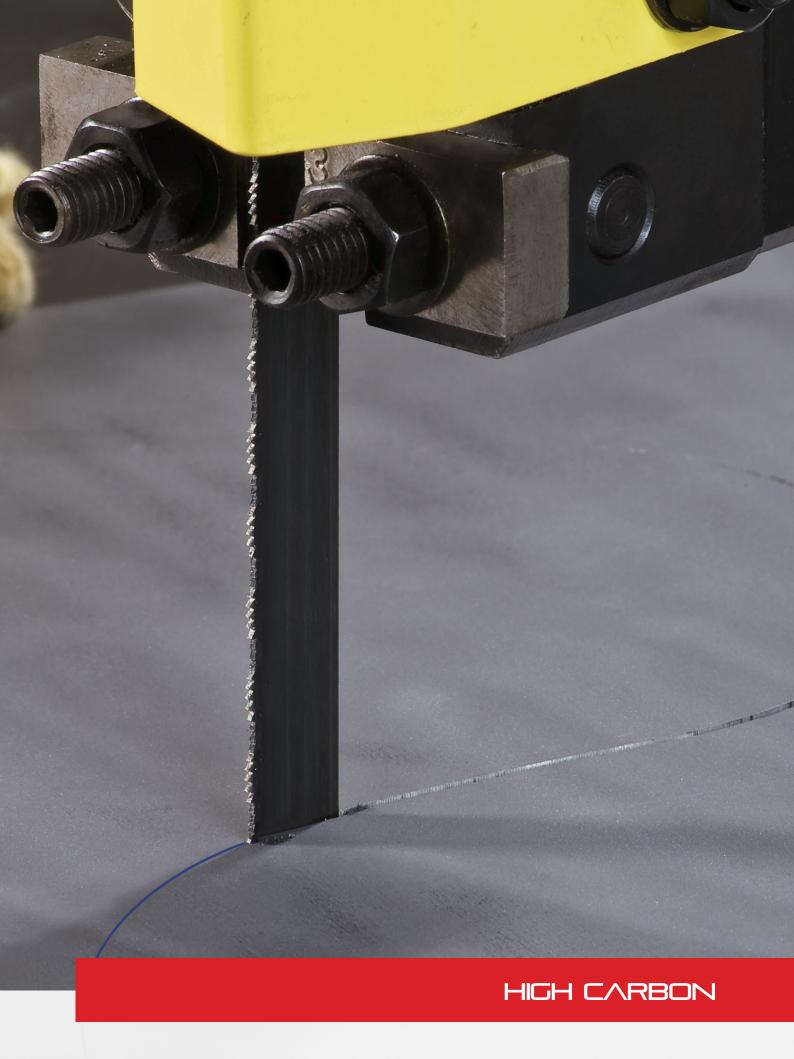


Width x Thickness		Edge	Grit
mm	inches	Euge	dit
13 x 0.50	1/2 x .020	Continuous	Medium 60/85

Furnished in welded bands and random length coils. Note: Other widths and gulleted blades available on request.







# HIGH CARBON

# **DURATEC™ SUPER FB**

**Starrett®** Duratec™ Super FB

#### **FEATURES**

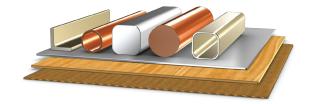
- Made from special high carbon steel
- Flexible back

#### **BENEFITS**

- Contour and straight cutting
- Economical cutting
- Can be welded with 'standard' welders

#### **APPLICATIONS**

- Easy-to-machine carbon steel
- Metalon
- Non-ferrous metals
- Celeron and plastics
- Plywood and MDF
- Cardboard
- Ideal for light vertical and horizontal machines
- For workshop and carpentry use.





# HIGH CARBON

Width x Thickness		P'r I	To a the Ci
mm	inches	Pitch	Tooth Shape
3 x 0.65	1/0 025	14	Regular
3 X U.65	1/8 x .025	18	Regular
5 x 0.35	3/16 x .014	8	Regular
		4	Skip
		10	Regular
5 x 0.65	3/16 x .025	14	Regular
		18	Regular
		24	Regular (Wavy Set)
6 x 0.35	1/4 x .014	14	Regular
		4	Skip
		4	Hook
		6	Skip
		6	Regular
		6	Hook
6 x 0.65	1/4 x .025	8	Regular
		10	Regular
		14	Regular (Wavy Set)
		18	Regular (Wavy Set)
		24	Regular (Wavy Set)
		32	Regular (Wavy Set)
		3	Regular
		3	Hook
		4	Skip
		4	Hook
		6	Skip
10 x 0.65	3/8 x .025	6	Regular
10 X 0.05	3/6 X .UZ3	6	Hook
		8	Regular
		10	Regular
		14	Regular (Wavy Set)
		18	Regular (Wavy Set)
		24	Regular (Wavy Set)
		3	Hook
		3	Skip
13 x 0.65	1/2 x .025	4	Skip
		4	Hook
		6	Skip

Width x Thickness		Pitch	Tooth Shape
mm	inches	PILCII	rooth Shape
		6	Regular
		6	Hook
		8	Regular
13 x 0.65	1/2 x .025	10	Regular
		14	Regular (Wavy Set)
		18	Regular (Wavy Set)
		24	Regular (Wavy Set)
		3	Skip
		4	Skip
		6	Skip
16 x 0.80	5/8 x .032	6	Regular
		8	Regular
		10	Regular
		14	Regular (Wavy Set)
	2/4 022	3	Skip
		3	Hook
		4	Skip
		4	Regular
19 x 0.80		4	Hook
19 X U.8U	3/4 x .032	6	Regular
		8	Regular
		10	Regular
		14	Regular (Wavy Set)
		18	Regular (Wavy Set)
		2	Hook
		3	Skip
		3	Hook
		4	Skip
25 x 0.90	1 x .035	4	Regular
		6	Regular
		8	Regular
		10	Regular

Raker Tooth Set Furnished in welded bands, random length coils, 30 metre and 75 metre coils. Note: Special products on request.





# HIGH CARBON

# DUR∧TEC™ FC

Starrett® Duratec™ FC

#### **FEATURES**

- Made of high-carbon steel with 1.5% silicon-content alloy
- Highly flexible backing material

#### **BENEFITS**

- Ideal for cutting materials that conventional blades cannot cut
- High resistance to wear and abrasion

#### **APPLICATIONS**

- Steel-belted radial tires
- Hardened sheets with thickness up to 16mm (5/8")
- For vertical machines at speeds over 2,000m/min.



Width x Thickness		Pitch	Tooth Chana	
mm	inches	Pitti	Tooth Shape	
25 0.00	1 x .035	8 Regu	Regular	
25 x 0.90	1 X .U35	10	Regular	

Furnished in welded bands and random length coils. Note: Special products on request.



## HIGH CARBON

## **BAND KNIVES**

## **FEATURES**

- Available with straight, scallop, wavy or "V" tooth cutting edges and a single or double edge bevel
- Made of high-carbon steel and stainless steel
- Blades extremely sharp

## **BENEFITS**

- Quick, smooth and precise cuts, with excellent finish
- No material waste.

## **APPLICATIONS**

- Foam
- Rubber and soft plastics
- Cardboard and paper







Straight Edge, Single Bevel



Straight Edge, Double Bevel



Scallop Edge, Double Bevel



Wavy Edge, Double Bevel



"V" Edge, Double Bevel – 10 TPI



"V" Edge, Double Bevel – 14 TPI



Width x 1	Thickness	- Edge & Bevel	
mm	inches	Euge & Bever	
6 x 0.50	1/4 x .020	Straight Edge, Single Bevel	
0 X U.5U	1/4 X .020	Straight Edge, Double Bevel	
		Straight Edge, Single Bevel	
10 x 0.55	3/8 x .022	Straight Edge, Double Bevel	
10 X 0.55	3/6 X .UZZ	Wavy Edge, Double Bevel	
		Scallop Edge, Double Bevel	
		Straight Edge, Single Bevel	
		Straight Edge, Double Bevel	
13 x 0.55	1/2 x .022	Wavy Edge, Double Bevel	
13 X 0.33	1/2 X .022	Scallop Edge, Double Bevel	
		"V" Edge, Double Bevel – 10 TPI	
		"V" Edge, Double Bevel – 14 TPI	
		Straight Edge, Single Bevel	
		Straight Edge, Double Bevel	
16 x 0.45	5/8 x .018	Wavy Edge, Double Bevel	
		Scallop Edge, Double Bevel	
		Scallop Edge, Double Bevel*	
		Straight Edge, Single Bevel	
16 x 0.55	5/8 x .022	Straight Edge, Double Bevel	
10 x 0.55	3/8 X .UZZ	Wavy Edge, Double Bevel	
		Scallop Edge, Double Bevel	
19 x 0.55	3/4 x .022	Straight Edge, Single Bevel	
19 X 0.55 3/4 X .022	Straight Edge, Double Bevel		

Width x Thickness		- Edge & Bevel	
mm	inches	Euge & Bever	
		Wavy Edge, Double Bevel	
19 x 0.55	3/4 x .022	Scallop Edge, Double Bevel	
19 X 0.55	3/4 X .UZZ	"V" Edge, Double Bevel – 10 TPI	
		"V" Edge, Double Bevel – 14 TPI	
		Straight Edge, Single Bevel	
19 x 0.70	3/4 x .028	Straight Edge, Double Bevel	
19 X 0.70	3/4 X .U20	Wavy Edge, Double Bevel	
		Scallop Edge, Double Bevel	
		Straight Edge, Single Bevel	
		Straight Edge, Double Bevel	
25 x 0.60	1 x .0236	Wavy Edge, Double Bevel	
		Scallop Edge, Double Bevel	
		"V" Edge, Double Bevel – 14 TPI	
		Straight Edge, Single Bevel	
25 x 0.90	1 x .035	Straight Edge, Double Bevel	
25 X 0.90		Wavy Edge, Double Bevel	
		Scallop Edge, Double Bevel	
38 x 1.10	1.1/2 x .045	Straight Edge, Double Bevel	

Furnished in welded bands and 30 metre (100') coils for 6mm - 25mm widths. Furnished in welded bands and random length coils for 1.1/2" width. Note: Special products on request.



## WOOD CUTTING

## WOODPECKER™ **PREMIUM**

## BI-METAL WOODPECKER™ PRO



#### **FEATURES**

- A selection of blades ideal for a variety of woodworking applications
- Includes blades as thin as 0.50mm (.020") for contour cutting fine hardwoods and thicker blades for tough tasks including pallet work
- Hardened spring tempered back and ground, precision set teeth with positive tooth angles
- Thin kerf available
- Longer life and faster cutting with less feed
- High production rates and increased yields
- Can be re-sharpened

Width x Thickness		Ditch	
mm	Inches	Pitch	
6 x 0.50	1/4 x .020	4	
6 X 0.50	1/4 X .020	6*	
		3	
10 x 0.55	3/8 x .022	4	
		6*	
		3	
13 x 0.55	1/2 x .022	4	
		6*	
16 x 0.55	5/8 x .022 —	3	
10 x 0.55	3/0 X .022	4	
19 x 0.70	3/4 x .028	3	
27 x 0.60	1 x .0236	3	
27 x 0.90	1 x .035 —	1.3	
27 X 0.50	1 X .033	2	
32 x 0.90	1.1/4 x .035	1.1	
32 X 0.30	1.1/ TX .033	1.3	
32 x 1.10	1.1/4 x .042	1.1	
32 X 1.10		1.3	
38 x 1.10	1.1/2 x .042	1.1	
50 x 1.10	2 x .042	1.1	
65 x 1.10	2.9/16 x .042	1.1	

Tooth shape: Hook

\* = Skip Tooth, Straight (Zero) Rake All blades are Raker Tooth Set

Furnished in welded bands, random length coils and 30 metre (100') coils.

#### **FEATURES**

- Manufactured from high speed steel M42 containing 8% cobalt
- Specifically designed for all types of hard wood
- Electron beam welded bi-metal construction
- Rockwell tooth hardness C67-69 ensures longer blade life

Width x Thickness		Pitch	
mm	Inches	FILCH	
6 x 0.65	1/4 x .025	6*	
10 x 0.65	3/8 x .025	4	
13 x 0.65	1/2 x .025	3	
19 x 0.90	3/4 x .035	3	
27 x 0.90	1 x .035	2	
34 x 0.90	1.1/4 x .035	1.1	
34 X 0.90	1.1/4 X .U35	1.3	
		5-8**	
34 x 1.10	1.1/4 x .042	1.3	
		1.1	
41 x 1.30	1.1/2 x .050	1.1	
54 x 1.30	2 x .050	1.1	

Tooth shape: Hook

\* = Positive Rake, High Profile Teeth

\*\* = Straight (Zero) Rake

All blades are Raker Tooth Set

Furnished in welded bands, random length coils and 30 metre (100') coils.



## FOOD PROCESSING

## MEATKUTTER™ PREMIUM

## MEATKUTTER™ STAINLESS



- Polished high carbon steel
- Hardened, ground teeth
- Hardened back

### **FEATURES**

- Clean and sanitary operation
- Fast, smooth and clean cuts, with less waste
- Accurate cuts with less effort
- Laser-etched blade identification guarantees product quality and satisfaction

#### MEAT TYPES

- Fresh meat
- Frozen meat
- Poultry
- Fish

### **APPLICATIONS**

 Suitable for butcheries, food industry, slaughterhouses, supermarkets

Width x Thickness		Pitch	
mm	Inches	PICH	
		3	
13 x 0.55	1/2 x .022	4	
		6*	
16 x 0.45	5/8 x .018	4	
16 X U.45	5/8 X .018	6*	
16 x 0.55	5/8 x .022	3	
16 X U.55	5/8 X .UZZ	4	
10 × 0 FF	2/4 × 022	3	
19 x .0.55 3/4 x .022		4	

#### Hook

\* = Skip

Furnished in welded bands and random length coils.

#### **SPECIFICATIONS**

- Stainless steel AISI 420
- Ground teeth

### **FEATURES**

- Rust-proof
- Fast, smooth and clean cuts, with less waste
- Laser-etched blade identification guarantees product quality and satisfaction

### MEAT TYPES

- Bone-in or boneless, thawed or frozen
- Poultry
- Fish

### **APPLICATIONS**

 Suitable for butcheries, food industry, slaughterhouses, supermarkets

Width x Thickness		Pitch
mm	Inches	Pitten
16 x 0.45	5/8 x .018 —	4
10 X U.45	5/6 X .016	6*

Hook

\* = Skip

Furnished in welded bands and random length coils...



## FOOD PROCESSING

## MEATKUTTER™ FROZEN

## MEATKUTTER™ FROZEN BI-METAL

### **SPECIFICATIONS**

- Polished high carbon steel
- Hardened, ground teeth

#### **FEATURES**

- Minimal meat residue guaranteeing clean and sanitary operation
- Fast, smooth and clean cuts, with less food loss in comparison to conventional blades
- Excellent cutting precision

#### MEAT TYPES

• Fish & frozen meat up to -4°F (-20° C)

## **APPLICATIONS**

Meat packing industries

Width x Thickness		Pitch
mm	Inches	FILCII
16 x 0.35	5/8 x .014	3
16 x 0.50	5/8 x .020	3
16 X 0.50	5/6 X .U2U	4
19 x 0.55	3/4 x .022	3
27 x 0.60	1 x .0236	3
34 x 0.80	1-1/4 x .032	2
50 x 0.90	2 x .035	1.3

Tooth shape: Hook. Furnished in welded bands and random length coils.

#### **SPECIFICATIONS**

- Bi-metal high-speed steel band saw blade
- Hardened teeth and back

#### **FEATURES**

- Greater durability compared to conventional blades
- Fast, clean, accurate cuts with less waste

## MEAT TYPES

• Large frozen fish up to -76°F (-60° C)

#### **APPLICATIONS**

Suitable for meat packing, portioning and seafood processing

Width x Thickness		Pitch	
mm	Inches	Pitti	
34 x 0.90	1-1/4 x .035	3	

Tooth shape: Hook

Furnished in welded bands and random length coils

## CARCASSKUTTER™ PREMIUM



## **SPECIFICATIONS**

- Polished high carbon steel
- Hardened, ground teeth & hardened back

Width x Thickness		Pitch	
mm	Inches	FICH	
19 x 0.55	3/4 x .022	3	
19 X U.55	3/4 X .UZZ	4	

Hook. Furnished in welded bands, random length coils and 30 metre (100') coils...

#### **FEATURES**

- Fast, smooth and clean cuts with less waste
- Accurate cuts with less effort
- Laser-etched blade identification guarantees product quality and satisfaction

#### CARCASS TYPES

• Animal carcass cuts - Cattle, Pigs & Goats

## **APPLICATIONS**

- Suitable for frozen meat and slaughter houses
- Cold storage facilities
- Meat packing and processing plants





## BI-METAL HSS - BS

HIGH SPEED STEEL CUTTING EDGE

### **FEATURES**

- Available in metric and inch lines
- Hardened and tempered high-speed steel teeth
- Tough alloy steel back resistant to shocks and breakages.

#### **BENEFITS**

• Alloy back resists breakage under the most adverse conditions

### **APPLICATIONS**

- Ideal for all general steel cutting
- Works well in a wide variety of applications, including interrupted cuts



CUTTING CHART FOR POWER HACKSAW BLADES - BS AND RS					
	Material Thickness				
Cross Section to be cut	Up to 20mm (3/4")		From 40mm to 90mm (From 1.1/2" to 3.1/2")	Above 90mm (Above 3.1/2")	Bow Speeds in Strokes per minute **
		Pito	:h*		
Low-Carbon Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	70 - 90
Medium Carbon Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	60 - 80
High Carbon Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	55 - 70
Carbon Low Alloy Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	65 - 80
Carbon High Alloy Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	45 - 60
Easy to machine Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	80 - 100
Tool Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	55 -70
Low-Alloy High Speed Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	50 - 60
High-Alloy High Speed Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	45 - 55
Cast Iron Class 20	14 - 10	10 - 6	6 - 4	4 - 2.1/2	70 - 80
Cast Iron Class 40	14 - 10	10 - 6	6 - 4	4 - 2.1/2	65 - 75
Cast Iron Class 60	14 - 10	10 - 6	6 - 4	4 - 2.1/2	40 -55
Malleable Cast Iron	14 - 10	10 - 6	6 - 4	4 - 2.1/2	65 - 75
Austenitic Cast Iron	14 - 10	10 - 6	6 - 4	4 - 2.1/2	40 - 55
Inconel and Monel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	40 - 55
Stainless Steels	14 - 10	10 - 6	6 - 4	4 - 2.1/2	50 - 60
Copper	14 - 10	10 - 6	6 - 4	4 - 2.1/2	95 - 140
Bronze	14 - 10	10 - 6	6 - 4	4 - 2.1/2	85 - 105
Brass	14 - 10	10 - 6	6 - 4	4 - 2.1/2	90 - 110
Aluminium	14 - 10	10 - 6	6 - 4	4 - 2.1/2	100 - 140



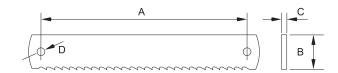
<sup>\*</sup>The blade should be tensioned correctly .

\*Since you have two options for each thickness range, use a finer pitch (more teeth per inch) for thinner sections and coarser pitches (fewer teeth per inch) for thick sections.

\*\* For materials with a width greater than 76mm (3"), reduce the cutting rate by at least 20%.

## BI-METAL HSS - BS

HIGH SPEED STEEL CUTTING EDGE



METRIC LINE					
Dimensions in mm (A x B x C x D)	Teeth per inch (25.4mm)	Pack Qty	Cat. No.		
350 x 34 x 2.00 x 8.50	6	5	BS350-6		
330 X 34 X 2.00 X 6.30	10	5	BS350-10		
	4	5	BS400-4		
400 x 34 x 2.00 x 8.50	6	5	BS400-6		
	10	5	BS400-10		
	4	5	BS450-4		
450 x 41 x 2.00 x 8.50	6	5	BS450-6		
	10	5	BS450-10		
500 x 54 x 2.50 x 10.50	6	5	BS500-6		
550 x 54 x 2.50 x 10.50	6	1	BS550-6		
F7F F4 2 F0 10 F0	4	1	BS575-4		
575 x 54 x 2.50 x 10.50	6	1	BS575-6		
600 x 54 x 2.50 x 10.50	4	1	BS600-4		
000 X 54 X Z.50 X 10.50	6	1	BS600-6		
650 x 54 x 2.50 x 10.50	6	1	BS650-6		

Blades from 300mm (12") to 500mm (20") length packaged and sold 5 blades per plastic tube. Blades from 525mm (21") or wider, packaged and sold 1 blade per envelope.

INCH LINE					
Length x Width x Thickness x Diameter		Teeth	Pack	C . N	
inch (A x B x C x D)	mm (A x B x C x D)	per inch (25.4mm)	Qty	Cat. No.	
12 x 5/8 x .032 x .200	300 x 16 x 0.80 x 5	18	5	BS1218-3	
12 x 1.1/8 x .050 x .334	300 x 28 x 1.25 x 8.50	10	5	BS1210-5	
12 X 1.1/6 X .050 X .554	300 X 26 X 1.23 X 6.30	14	5	BS1214-5	
14 x 1 1/8 x 050 x 334	350 x 28 x 1 25 x 8 50	10	5	BS1410-5	
14 X 1.1/6 X .050 X .554	330 X 26 X 1.23 X 6.30	14	5	BS1414-5	
14 x 1 3/8 x 062 x 334	350 x 34 x 1 60 x 8 50	6	5	BS1406-6	
14 X 1.3/8 X .062 X .334	350 X 34 X 1.60 X 8.50	10	5	BS1410-6	
14 x 1.5/8 x .075 x .413	350 x 41 x 2.00 x 10.50	6	5	BS1406-7	
16 x 1.3/8 x .062 x .334	400 x 34 x 1.60 x 8.50	6	5	BS1606-6	
10 X 1.3/8 X .002 X .334	400 X 34 X 1.00 X 8.50	10	5	BS1610-6	
16 x 1 5/8 x 075 x 413	400 x 41 x 2 00 x 10 50	6	5	BS1606-7	
10 X 1.5/8 X .U/5 X .413	400 X 41 X 2.00 X 10.50	10	5	BS1610-7	
18 x 1 3/8 x 062 x 413	450 x 34 x 1 60 x 10 50	6	5	BS1806-6	
10 X 1.3/0 X .002 X .413	450 X 54 X 1.00 X 10.50	10	5	BS1810-6	
	450 x 41 x 2.00 x 10.50	4	5	BS1804-7	
18 x 1.5/8 x .075 x .413		6	5	BS1806-7	
		10	5	BS1810-7	

## HIGH SPEED STEEL - RS

### **FEATURES**

- Available in metric and inch lines
- Made of molybdenum high-speed steel for long wear life
- Fully hardened

## **APPLICATIONS**

Ideal for cutting a wide range of materials

#### **BENEFITS**

- Long wear life and top performance.
- Withstands heavier feed pressures providing faster cutting



	CUTTING CI	HART FOR POWER HAC	KSAW BLADES - BS AND	RS	
		Material <sup>-</sup>	Thickness		
Cross Section to be cut	Up to 20mm (3/4")		From 40mm to 90mm (From 1.1/2" to 3.1/2")	Above 90mm (Above 3.1/2")	Bow Speeds in Strokes per minute **
		Pito	:h*		
Low-Carbon Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	70 - 90
Medium Carbon Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	60 - 80
High Carbon Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	55 - 70
Carbon Low Alloy Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	65 - 80
Carbon High Alloy Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	45 - 60
Easy to machine Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	80 - 100
Tool Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	55 -70
Low-Alloy High Speed Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	50 - 60
High-Alloy High Speed Steel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	45 - 55
Cast Iron Class 20	14 - 10	10 - 6	6 - 4	4 - 2.1/2	70 - 80
Cast Iron Class 40	14 - 10	10 - 6	6 - 4	4 - 2.1/2	65 - 75
Cast Iron Class 60	14 - 10	10 - 6	6 - 4	4 - 2.1/2	40 -55
Malleable Cast Iron	14 - 10	10 - 6	6 - 4	4 - 2.1/2	65 - 75
Austenitic Cast Iron	14 - 10	10 - 6	6 - 4	4 - 2.1/2	40 - 55
Inconel and Monel	14 - 10	10 - 6	6 - 4	4 - 2.1/2	40 - 55
Stainless Steels	14 - 10	10 - 6	6 - 4	4 - 2.1/2	50 - 60
Copper	14 - 10	10 - 6	6 - 4	4 - 2.1/2	95 - 140
Bronze	14 - 10	10 - 6	6 - 4	4 - 2.1/2	85 - 105
Brass	14 - 10	10 - 6	6 - 4	4 - 2.1/2	90 - 110
Aluminium	14 - 10	10 - 6	6 - 4	4 - 2.1/2	100 - 140

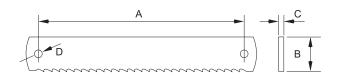


<sup>\*</sup>The blade should be tensioned correctly .

\*There are two options for each thickness range, use a finer pitch (more teeth per inch) for thinner sections and coarser pitches (fewer teeth per inch) for thick sections.

\*\* For materials with width higher than 3", decrease at least 20% of cutting rates.

## HIGH SPEED STEEL - RS



	METRIC LINE		
Dimensions in mm (A x B x C x D)	Teeth per inch (25.4mm)	Pack Qty	Cat. No.
300 x 32 x 2.00 x 8.50	6	5	RS300-6
300 X 32 X 2.00 X 6.30	10	5	RS300-10
350 x 32 x 2.00 x 8.50	6	5	RS350-6
330 X 32 X 2.00 X 6.30	10	5	RS350-10
	4	5	RS400-4
400 x 32 x 2.00 x 8.50	6	5	RS400-6
	10	5	RS400-10
	4	5	RS450-4
450 x 38 x 2.00 x 8.50	6	5	RS450-6
	10	5	RS450-10
	4	5	RS500-4
500 x 45 x 2.00 x 10.50	6	5	RS500-6
	10	5	RS500-10
	4	1	RS550-4
550 x 45 x 2.00 x 10.50	6	1	RS550-6
	10	1	RS550-10
	4	1	RS575-4
575 x 50 x 2.50 x 10.50	6	1	RS575-6
500 50 050 4050	4	1	RS600-4
600 x 50 x 2.50 x 10.50	6	1	RS600-6
	4	1	RS650-4
650 x 54 x 2.50 x 10.50	6	1	RS650-6
700 54 250 4650	4	1	RS700-4
700 x 54 x 2.50 x 10.50	6	1	RS700-6
050 60 000 45 55	4	1	RS850-4
850 x 60 x 3.00 x 12.50	6	1	RS850-6
1000 x 125 x 3.50 x 12.50	2.1/2	1	RS1000-2.1/2

Blades from 300mm (12") to 500mm (20") length packaged and sold 5 blades per plastic tube. Blades from 525mm (21") or wider, packaged and sold 1 blade per envelope.

	INCH LINE			
Length x Width x Th	nickness x Diameter	Teeth	Pack	
inch (A x B x C x D)	mm (A x B x C x D)	per inch (25.4mm)	Qty	Cat. No.
12 x 1 x .050 x .334	300 x 25 x 1.25 x 8.50	10	5	RS1210-5
12 X 1 X .030 X .334	300 X 23 X 1.23 X 6.30	14	5	RS1214-5
14 x 1 x .050 x .334	350 x 25 x 1.25 x 8.50	10	5	RS1410-5
14 X 1 X .030 X .334	350 X Z5 X 1.Z5 X 6.50	14	5	RS1414-5
		6	5	RS1406-6
14 x 1.1/4 x .062 x .334	350 x 32 x 1.60 x 8.50	10	5	RS1410-6
		14	5	RS1414-6
16 x 1.1/4 x .062 x .334	400 x 32 x 1.60 x 8.50	6	5	RS1606-6
10 X 1.1/4 X .002 X .554	400 X 32 X 1.00 X 6.30	10	5	RS1610-6
16 x 1.1/2 x .075 x .334	400 x 38 x 2.00 x 8.50	4	5	RS1604-7
10 X 1.1/2 X .0/5 X .554	400 X 36 X 2.00 X 6.30	6	5	RS1606-7
17 x 1.1/4 x .062 x .334	425 x 32 x 1.60 x 8.50	6	5	RS1706-6
17 X 1.1/4 X .002 X .554		10	5	RS1710-6
18 x 1.1/4 x .062 x .413	450 x 32 x 1.60 x 10.50	6	5	RS1806-6
10 X 1.1/4 X .002 X .413	430 X 32 X 1.00 X 10.30	10	5	RS1810-6
		4	5	RS1804-7
18 x 1.1/2 x .075 x .413	450 x 38 x 2.00 x 10.50	6	5	RS1806-7
		10	5	RS1810-7
20 x 1.1/2 x .075 x .413	500 x 38 x 2.00 x 10.50	6	5	RS2006-7
20 x 1.1/2 x .0/3 x .413	300 X 38 X 2.00 X 10.30	10	5	RS2010-7
20 x 1.3/4 x .088 x .413	500 x 45 x 2.25 x 10.50	4	5	RS2004-8
21 x 1.1/2 x .075 x .413	525 x 38 x 2.00 x 10.50	10	1	RS2110-7
21 x 1.3/4 x .088 x .413	525 x 45 x 2.25 x 10.50	4	1	RS2104-8
Z 1 A 1.3/4 A .000 A .413	J2J X 4J X 2.2J X 10.30	6	1	RS2106-8
24 x 1.3/4 x .088 x .492	600 x 45 x 2.25 x 12.50	4	1	RS2404-8
∠+ ∧ 1. <i>31</i> 4 ∧ .U00 ⊼ .492	000 x 45 x 2.25 x 12.30	6	1	RS2406-8
24 x 2 x .100 x .492	600 x 50 x 2.50 x 12.50	4	1	RS2404-0
24 X Z X . 100 X .49Z	000 X 30 X 2.30 X 12.50	6	1	RS2406-0
26 x 2 x .100 x .492	650 x 50 x 2.50 x 12.50	4	1	RS2604-0
30 x 2.1/2 x .100 x .492	650 x 63 x 2.50 x 12.50	4	1	RS3004-0



## BAND SAW MACHINES

						Capacities (r	nm)				
	Band Saw Machines		0°			45° Positiv	re		60° Positiv	ve	75° Positive
		Round	Square	Rectangular	Round	Square	Rectangular	Round	Square	Rectangular	Round
STOCK	S1101-F1	100	-	100 x 150	60	-	60 x 100	-		-	
STOCK	S3120	170	170 x 170	95 x 210	120	100 x 100	110 x 110	70	60 x 60	60 x 60	
	S3220	170	170 x 170	95 x 210	-		-	-		-	
	S3420NG	230	230 x 230	150 x 300	180	130 x 130	125 x 170	100	90 x 90	90 x 90	
STOCK	S3720NG	250	250 x 250	250 x 320	230	145 x 145	145 x 240	110	80 x 80	80 x 130	
	S4220	230	230 x 230	230 x 270	180	130 x 130	130 x 180	90	90 x 90	90 x 90	
STOCK	S4230	300	270 x 270	250 x 350	235	220 x 220	200 x 225	140	115 x 115	115 x 130	
ÍN STØCK	S4240	300	300 x 300	220 x 450	300	240 x 240	170 x 240	170	170 x 170	170 x 170	80
. –	S6330	300	300 x 300	-	-		-	-		-	

Non stocked Band Saw Machines are available on request.



## BAND SAW MACHINES

	Capacities (mm) 45° Negative		Vise fixing System Power		Feed	Cutting Speed	Blade dimensions
Round	Square	Rectangular				(m/min.)	(mm)
-		-				54	13 x 1470
-		-				35 and 70	19 x 2110
-		-	manual	gravity		35 and 70	19 x 2110
-		-				40 and 80	27 x 2535
-		-			manual	45 and 90	27 x 2710
160	130 x 130	115 x 200				20 to 85	27 x 2535
220	150 x 150	115 x 220	hudroulia	budroulia		20 to 85	27 x 3140
270	160 x 160	160 x 210	hydraulic	hydraulic		20 to 85	27 x 3490
-		-			automatic	20 to 100	34 x 3920

















**Manufacturing Quality Tools Since 1880** 

## TECHNICAL ASSISTANCE



### TECHNICAL SUPPORT

- Troubleshooting, technical information or questions.
- Visit schedule, suggestions, quotes etc

### TRAINING

New and modern Starrett Demo Zone

- Equipped with the state-of-the-art equipment for practical and theoretical training in saws and machines.
- Courses and conferences for companies

### ON-SITE TECHNICAL SUPPORT

- Free of charge, a team of specialised technicians provides assistance and advice around the UK.
- When visiting a customer plant, our technicians can perform a complete analysis checking saw performance and proper installation and machine adjustments, ensuring better blade performance and minimum cost on cutting operations.

## CONTACT TECHNICAL SUPPORT

The Starrett Saw Support Team Tel.: 00 44 (0)1835 866205 Email: sawsupport@starrett.co.uk

## **RECOMMENDATIONS**

# USING THE RIGHT BREAK-IN PROCEDURES FOR A NEW BLADE ASSURES LONGER BLADE LIFE

All new saws should be broken-in. This procedure ensures longer blade life, faster cuts and consistent performance.

**Attention!** Conversely, blade life can be significantly compromised if the proper break-in procedures are not followed.







Tooth correctly broken in



Tooth incorrectly broken in

## HOW TO USE THE RIGHT BREAK-IN AND ENSURE LONGER BLADE LIFE

The teeth of a new band saw blade are razor sharp. To withstand the cutting pressure of band sawing, the tip of each tooth should be honed to create an extremely small radius on its tip.

## Easy-to-cut materials (with cutting rate over 38 cm<sup>2</sup>) e.g. carbon steel

- Adjust the recommended cutting rate for the material to be cut
- Adjust the feed pressure to about one-half the normal cutting rate for the first 30 minutes
- Gradually Increase to the normal cutting rate
- Ensure there is chip removal
- Avoid vibration

Start to cut material at reduced cutting rate

# Hard-to-cut materials (with cutting rate below 38 cm²) e.g. nickel-based alloys like inconel, hardened steels, tool steels and stainless steels

- Adjust the recommended cutting rate for the material to be cut
- Adjust the feed pressure to about 30% the normal cutting rate for the first 20-30 minutes
- Gradually Increase to the normal cutting rate
- Ensure there is chip removal
- Avoid vibration



After break-in when the blade has fully entered the work-piece, increase the feed rate over a series of cuts until the recommended cutting rate is achieved

## **RECOMMENDATIONS**

## BAND SAW BLADE INSTALLATION GUIDELINES

Always follow the machine manufacturer's instruction and recommendations for blade changes and the safe operation for the band saw machine. The general information contained in the guidelines is intended to assist in the proper installation of band saw blades, however Starrett® nor its employees shall not be held responsible for the accuracy or completeness of these guidelines.

Proper blade installation achieves more efficient blade performance.

Wear gloves when handling a band saw blade



Use eye protection, safety shoes, and hearing protection







## FOLLOW THESE INSTRUCTIONS CAREFULLY

- Follow all the safety instructions shown in the band saw machine operator's manual and on the machine labels. Recognize and read safety and warning signs such as Danger, Warning and Caution
- Follow the saw blade installation instructions on the specific make and model of the band saw machine requiring a blade change

## BASIC BLADE CHANGE GUIDELINES

- Remove any chips from saw guides and band wheels
- Position chip brush away from saw
- Relieve saw blade tension and remove blade

- Select appropriate blade for cutting application
- Unfold blade properly. Do not throw. Throwing the blade will result in tooth damage that will reduce saw blade performance
- Install blade with saw teeth pointing in proper direction



- Apply appropriate tension to the blade
- Be aware of pinch points and keep hands and clothing clear of rotating blade



- Adjust guide arms to appropriate positions to workpiece
- Adjust blade guides for proper blade support
- Adjust chip brush to fully engage saw blade teeth to ensure proper chip removal







- Check hydraulic fluid levels when applicable
- Ensure appropriate cutting fluid placement and mix ratios as applicable per machine, cutting fluid, and blade manufacturer's recommendations



## CUTTING TABLE / BI-METAL

	Work piece dimension (mm) 50-	-125mm	50-12	25mm
Work Material Type	Speed/Cutting Rate	Blade Speed Cutti		
	ABNT/AISI/SAE	Hardness	m/min.	cm²/miı
	1005-1012	150HB	79 - 91	77 - 10
Carbon Steels	1015-1026	150HB	76 - 88	71 - 97
	1030-1055, A36	175HB	55 - 67	52 - 58
	1060-1095	200HB	49 - 61	39 - 52
	1110-1117-1118	150HB	79 - 98	77 - 10
Easy-to-machine carbon Steels	1137-1151	175HB	67 - 79	52 - 77
	1211-1215	150HB	79 - 98	97 - 12
	1330-1345	200HB	55 - 67	39 - 52
	1513-1527	150HB	79 - 91	77 - 10
Manganese steels	1536-1552	175HB	61 - 79	52 - 65
	1561-1572	200HB	49 - 61	39 - 52
	4012-4024	175HB	61 - 73	45 - 58
Molybdenum steels	4030-4042	175HB	58 - 70	45 - 52
	4047-4068	175HB	55 - 67	39 - 52
Chrome Moly Steels	4130-4140	200HB	55 - 67	39 - 52
	4142-4161	200HB	52 - 64	32 - 4!
	4320	175HB	61 - 73	45 - 58
	4340	200HB	55 - 67	39 - 52
	8115, 8615-8622, 8145, 8625-8637	175HB	61 - 73	45 - 58
Nickel Chrome Moly Steels	8640-8660, 8740	200HB	55 - 67	39 - 52
	8720, 8822	200HB	61 - 73	45 - 58
	9310	175HB	49 - 58	19 - 26
	9430-9445	200HB	55 - 67	39 - 52
Nickel Moly Steels	4625-4626, 4815-4820	175HB	61 - 73	45 - 58
	5040-5060	200HB	55 - 67	39 - 52
	5115-5120	175HB	61 - 73	45 - 58
Chrome Steels	5130-5160	200HB	55 - 67	39 - 52
	50100, 51100, 52100	225HB	40 - 49	26 - 32
	6118	175HB	61 - 73	45 - 58
Chrome Vanadium Steel	6150	200HB	55 - 67	39 - 52
Silicon steels	9255-9262	200HB	55 - 67	39 - 52
	A2-A6, A8-A10	200HB	55 - 67	19 - 26
Tool steels - Cold work	D2-D7, A7	250HB	20 - 30	13 - 19
	01, 02, 06, 07	200HB	55 - 67	26 - 39
	H10-H19, H21-H42, P20	200HB	40 - 49	19 - 20
Tool steels - Hot work	L2, L6	200HB	52 - 64	19 - 2
	S1-S7	200HB	40 - 49	19 - 20
Carbon tool steels	W1-W5	200HB	55 - 67	26 - 39
Ferritic stainless steels	405, 409, 430, 434, 436, 442, 446	175HB	24 - 30	19 - 26





## CUTTING TABLE / BI-METAL

	CUTTING TABLE FOR BI-METAL BAND SAW B	LADES		
	Work piece dimension (mm) 50-	125mm	50-12	5mm
Work Material Type	Speed/Cutting Rate	Speed/Cutting Rate		
	ABNT/AISI/SAE	Hardness	m/min.	cm²/min.
	M1, M2, M7, M10	225HB	34 - 40	19 - 26
High speed steels	M3, M4, M30-M47	225HB	20 - 30	13 - 19
	T1, T2, T6	250HB	34 - 40	19 - 26
	T15	250HB	18 - 27	13 - 19
	T4, T5	250HB	27 - 37	13 - 19
A	201, 202, 301-305, 308, 321, 347	150HB	30 - 37	19 - 26
Austenitic stainless steels	A286, 309, 310, 314, 316, 317, 330	175HB	21 - 24	10 - 13
5	330	150HB	30 - 43	26 - 32
Easy-to-machine Stainless Steels	416, 420F, 430F	150HB	43 - 55	32 - 39
Maytanaitia atainlass ataola	403, 410, 420, 422, 501, 502	175HB	30 - 40	19 - 26
Martensitic stainless steels	440A-C, 414, 431	225HB	27 - 30	19 - 26
Hardened Stainless Steel	15-5PH, 17-4PH, 17-7PH	200HB	21 - 27	13 - 19
	Class 20	125HB	49 - 61	71 - 97
Cast iron	Class 40	200HB	37 - 49	52 - 77
	Malleable 60-40-18	150HB	61 - 76	52 - 65
	Malleable 80-55-06	225HB	37 - 49	32 - 45
	Hastelloy, Rene 41	250HB	15 - 21	6 - 6
	Inconel 600, 601	250HB	18 - 24	13 - 19
Nickel alloys	Inconel 625, 718, Waspaloy	250HB	18 - 24	6 - 6
Nickel alloys	Monel 400, 401	250HB	21 - 27	13 - 19
	Monel K500	250HB	18 - 24	6 - 13
	Alpha, Alpha-Beta, Beta	325HB	14 - 18	6 - 6
Titanium alloys	Titanium 99%	150HB	21 - 27	6 - 13
	Columbium	-	18 - 24	6 - 6
Refractory metals	Molybdenum	-	24 - 30	6 - 6
•	Tantalum	-	15 - 18	6 - 6
	Tempered Aluminium Bronze	30HRC	24 - 30	10 - 14
	Tempered Beryllium Copper	38HRC	12 - 17	3 - 6
	Aluminium Bronze	70HRB	50 - 58	39 - 52
	Phosphor Bronze	70HRB	46 - 58	52 - 65
Copper alloys	Copper 99%	50HRB	43 - 55	45 - 58
	Copper Belirio	70HRB	52 - 58	26 - 39
	Yellow/Red Brass	70HRB	61 - 79	52 - 65
	Easy machining brass	70HRB	67 - 76	65 - 77
	1200	30HB		
	2024	120HB		
Aluminium Alloys	5052	50HB	120 - 135	77 - 110
Addition Alloys	6061	110HB	120 133	,, 110
	7075	160HB		

## CUT-OFF CALCULATION

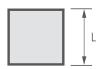
The calculations set out below are intended as guidance for band saw machine operators. There are a number of different opinions that exist as to the correct calculations for different material types, and this guidance does not attempt to disprove other opinions. The guidance is offered as a reference rather than as strict technical instructions.

### CUTTING CALCULATION:

Use all the measures in centimetres to get the area in  ${\bf cm^2}$ .

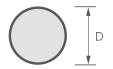
### **SQUARE**

 $area = L^2$ 



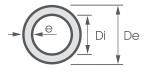
#### **ROUND**

area =  $D^2 \times 0.7854$ 



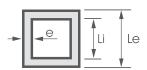
#### **ROUND TUBE**

area =  $(De^2 - Di^2) \times 0.7854$ 



#### **SQUARE TUBE**

 $area = Le^2 - Li^2$ 



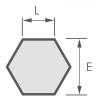
### **RECTANGLE**

 $area = E \times L$ 



#### **HEXAGON**

area =  $L^2 \times 2.598$  $E^2 \times 0.866$ 



## EXAMPLE OF CUTTING CALCULATION

Material: Austenitic stainless steel (SAE 316)

Format: Round

**Dimension:** 101.6mm (4") **Speed:** 21 to 24 m/min.\*

**Cutting Rate:** 10 to 13cm<sup>2</sup> min\* \*according to the chart on page 55

 $\textbf{CT} = \frac{\textbf{A}}{\textbf{CR}} \quad \textbf{A} = \text{Material Area}$  CR = Cutting Rate

**Cutting Time** =  $81.07 \text{cm}^2 \div 13 \text{cm}^2/\text{min}$ .

**Cutting Time** = 6:14 minutes **Band saw machine used**: S6330 (page 49)

**Blade to be used:** Primalloy™ (page 18) **Tooth:** Variable Pitch 3-4/P (page 14) **Catalogue No.:** 3920 x 34 x3-4 Primalloy

## CUTTING OF OTHER DIMENSIONS

Multiply the speed indicated in the tables - pages 54 and 55 by the following factors.

Dimension / mm	Factor
< 13	1.20
13 - 25	1.10
25 - 50	1.07
50 - 125	1
125 - 250	0.92
250 - 600	0.85
> 600	0.75

## HARDENED MATERIAL CUTTING

If the material to be cut has hardness above that specified in the tables (pages 54 and 55), multiply the speed and the cutting rate (decreasing speed and increasing cutting time) by the factors below.

Difference between	Factors			
expected and found hardness	Blade Speed	Cutting Rate		
Up to 40%	0.75	0.75		
From 40% to 75%	0.60	0.54		
From 75% to 100% (max. 40HRC)	0.50	0.40		

## TUBE OR STRUCTURAL MATERIAL CUTTING

Do the same, calculating the material area, choosing the tooth (page 14), speed and cutting rate (pages 54 and 55), however correct the cutting time, by multiplying the time calculated by the correction factor, according to the table below.

Cutting Time Correction Factor	Thickness (e) mm
2.5	2 to 5
2	6 to 10
1.7	12 to 15
1.4	20 to 25
1.2	30 to 60

Note: when dry cutting, adjust the feed pressure to about 40%-50% of the normal cutting rate (use data on pages 54 and 55). Note: dry cutting reduces the blade life

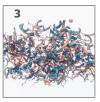
For Duratec™ Super FB Carbon Steel Blades: adjust the feed pressure to 50% of the normal cutting pressure and the Cutting Rate to 85%.

### CHIP ANALYSIS

- Thick and heavy chips with normal material colour indicate high cutting feed
- 2. Thick and blue chips indicate high speed and cutting feed
- Thin chips with dark coloration indicate low feed and high cutting speed
- Flexible chips, spring type, with clear material colour indicate ideal cutting condition.









## **ACCESSORIES**

## POCKET LASER TACHOMETER KIT WITH CASE N° 57793Z

- Powerful tachometer with 32 functions for measurements with or without contact
- Optical range 5 200,000 RPM
- Contact range 0.5 20,000 RPM
- Measurement with contact 0.050 2,000 m/min. (linear speed)
- Different measurement units: RPM, cm, inches, feet, yards etc.



## BAND SAW BLADE SERVICE KIT

- For checking and adjusting band saw blades
- Supplied with the key tools needed to maintain a band saw machine at optimum performance:
- Tachometer, Saw tension gauge, stopwatch, square, level, Refractometer, caliper, Band saw blade alignment gauge etc.



## SAW TENSION GAUGE FOR BAND SAW BLADES N° 682EMZ

- Check for proper tension in either English or metric
- Graduated in kg/cm² (0 to 4.000) and in pounds/in² (0 to 60.000)
- Supplied in a case with instructions

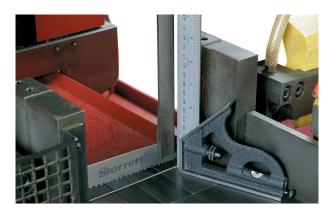


Saw blades	Width (mm)	English System lb/in² (PSI)	Metric System (Kg/cm²)
Primalloy™; Intenss™ PRO-VTH; Intenss™ PRO; Versatix™ MP; Intenss™; Advanz™ MC7, Advanz™ MC5, TS, CS, FS and CG	19, 27 and 34	20.000 - 35.000	1.400 - 2.500
Primalloy™; Intenss™ PRO-VTH; Intenss™ PRO; Versatix™ MP; Intenss™; Advanz™ MC7, MC5, Advanz™ TS, CS and FS	41 or greater	30.000 - 40.000	2.100 - 2.800
Intenss™; Intenss™ PRO-DIE; Univerz™; Duratec™ Super FB; Band Knives High-carbon Steel	Up to 16	20.000 - 25.000	1.400 - 1.800
Duratec <sup>™</sup> Super FB; Duratec <sup>™</sup> FC; Band Knives High-carbon Steel	19 or greater	20.000 - 30.000	1.400 - 2.100
Machine Saw Blades RS and BS	41 or less	20.000 - 30.000	1.400 - 2.100
Machine Saw Blades RS and BS	45 or greater	25.000 - 35.000	1.800 - 2.500



## BAND SAW BLADE ALIGNMENT GAUGE N° PT92925

Gauge to ensure that the blade is running square to the cut.



## TROUBLESHOOTING

		Solution
	Incorrect blade.	Check tooth selection.
BLADE BREAKAGE	Incorrect blade tension.	Adjust the blade tension, refer to operator's manual.
DEADE BREAKAGE	Excessive feed.	Reduce feed pressure.
	Incorrect cutting fluid.	Check coolant recommendations.
	Pressure blocks too tight.	Adjust the guides.
	Blade rubbing on wheel flange.	Adjust wheel alignment.
(straight break indicates fatigue)	Guide arms too far apart.	Adjust guide arms closer to material.
	Side guides too tight.	Adjust guides.
PREMATURE TOOTH WEAR	Blade on machine backwards.	Install blade correctly.
FREWATORE TOOTH WEAR	Improper blade break-in procedure.	Refer to recommended procedures.
	Hard Material or heavy surface scale.	Check material hardness and surface conditions.
	Hard Material.	Increase feed pressure.
	Improper cutting fluid or mix ratio.	Follow coolant mixing procedures.
	Speed or feed too high.	Check cutting recommendations.
	Guide arms too far apart.	Adjust guide arms closer to material.
INACCURATE CUT	Blade worn out.	Replace blade.
	Over or under feeding.	Check cutting recommendations.
<b> </b>	Improper tooth pitch.	Use proper tooth selection.
<b></b>	Cutting fluid not applied properly.	Adjust coolant nozzles.
	Guides worn or loose.	Tighten or replace guides.
	Over feeding.	Check cutting recommendations.
CUTTING DEVIATION	Low band tension.	Refer to operator's manual.
	Tooth set damaged.	Check material hardness, replace blade.
	Guide arms loose or space too wide.	Adjust guides and guide arms.
	Worn or missing chip brush.	Replace or adjust chip brush.
CHIPS RESIDUES IN THE TEETH	Improper or lack of cutting fluid.	Check coolant flow and fluid type.
	Wrong coolant rate.	Check coolant type and ratio.
and but	Excessive feed or speed.	Reduce speed or feed.
	Incorrect blade pitch.	Use proper tooth selection.
	Saw guides not properly adjusted.	Align or adjust saw guides.
TOOTH - BREAKING AWAY	Incorrect feed or speed.	Refer to cutting recommendations.
hand of a	Incorrect blade.	Use proper blade type and pitch.
	Material moved in vise.	Inspect and adjust vise.
WEAR ON ONLY ONE	Material with impurities.	Replace material.
SIDE OF THE TEETH	Wheel with worn flange and band rising out of the track.	Align or replace wheel.
	barra rising out or the track.	
aa Caaaaa	Guide rubbing on set.	Adjust and align guide.

## TROUBLESHOOTING

Improper biade brook-in procedure.  Speed too slove.  Refer to cutting recommendations.  Feed pressure too high.  Feed pressure too high.  Feed pressure too high.  Poor cutting fluid application or ratio.  Hard material or beavy scale.  Check material or surface handness.  Words pluide patch.  Words pluide patch.  Words pluide patch.  Words pluide patch.  Excessive back-up guide probabat.  Low blade frence.  Blade vorn out.  Bl	Blade Effect	Probable Cause	Solution
Feed pressure too high. Tooth jammed in out. Low speed and high custing pressure. Poor cutting fluid application or ratio. Adjust coolant flow and ratio. Hard material or heavy scale. Check material or selection. Work spinning one the corner of the material.  Start the cut skowly.  Excessive back-up guide preload. Adjust pressure block.  Low blade tension. Befor to operator's manual.  Excessive back-up guide preload. Adjust pressure block.  Low blade tension. Befor to operator's manual. Blade worm out. Blade rubbing band wheel flanges. Adjust wheel alignment. Adjust quides.  Blade rubbing band wheel flanges. Adjust wheel alignment. Align guides.  Drull or damaged blade. Incorrect guide alignment. Align guides. Blade not supported properly. Adjust originite guide arms. Incorrect feed or speed. Blade not supported properly. Adjust guides guides properly. Adjust guides properly. Adjust guides guides properly. Adjust guides properly. Adjust guides properly. Adjust guides guides guides. Adjust feed. Adjust deed. Adjust guides. Adjust guides. Adjust guides. Adjust guides. Adjust guides. Adjust g	BREAKS OF THE TEETH	Improper blade break-in procedure.	Follow proper break-in procedure.
Free pressure to high.  The pressure to high.  The pressure to high.  Tooth jammer in out.  Poor curting fluid application or ratio.  Adjust codant flow and ratio.  Hard material or heavy scale.  Check material or surface hardness.  Wrong blade pitch.  Wise proper tooth selection.  Work spinning or toose nested bundles.  Cut beginning over the corner of the material.  Excessive hack-up guide preload.  Low blade tension.  Brefer to operator's manual.  Excessive freed rate or pressure.  Blade worm out.  Blade worm out.  Replace pleasure block.  Guide arms spaced too far apart or too tight.  Adjust spinear place.  Damaged or worn pressure block.  Guide arms spaced too far apart or too tight.  Adjust spinear place arms.  Incorrect guide alignment.  Align guides.  Blade not supported properly.  Adjust or tighten guide arms.  Low blade tension.  Refer to operator's manual.  Blade not supported properly.  Adjust or tighten guide arms.  Low blade tension.  Refer to operator's manual.  Incorrect tend or speed.  Refer to operator's manual.  Low blade tension.  Refer to operator's manual.  Low blade tension.  Refer to operator's manual.  Sav side guides too light.  Adjust guides properly.  Adjust guides properly.  Adjust guides properly.  Blade red my speed.  Adjust guides arms and the relation.  Refer to operator's manual.  Worn plade width for machine.  Chips being curried back into out.  Replace guides.  Low blade tension.  Replace guides.  Adjust guides properly.  Adjust guides guides too tight.  Adjust guides free do guides.  Replace guides.  Adjust guides.  Refer to operator's manual.  Refer to operator's manual		Speed too slow.	Refer to cutting recommendations.
Peor cutting fluid application or ratio.  Hard material or heavy scale.  Check material or surface hardness.  Wrong blade pitch.  Work sprinning or lose nested bundles.  Cut beginning over the corner of the material.  Start the cut slowly.  Excessive back-up guide preload.  Adjust pressure block.  Low blade tension.  Belade worn out.  Replace blade.  Excessive feed rate or pressure.  Damaged or worn pressure block.  Guide arms speed to far apart or too sight.  Adjust guides.  Blade rubbing band wheel flanges.  Adjust quides.  Adjust guides.  Dull or damaged blade.  Incornect guide alignment.  Adjust or tighten guide arms.  Dull or damaged blade.  Incornect feed or speed.  Refer to cutting recommendations.  Blade not supported property.  Adjust or tighten guide arms.  Low blade tension.  Refer to operator's manual.  Blade most pressure block.  Guide arms too far apart.  Adjust guides arms.  Low blade tension.  Refer to operator's manual.  Blade most supported property.  Adjust or tighten guide arms.  Low blade tension.  Refer to operator's manual.  Blade not supported property.  Adjust guide arms closer to material.  Saw side guides too tight.  Adjust guide arms closer to material.  Saw side guides too tight.  Adjust guides property.  Adjust guides.  Replace guides.  Adjust guides.  Adjust guides.  Adjust		Feed pressure too high.	Reduce feed pressure.
Hard material or heavy scale.  When plade pitch.  Use proper tooth selection.  Work spinning or loose nested bundles.  Tighten vise or use nesting clamps.  Cut beginning over the corner of the material.  Samt the cut slowly.  Excessive back-up guide prelead.  Low blade tension.  Blade worn out.  Blade worn out.  Blade worn out.  Blade effect to operator's manual.  Excessive feed rate or pressure.  Damaged or worn pressure block.  Guide arms spaced too far apart or too tight.  Adjust guides.  Blade rubbing band wheel flanges.  Adjust or worn pressure block.  Guide arms spaced too far apart or too tight.  Adjust guides.  Blade not supported properly.  Adjust or light engulee arms.  Incorrect guide alignment.  Blade not supported properly.  Adjust or pressure block.  Blade not supported properly.  Adjust or guide arms.  Low blade tension.  Blade not supported properly.  Adjust guide arms.  Low blade tension.  Blade not supported properly.  Adjust guide arms closer to material.  Saw side guides too tight.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Blade riding too high in guide.  Adjust guides properly.  Adjust guides properly.  Adjust guides properly.  Adjust guides properly.		Tooth jammed in cut.	Low speed and high cutting pressure.
Work pointing or loose nested bundles.  Cut beginning over the corner of the material.  Excessive back-up guide preload.  Lov blade tersion.  Befer to operator's manual.  Excessive feed rate or pressure.  Blade worn out.  Excessive block.  Excessive feed rate or pressure.  Replace feed rate or pressure.  Damaged or worn pressure block.  Guide arms spaced too far apart or too tight.  Adjust quides.  Blude rubbing band wheel flanges.  Adjust wheel alignment.  Incorrect guide alignment.  Align guides.  Dull or damaged blade.  Install new blade.  Incorrect guide alignment.  Align guides.  Blude not supported preperly.  Adjust or tighten guide arms.  Exceptional array.  Exceptional array.  Blade install new blade.  Incorrect point incorrect guide arms.  Blade install new blade.  Blade install new blade.  Incorrect guide alignment.  Adjust guide arms closer to material.  Saw side guides too tight.  Adjust guide arms closer to material.  Saw side guides too tight.  Adjust guide arms closer to material.  Adjust guides properly.  Blade inding too high in guide.  Adjust rollers prepare wheel.  Worn glade with for machine.  Chips being carried back into cut.  Beplace or adjust chip brush.  Worn or damaged guides.  Insufficient cooling flow.  Adjust guides.  A		Poor cutting fluid application or ratio.	Adjust coolant flow and ratio.
Wear on the Back of the Back o		Hard material or heavy scale.	Check material or surface hardness.
Cut beginning over the corner of the material.  Excessive back-up guide prebad.  Adjust pressure block.  Low blade tension.  Refer to operator's manual.  Blade worn out.  Replace blade.  Excessive feed rate or pressure.  Damaged or worn pressure block.  Guide arms spaced too far apart or too tight.  Adjust wheel alignment.  Align guides.  Blade rubbing band wheel flanges.  Adjust wheel alignment.  Align guides.  Dull or damaged blade.  Incorrect feed or speed.  Refer to cutting recommendations.  Blade not supported properly.  Adjust or tighten guide arms.  Low blade tension.  Refer to operator's manual.  Incorrect tooth pitch.  Use proper tooth selection.  Guide arms too far apart.  Adjust guides arms closer to material.  Adjust guide arms closer to material.  Blade riding too high in guide.  Adjust guide arms closer to material.  Adjust guide arms closer to material.  Adjust guide arms closer to material.  Worn or damaged guides.  Adjust folers or pressure blocks.  Adjust folers or pressure blocks.  Adjust guides or pressure blocks.  Adjust guides or pressure blocks.  Adjust guides arms closer to material.  Adjust guides or pressure blocks.  Adjust guides or pressure blocks.  Adjust guides arm closer to material.  Worn or damaged guides.  Refer to operator's manual.  Chips being carried back into cut.  Replace or adjust chip brush.  Worn or damaged guides.  Refer to operator's manual.  Adjust guides.  Refer to operator's manual.  Chips being carried back into cut.  Replace or adjust dhip brush.  Refer to operator's manual.  Adjust guides.  Adjust guides.  Adjust guides.  Adjust guides.  Adjust guides.  Refer to operator's manual.  Refer to oper		Wrong blade pitch.	Use proper tooth selection.
Excessive back-up guide preload. Adjust pressure block.  Low blade tension. Refer to operator's manual.  Blade worn out. Replace blade.  Excessive feed rate or pressure. Reduce feed rate or pressure.  Damaged or worn pressure block. Replace pressure block.  Guide arms spaced too far apart or too tight. Adjust guides.  Blade rubbing band wheel flanges. Adjust wheel alignment.  Incorrect guide alignment: Align guides.  Dull or damaged blade. Install new blade.  Incorrect feed or speed. Refer to cutting recommendations.  Blade not supported properly. Adjust or tighten guide arms.  Low blade tension. Refer to operator's manual.  Incorrect tooth pitch. Use proper tooth selection.  Guide arms too far apart. Adjust guides properly.  FRAYED LINES  - LOSS OF SET  Blade riding too high in guide. Adjust rollers or pressure blocks.  Blade testh riding on band wheel surface. Adjust guides properly wheel.  Wrong blade width for machine. Refer to operator's manual.  Chips being carried back into cut. Replace or adjust chip brush.  Worn or damaged guides. Replace guides.  Insufficient cooling flow. Adjust coolant flow.  Blade binding in cut. Adjust guides.  Guides misaligned. Adjust and align guides.  Side guides are too tight. Adjust and align guides.  Side guides are too tight. Adjust guides.  Adjust feed.  Guides misaligned. Adjust and align guides.  Feed too heavy. Reduce feed pressure.  High blade tension. Refer to operator's manual.  Worn wheels. Machine or replace wheels.		Work spinning or loose nested bundles.	Tighten vise or use nesting clamps.
Low blade tension.   Refer to operator's manual.		Cut beginning over the corner of the material.	Start the cut slowly.
Low blade tension.   Refer to operator's manual.		Excessive back-up quide preload.	Adjust pressure block.
Blade worn out. Replace blade.  Excessive feed rate or pressure. Reduce feed rate or pressure.  Damaged or worn pressure block. Replace pressure block.  Guide arms spaced too far apart or too tight. Adjust guides.  Blade rubbing band wheel flanges. Adjust wheel alignment.  Incorrect guide alignment. Align guides.  Dull or damaged blade. Install new blade.  Install new blade.  Blade not supported properly. Adjust or tighten guide arms.  Low blade tension. Refer to cutting recommendations.  Blade not supported properly. Adjust or tighten guide arms.  Low blade tension. Refer to operator's manual.  Incorrect tooth pitch. Use proper tooth selection.  Guide arms too far apart. Adjust guide arms closer to material.  Saw side guides too tight. Adjust guide properly.  Blade riding too high in guide. Adjust rollers or pressure blocks.  Blade teeth riding on band wheel surface. Adjusting tracking or replace wheel.  Wrong blade width for machine. Refer to operator's manual.  Chips being carried back into cut. Replace or adjust chip brush.  Worn or damaged guides. Replace guides.  Insufficient cooling flow. Adjust coolant flow.  Blade binding in cut. Adjust guides.  Guides misaligned. Adjust and align guides.  Side guides are too tight. Adjust guides.  Adjust guides.  Pour damaged guides. Replace or adjust chip brush.  Work loose in vice. Adjust guides.  Refer to operator's manual.  Work loose in vice. Adjust guides.  Refer to operator's manual.  Work loose in vice. Adjust or greater wheels.			
Excessive feed rate or pressure.  Damaged or worn pressure block.  Guide arms spaced too far apart or too tight.  Adjust guides.  Adjust wheel alignment.  Incorrect guide alignment.  Align guides.  Dull or damaged blade.  Install new blade.  Incorrect feed or speed.  Blade not supported properly.  Adjust or tighten guide arms.  Low blade tension.  Refer to cutting recommendations.  Blade not supported properly.  Adjust or tighten guide arms.  Low blade tension.  Refer to operator's manual.  Incorrect tooth pitch.  Use proper tooth selection.  Guide arms too far apart.  Adjust guide arms closer to material.  Saw side guides too tight.  Adjust guide arms closer to material.  Adjust guide properly.  Blade riding too high in guide.  Adjust rollers or pressure blocks.  Blade teeth riding on band wheel surface.  Adjust rollers or pressure blocks.  Wrong blade width for machine.  Refer to operator's manual.  Chips being carried back into cut.  Replace guides.  Replace guides.  Insufficient cooling flow.  Adjust coolant flow.  Blade binding in cut.  Adjust guide.  Adjust guides.  Adjust feed.  Guides misaligned.  Adjust and align guides.  Side guides are too tight.  Adjust guides.  Adjust guides.  Adjust guides.  Replace guides.  Repla		Blade worn out.	
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Guide arms spaced too far apart or too tight.  Blade rubbing band wheel flanges.  Adjust wheel alignment.  Incorrect guide alignment.  Align guides.  Dull or damaged blade.  Install new blade.  Install new blade.  Install new blade.  Incorrect feed or speed.  Refer to cutting recommendations.  Blade not supported properly.  Adjust or tighten guide arms.  Low blade tension.  Refer to operator's manual.  Incorrect tooth pitch.  Use proper tooth selection.  Guide arms too far apart.  Adjust guide arms closer to material.  Saw side guides too tight.  Adjust guides properly.  Blade riding too high in guide.  Adjust rollers or pressure blocks.  Blade teeth riding on band wheel surface.  Adjust forliers or pressure blocks.  Blade teeth riding on band wheel surface.  Adjust guides ror pressure blocks.  Insufficient cooling flow.  Adjust coolant flow.  Adjust coolant flow.  Blade binding in cut.  Adjust coolant flow.  Adjust coolant flow.  Adjust guides.  Side guides are too tight.  Adjust quides.  Adjust quides.  Adjust guides.  Adjust guides.  Adjust guides.  Replace or adjust chip brush.  Worn or damaged guides.  Replace or adjust chip brush.  Adjust guides.  Adjust quides.  Adjust quides.  Adjust quides.  Adjust quides.  Adjust quides.  Refer to operator's manual.  Refer to operator's manual.  Refer to operator's manual.  Work loose in vice.  Adjust vice.  Reduce feed pressure.  Refer to operator's manual.  Worn wheels.		· ·	·
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Dull or damaged blade. Install new blade.  Incorrect feed or speed. Refer to cutting recommendations.  Blade not supported properly. Adjust or tighten guide arms.  Low blade tension. Refer to operator's manual.  Use proper tooth selection.  Guide arms too far apart. Adjust guide arms closer to material.  Saw side guides too tight. Adjust guide arms closer to material.  Blade riding too high in guide. Adjust rollers or pressure blocks.  Blade teeth riding on band wheel surface. Adjusting tracking or replace wheel.  Wrong blade width for machine. Refer to operator's manual.  Chips being carried back into cut. Replace or adjust chip brush.  Worn or damaged guides. Replace guides.  Insufficient cooling flow. Adjust coolant flow.  Blade binding in cut. Adjust feed.  Guides misaligned. Adjust and align guides.  Side guides are too tight. Adjust guides.  Side guides are too tight. Adjust guides.  Feed too heavy: Reduce feed pressure.  High blade tension. Refer to operator's manual.  Worn wheels. Machine or replace wheels.			
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Low blade tension.  Refer to operator's manual.  Use proper tooth selection.  Guide arms too far apart.  Adjust guide arms closer to material.  Saw side guides too tight.  Adjust guide arms closer to material.  Blade riding too high in guide.  Adjust rollers or pressure blocks.  Blade teeth riding on band wheel surface.  Wrong blade width for machine.  Chips being carried back into cut.  Refer to operator's manual.  Chips being carried back into cut.  Replace or adjust chip brush.  Worn or damaged guides.  Insufficient cooling flow.  Adjust coolant flow.  Blade binding in cut.  Adjust and align guides.  Side guides misaligned.  Adjust and align guides.  Side guides are too tight.  Adjust guides.  Adjust guides.  High blade tension.  Refer to operator's manual.  Worn wheels.  Machine or replace wheels.			
Incorrect tooth pitch.  Guide arms too far apart.  Saw side guides too tight.  Adjust guide arms closer to material.  Saw side guides too tight.  Adjust guide properly.  Blade riding too high in guide.  Adjust rollers or pressure blocks.  Blade teeth riding on band wheel surface.  Adjusting tracking or replace wheel.  Wrong blade width for machine.  Refer to operator's manual.  Chips being carried back into cut.  Replace or adjust chip brush.  Worn or damaged guides.  Insufficient cooling flow.  Adjust coolant flow.  Blade binding in cut.  Adjust and align guides.  Side guides are too tight.  Adjust and align guides.  Side guides are too tight.  Adjust guides.  Adjust guides.  Adjust guides.  High blade tension.  Refer to operator's manual.  Worn wheels.  Machine or replace wheels.			
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BLADE TWISTED  Blade teeth riding on band wheel surface.  Worn or damaged guides.  Blade binding in cut.  Guides misaligned.  Guides are too tight.  Adjust quides.  BLADE TWISTED  BLADE			
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Side guides are too tight.  Work loose in vice.  Feed too heavy.  High blade tension.  Worn wheels.  Machine or replace wheels.		Blade binding in cut.	Adjust feed.
BLADE TWISTED  Work loose in vice.  Feed too heavy.  High blade tension.  Refer to operator's manual.  Worn wheels.  Machine or replace wheels.		Guides misaligned.	Adjust and align guides.
Feed too heavy.  Reduce feed pressure.  High blade tension.  Refer to operator's manual.  Worn wheels.  Machine or replace wheels.		Side guides are too tight.	Adjust guides.
High blade tension. Refer to operator's manual.  Worn wheels. Machine or replace wheels.		Work loose in vice.	Adjust vice.
Worn wheels. Machine or replace wheels.		Feed too heavy.	Reduce feed pressure.
		High blade tension.	Refer to operator's manual.
Guides arms too far apart.  Adjust guide arms closer to material.		Worn wheels.	Machine or replace wheels.
		Guides arms too far apart.	Adjust guide arms closer to material.

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