

A MANUAL FROM SANDVIK STEEL

The Handbook

Production, use and maintenance
of wood bandsaw blades



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The Handbook

- Efficiency in terms of longer operational times or higher feed speeds.
- Better utilisation of raw materials.
- Safe and reliable production.

Three vital issues that are equally important to the overall productivity of our wood bandsaw blade operation. They form the base for our development of steel grades, and new and improved products in bandsawing. They play an important role in the co-operation with our customers and partners in the business, to improve the economy of sawmills worldwide, now and in the future.

The continuous development has to include considerations about our forest resources, to meet environmental and other needs in our society.

In *The Handbook* we cover production, use and maintenance of wood bandsaw blades. The detailed descriptions comprise technical information as well as practical hints on how to make better use of bandsaw blades and machines.

To producers of wood bandsaw blades, manufacturers of sawn products and the management of sawmills, we believe *The Handbook* could be of help in more ways than one.

We hope you will find it useful!

Sandvik Steel

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Forests of the earth



Harvesting and wood production

Cost structure

Certification and the environment

A

Forests of the earth

Harvesting and wood production

In very approximate figures the world log timber harvest amounts to some 3.5 billion m³ a year. Of this a little less than 50% consists of industrial wood, whereas the balance is fuel wood. The major producers are North America, Asia including China and Japan, and Western Europe, which together supply over 70% of the world demand.

Although no significant increase in the world production of timber is foreseen in the near future, it is estimated that fast-growing plantations will play an important future role for the wood harvest.

The production of sawn wood is less than 500 million m³, where softwood accounts for 75%. The largest producing markets are North America and Western Europe including Scandinavia.

The forecast for demand of sawn wood products is stable and increasing very little. Globally, wood substitute products have not significantly affected the wood market and it is likely that sawn wood will remain first choice for wood products for some time to come.

Cost structure

The more developed a market, the higher is the demand for advanced sawing technology. The price of logs is by far the most important factor influencing the competitiveness of the sawmill industry. This, in combination with high personnel costs, makes it vital to make

efficient use of the available resources. It is also a fact that high production costs in general appear in those areas where log costs are the highest.

Certification and the environment

We have a responsibility to make sure that forest resources are well managed to meet social, economic, ecological and other needs in our society, for the present as well as for future generations. In this context, the Forest Stewardship Council (FSC) has endeavoured to bring about a measure of control of the earth's forests. The FSC is an international body which gives accreditation to organisations whose job it is to certify companies in the industry for:

- the standards of forest management
- the products made from the wood from these forests

Certification is an important means to safeguard our forests and to see to it that the raw material is handled in an economic and efficient way, and where serious consideration is always taken to the environmental aspects. The growing public awareness of forest destruction and degradation has resulted in increasing demands that purchases of wood products help secure forest resources for the future.

Wood bandsaw steel



Wood bandsaw steel from Sandvik

Characteristics of wood bandsaw steel

The Sandvik Multishift™ Concept

– a case in point

Future trends

B

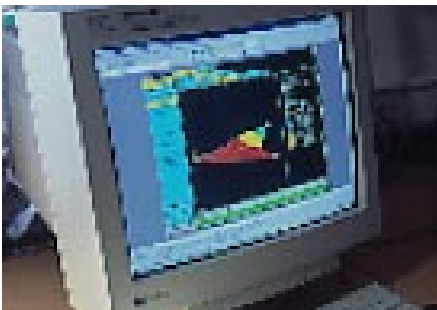
Wood bandsaw steel

The Sandvik Group is firmly committed to research. In the special steel sector we avail ourselves of one of the most sophisticated research centres in the world, in Sandviken, Sweden.

For well over a century we have been producing special steels for very exacting applications. Today the product range covers tube, strip, wire and bar, mainly in stainless steel and in titanium, nickel and zirconium alloys. Our operation focuses on niches in which we hold a leading position in the world market.

Research and development as well as the manufacture of all special steel products, is carried out with full control of the entire production chain. With a complete steel works at our disposal we supervise quality from the beginning to the end, from the melt to the finished product.

This integration is pursued also in the wood bandsaw steel sector, where we operate one of Europe's largest bandsaw manufacturing plants at our fully-owned subsidiary in Finland.



Detailed calculations help produce the steel best suited for the purpose.

Wood bandsaw steel from Sandvik

Sandvik Steel is a leading supplier of wood bandsaw steel and bandsaw blades to the sawmill industry. Based on well over a century of experience, we have concentrated on special quality steels and tools to increase the productivity of our customers.

Our R&D efforts concentrate on developing new materials for bandsaws and improving the properties of existing materials. There is an ongoing investigation of manufacturing processes to make sure quality levels are kept also for future applications.

The premises for wood bandsaw blade manufacture in Finland give us the unique possibilities needed to develop products for use in tough surroundings. The factory forms a solid base for the very close co-operation with our partners in the business, where end-users and machine manufacturers are very important for the contribution of ideas and improvements. Here, tests and other related activities in development of new materials, new techniques and other sawing parameters, can be carried out in full. The production facility is also an important foundation for all the development work which is the basis of our international business operation.



From melt to finished product. Full supervision of the steel from beginning to end.



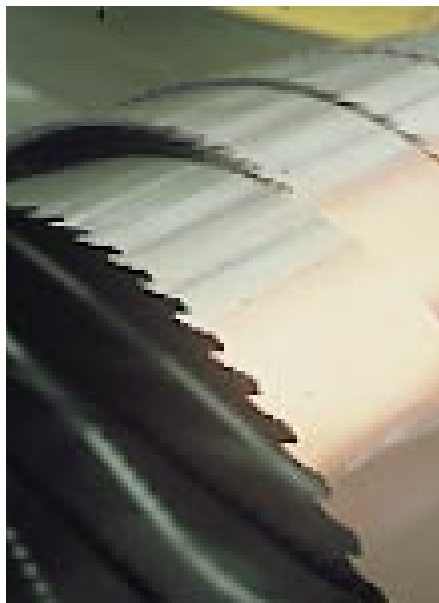
One of Europe's largest manufacturing units for wood bandsaw blades is situated at Sandvik's subsidiary near Helsinki in Finland.

Characteristics of wood bandsaw steel

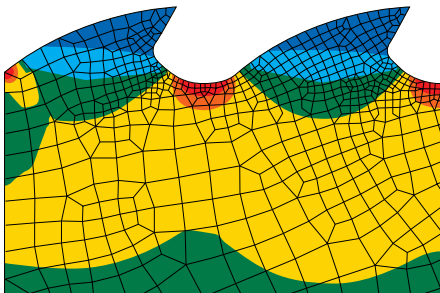
It is important that the characteristics of the bandsaw steel well match other factors vital to the sawing operation. Here are some of the features to which we attach special importance and which, taken together, will produce maximum results.

- mechanical properties combining high strength and toughness
- high purity
- excellent flatness
- excellent straightness
- close tolerances
- good weldability
- material suited for stellite tipping

Sandvik's wood bandsaw steels are available in a wide standard range for delivery from stock (complete information is contained in our brochure S-335-ENG).



Wood bandsaw blades ready for delivery from the Finnish factory.



The features of the Sandvik Multishift Concept will help sawmills to better yields.

The Sandvik Multishift™ Concept is a case in point

This is a very good example where many interests were combined to produce a new product with maximum properties. The special properties of the steel were matched against its further processing and refinement and a heavy emphasis was put on its function.

This produced a concept rather than a bandsaw blade and the results have been very positive. Increased productivity in terms of longer operational times, higher feed speeds, less need for maintenance as well as improved operational reliability, has given the sawmill industry another first.

Future trends

Development is an ongoing process. The Sandvik Multishift Concept is followed by the Multishift Saver Concept, where thinner sawblades are engaged in the manufacturing sequence. This results in more finished sawn goods from the same amount of raw material. The Multishift Saver concept has been thoroughly tested and investigated where a number of different parameters are concerned, such as tooth shapes, strain forces, cutting speed etc.

The close co-operation with manufacturers and endusers will eventually produce new achievements in fields such as higher feed speeds in bandsaws, to make the sawing process even more productive and economical.

The Sandvik Multishift and Multishift Saver Concepts are outlined in more detail in special sections in this handbook.

Economy



The sawmill cost structure

The three-leg philosophy

C

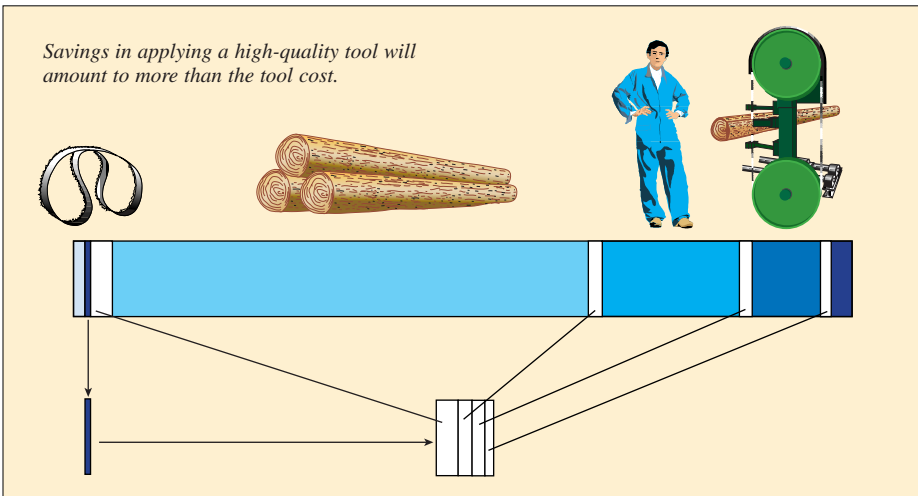
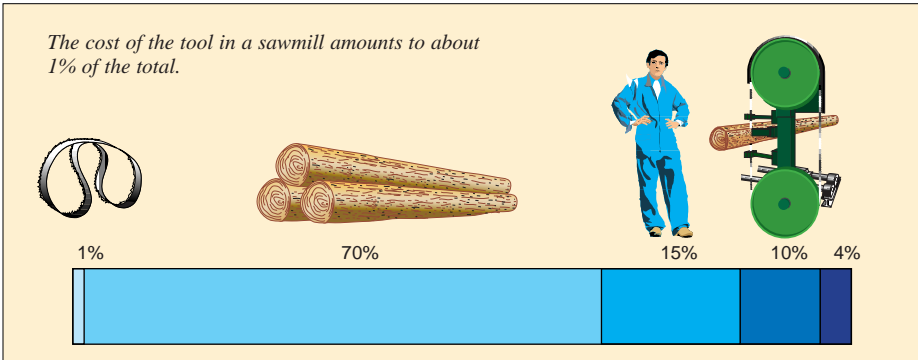
Economy

The sawmill cost structure

A number of factors influence the sawing operation. Therefore the cost structure in a sawmill is of vital importance in deciding how to reach maximum production output. Raw material, manpower, fixed assets and other costs make up the bulk of these expenses. The cost of the tool, in this case the sawblade including maintenance, is indeed a very minor investment or only about one percent of the total cost!

We would like to show you how you can get a lot more out of your operation by applying a quality tool.

This is a picture of the traditional spread of costs in a normal sawmill. The upper bar of the diagram shows that raw material or logs, amounts to 70%, manpower to 15%, fixed assets to 10% and other costs to 4%. You will also note that the tool cost is calculated at one percent of the total expense.



The lower bar shows what is possible to save on costs, if you invest in a high-quality tool; you will find that the savings add up to considerably more than your investment in the sawblade itself!

The chapter on Sandvik Multishift will give you more figures about cost savings and comparisons between different sawblades.

The three-leg philosophy

A quality tool will improve the overall productivity. It affects three important factors in the sawmilling industry: utilisation of raw material, operational reliability and efficiency.

Correctly applied, the tool will influence the sawmilling operation through:

- **better utilisation of raw materials**

- higher yields
- better sawing accuracy
- better surface finish

- **improved efficiency**

- longer operational times
- higher feed speed
- less maintenance

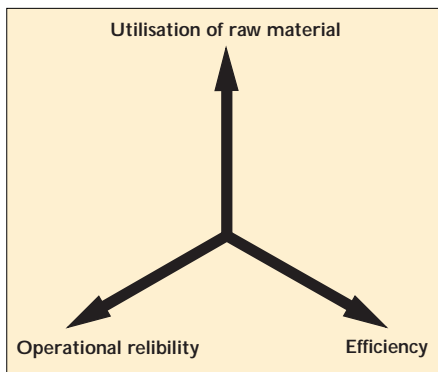
- **improved operational reliability**

- less downtime

The individual sawmill decides where its strongpoints are and how best to choose the most economical way to improve productivity. Where one sawmill may prefer to improve its efficiency, another might concentrate its efforts on better utilisation of raw materials. Operational reliability, however, is by far the most important factor.

Whatever the preference it is vital that the efforts are well planned. Optimum results are only possible if all three factors outlined above can be combined in a perfect match.

The illustration shows, basically, how the various legs influence the overall productivity. In the chapters on Sandvik Multishift and Sandvik Multishift Saver we have further outlined how varying parameters could influence the productivity.



The three-leg philosophy in practice.

Bandsawing



Advantages

Types of bandsaw

Operation of the bandsaw

The wheels

The blade guides

Strain

Cutting speed

Feed rate

Lubrication and cleaning

D

Bandsawing

Bandsawing is an economic way of splitting logs. The major advantage compared to other methods is that sawing is carried out with thin blades which give narrower kerfs and produce more boards.

Modern bandsawing is a rapid and flexible method for efficient production. In combination with good sawing economy, bandsawing is turning into an increasingly interesting alternative also in areas where other techniques dominate the woodworking industry today.

Not least has the compact design of modern bandsaws opened up the possibilities for efficient production lines where space is limited, also giving better yields and improved overall economy in the sawing operation.

Advantages

The modern bandsaw blade operates at a high, consistent speed. The angle of the teeth remain in the same position during the sawing process and move constantly in the same direction in relation to the log.

With only a fraction of its entire length engaged in the sawing process at the same time, the ambient air will cool the blade to eliminate thermal stresses and distortion.

The construction of modern bandsaws makes sawing virtually vibration-free which gives the blade high operational reliability, leading to better sawing accuracy. The narrow kerf produces a consistent and very fine surface finish and reduces energy consumption.

The development of the bandsawing technique using a thinner kerf in combination with sweepsawing, will drastically change the yield. Tests prove that in using the profiling method with circular saws instead of the bandsawing technique, some 10% more logs are needed to produce the same amount of sawn timber.

Stellite tipping combined with high blade strain is a further advantage which improves the sawing result as well as the tool economy of the sawing process.

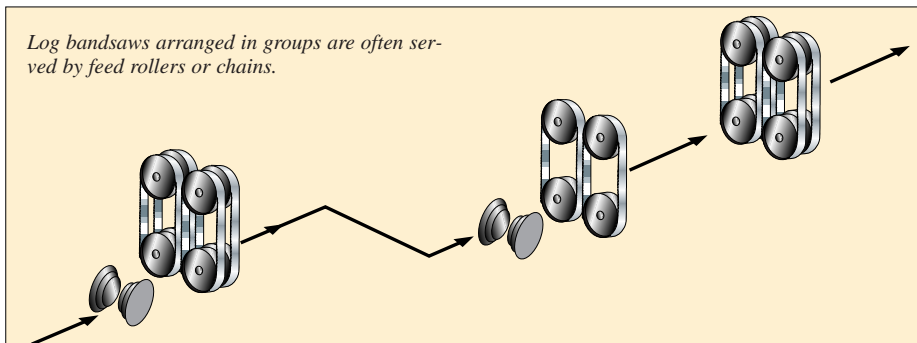
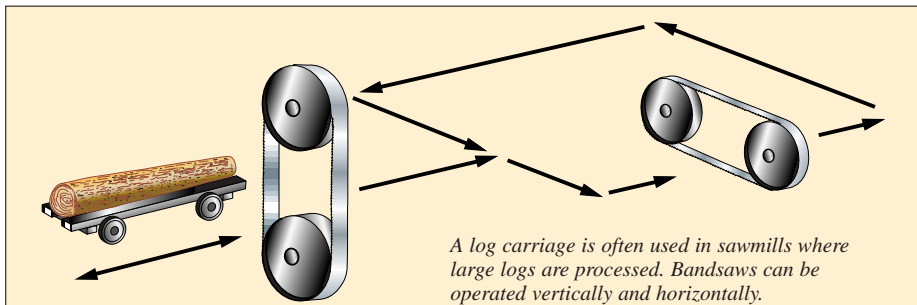
Types of bandsaw

Log bandsaws or head saws may be either vertical or horizontal, arranged as single machines or in groups of two or more units. They are primarily used for sawing logs into blocks or planks.

Band rip saws, mainly employed for processing blocks and planks, are often installed in groups. To an increasing extent also planing mills and similar industries are today installing band rip saws for the further processing of their products.

The feed arrangement is often the only feature which distinguishes the log bandsaw from the band rip saw. When large logs are sawn, the log bandsaw is usually fitted with a log carriage. This method often uses double-cut blades to increase productivity.

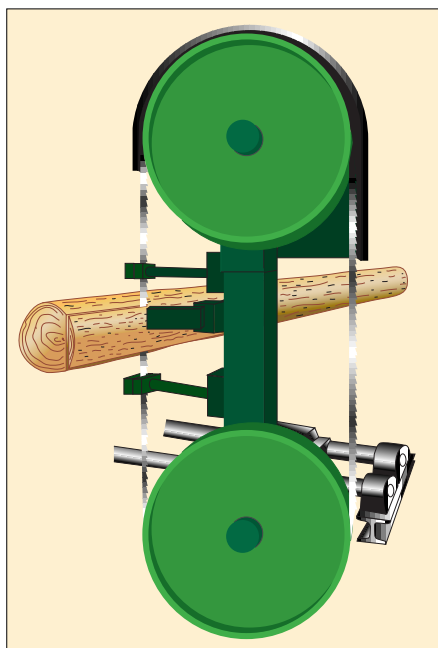
The band rip saw is served by feed rollers or chains. This system is normally used also when the log saws are arranged in groups. The technique is most common in Europe and notably in Scandinavia, where log sizes are smaller and the timber is normally pre-sorted.



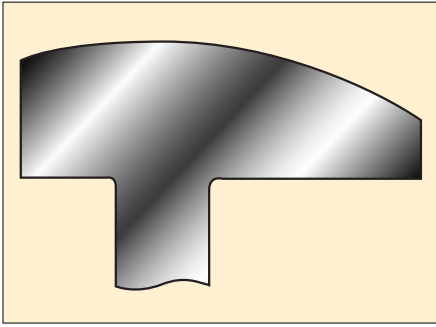
Operation of the bandsaw

The wheels

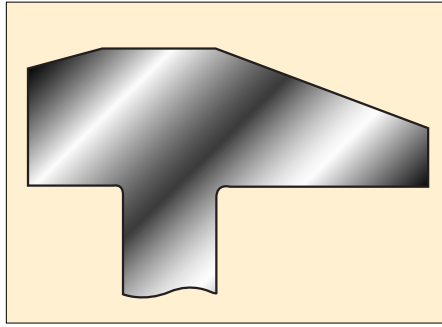
Most machines using wide bandsaw blades have wheels which are crowned for more stable sawing. The highest point of the crown should normally come on the forward third of the wheel. If the wheels are worn so much that their crown changes, the blades will be subjected to an unnecessary stress and may be damaged. If stellite-tipped blades are used, it is often sufficient that the crown is closer to the middle of the wheel, as regrinding of these blades does not decrease their width.



The modern bandsaw.



The highest point of the crown should come on the forward third of the wheel (exaggerated).

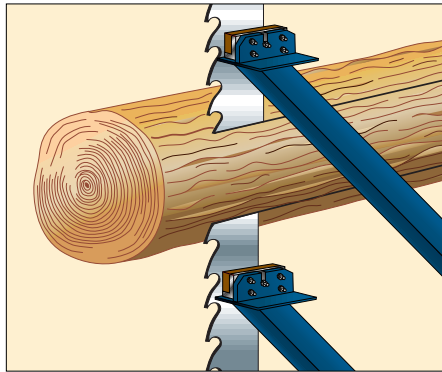


The shape of the wheel may differ, but the result is the same.

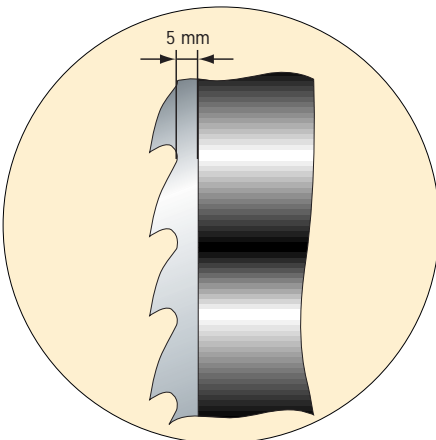
Check the wheels for crown with the help of a template, supplied by the machine manufacturer, or other available measuring equipment, which shows the original (= correct) crown of the wheels.

The top wheel, and sometimes both wheels, may be tilted backwards or forwards to make the blade run correctly, with the gullets about 5 mm (0.2 in) outside the wheels.

Bandsaw wheels should be ground after about 5000 hours of operation. Also check the wheel bearings frequently for wear.



One-sided guides press the blade slightly to one side.

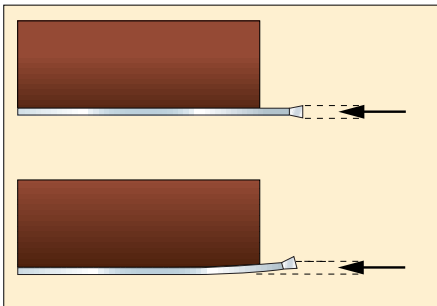


In the correct position the gullets should be approx. 5 mm outside the wheel during sawing.

The blade guides

The blade guides are steering blocks made of metal, hard plastic, hardwood or comparable materials. They can be one-sided or two-sided, as the case may be. On a vertical bandsaw, one blade guide will be mounted below the workpiece and the other above it. In machines where the upper guide is adjustable it should be set as close to the timber as possible to keep the blade under tight control.

On modern bandsaws the upper blade guide could be controlled so that it can be rapidly adjusted to the dimensions of each new log.



One-sided blade guides give better blade support, a worn one will, however, lead to crooked sawing.

Double-sided blade guides must not be set so closely as to generate heat in the blade. Make sure their front edges are not worn, since this results in poor guiding of the blade, with the risk of crooked sawing and fatigue cracks in the gullets due to vibration.

One-sided guides butt against the blade and press it slightly to one side during the sawing operation. These guides are to be preferred as they give better support, but they have to be checked and changed at intervals, as a worn-out blade guide will lead to crooked sawing.

Strain

The strain of the blades is adjusted pneumatically, hydraulically or with counterweights. High strain gives better sawing accuracy, but it is important that the machine manufacturers' recommendations are followed. The normal strain is 100 - 150 MPa (14,500 - 22,000 psi), while high strain is 200 - 250 MPa (29,000 - 36,000 psi).

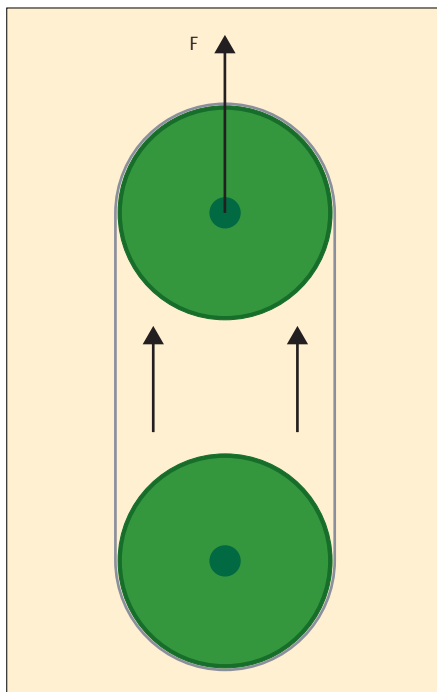
Note: MPa = N/mm²

Cutting speed

The cutting speed is determined by the speed of the wheels. A higher cutting speed will give a cut with better surface finish and sawing accuracy. It also permits a heavier feed speed if needed.

The normal cutting speed is 35 - 45 m/sec (115 - 150 ft/sec). A few manufacturers supply machines which will run at cutting speeds up to 75 m/sec (245 ft/sec) and with possibilities to also vary the cutting speed.

When considering what cutting speed to choose, it is also profitable to be able to vary the speed according to the log dimension to be sawn and the composition of the wood (frozen timber, hardwood etc.). A variable cutting speed is an important instrument to give optimum sawing result.



Application of strain force.

Feed rate

In Scandinavia the normal feed rate is about 60 - 80 m/min (200 - 260 ft/min). Modern machine manufacturers, however, have already today developed machines which operate at feed rates up to 120 m/min (400 ft/min). It is not unlikely that feed rates reaching 150 m/min (500 ft/min) will be possible in the future.

Feeds up to 120 m/min (400 ft/min) are encountered in North America, where heavier machines often operate with thicker blades in softer wood.

Generally speaking it is a good idea to vary the speed of the blade, as outlined above. The relation between the feed speed and the cutting speed must match perfectly to obtain the best result.

Lubrication and cleaning

Wheels and blades must be moistened with a suitable lubricant to prevent the accumulation of resinous deposits during the sawing process and to keep the blade clean. Resin will produce friction and excess heat which in turn will cause vibrations and lead to crooked sawing and cracks.

Keep the wheels clean by scrapers made of non-abrasive material.

Choosing blade



Length

Width

Thickness

Tooth shape and pitch

Hook angle

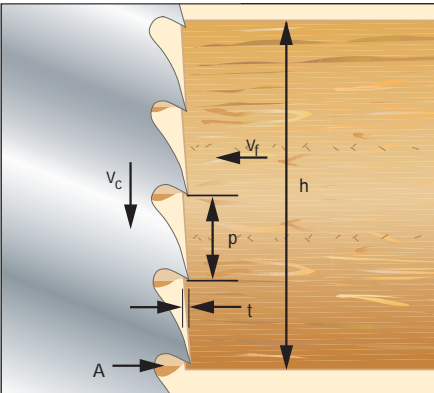
Clearance angle

Variable pitch

E

Choosing blade

There are a few details to think about when you choose the blades for your bandsaw. The essential information required is length, width, thickness, tooth shape with pitch and hook angle. A further important feature is the capacity of the gullet area which should be matched against feed speed to obtain the best sawing result.



Sawing parameters

v_f = feed speed

v_c = cutting speed

p = pitch

h = cutting height

t = feed per tooth

$$t = \frac{p \times v_f}{v_c}$$

A = "area" removed by a tooth

$$A = t \times h$$

Length

The length of the blade is determined by the machine in which it is to be fitted. Recommended blade lengths are supplied by the machine manufacturers. The actual length of the blade is defined as number of teeth and pitch.

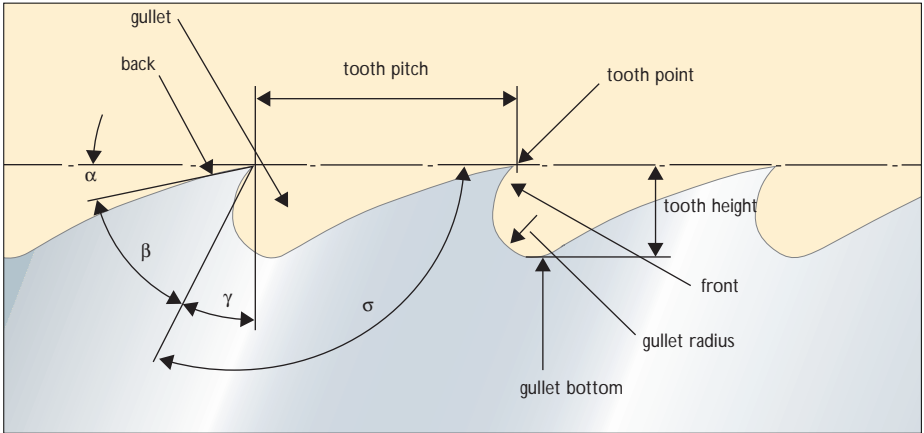
Width

The width of the blade is also determined by the machine. Maximum width = wheel width + tooth height + 5 mm (0.2 in). If your facilities for tensioning and straightening are limited or non-existent, a narrower blade will have to be accepted. Properly maintained, a bandsaw blade with swaged teeth can be used down to about 65% of its initial width, whereas stellite-tipped blades will maintain almost the same width during their entire life.

Thickness

The thickness of the blade is determined by the diameter of the wheels. Blade sizes below 1.47 mm (17 BWG) must not be thicker than 1/1000 of the wheel diameter, blade sizes above this thickness must not be thicker than 1/1200 of the wheel diameter. In certain cases it is possible to use thinner blades than those indicated here, see also the chapter on Multishift Saver sawing.

Theoretically speaking, a thin blade will last longer because it is subjected to smaller bending stresses.



Terminology for bandsaw teeth, α = back angle or clearance angle, β = tooth point angle or sharpness angle, γ = hook angle, σ = front angle ($\gamma + 90^\circ$).

Tooth shape and pitch

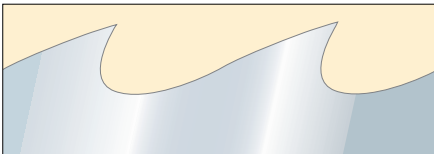
When you choose tooth shape and pitch there are a few important parameters which should be observed. The most important factors are

- type of wood hard or soft wood
- cutting height log diameter, block height
- cutting speed

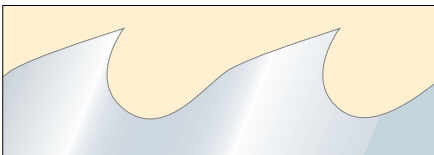
When these parameters have been considered, the tooth shape is selected according to

- sufficient gullet capacity
- adequate side stability
- cutting geometry

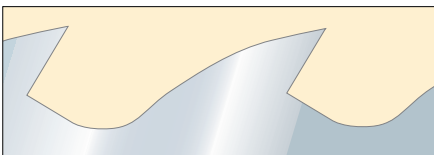
The most common tooth shapes are designed LS, S and SB.



Tooth shape LS is most widely used for sawing logs and in re-sawing, in both soft and hard wood.



Tooth shape S is used for log sawing thanks to its high gullet capacity and relatively good tooth stability. It is mainly applied in sawing large diameter logs.



Tooth shape SB has high side stability and is suited for log sawing, in both soft and hard wood. It is also the tooth shape most commonly used for sawing frozen logs.

The most commonly used tooth shapes.

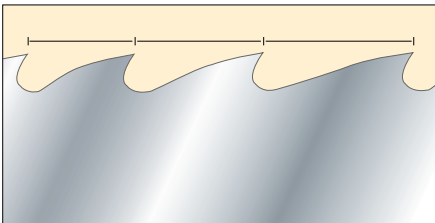
Sandvik's recommended tooth shapes for various sawing applications

Application			Tooth shape
Sawmills	Large logs	Hard wood	S, SB
		Soft wood	S
	Small logs	Hard wood	SB
		Soft wood	LS, SB
Planing mills	Frozen logs	Hard wood	LS, SB
		Soft wood	LS, SB
Special sawing applications		Hard wood	LS, SB
		Soft wood	S, SB

Hook angle

The hook angle is selected to give optimum cutting power. A larger hook angle gives a lighter and more efficient cut, but at the same time it reduces tooth stability. For soft woods and large-size timber you should use 25 - 30° on swaged and stellite-tipped blades and 10 - 15° on spring-set blades. For hard woods we recommend 15 - 25° on swaged and stellite-tipped blades and a somewhat smaller angle on spring-set blades.

If the hook angle is too large, the blade will be pulled sharply against the timber. If this happens, its forward edge may come too far outside the wheels. An undersized hook angle requires an unnecessarily high cutting power and gives low capacity, it may cause vibrations and unstable sawing. In both cases, the blades are liable to crack, especially in the gullets.



Variable-pitch sawblade.

Clearance angle

For Scandinavian conditions, a clearance angle of 8 - 12° can be used, whereas 12 - 16° is standard in the US.

Variable pitch

Variable pitch means that the saw teeth are unevenly spaced in the bandsaw blade. A blade may have several pitch of teeth, normally 3 - 5 different ones with the same, basic tooth shape. Also different tooth shapes with different pitch may appear in the same bandsaw blade. Variable-pitch bandsaw blades, a feature made possible by modern toothing and grinding techniques, are most widely used in North America.

One advantage of unevenly spaced teeth is that they eliminate or dampen the harmonic vibration that causes "washboard" in sawn timber. Feed speeds can be increased as target sizes and kerfs are reduced. This technique is claimed to be efficient in sawing frozen wood, which implies that variable-pitch bandsaw blades would work well also in the processing of hardwood.

Manufacturing and maintenance of bandsaw blades with variable pitch require special machines, mainly computer controlled, to achieve high accuracy in blade parameters.

Workshop



Safety

Storage and transport

Machines

Tools

Size of the workshop

Floor

Walls and roof

Lighting

Ventilation

F

Workshop

Proper care and continuous maintenance of your bandsaw blade is vital to the efficiency and prosperity of the sawmill operation. Here are a few tricks to help you in your work.

Safety

Adequate action has to be taken to make sure safety rules are followed and that personal protective equipment is used whenever needed.

Goggles have to be used in all grinding work. In dry grinding of stellite, special protective masks should be used to avoid the inhaling of hazardous particles.

Protective clothing to evade cutting fluids to come in contact with the skin, is an important part of the grinder's personal equipment.

Ear protectors are to be used when it is evident that the sound level is dangerously high. A noise level of 85 dB may already damage your hearing, and noise levels of 120 - 130 dB, not uncommon in many industrial surroundings, will be definitely painful.

Special arrangements must be made to collect grinding waste, especially from stellite, as this can be hazardous to your health.

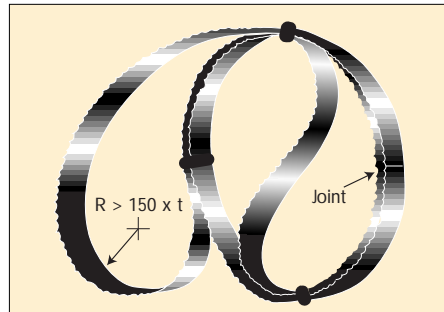
Storage and transport

Correct storage of bandsaw blades is important. The methods for storing vary, some users prefer to keep the blades hanging on the wall whereas others place them on the floor. The most important thing, however, is that enough space is left for the storing to permit easy and efficient access to the blades.

The most important recommendations to correct storing could be summarised as follows:

- Avoid too tight curvature in the blade, the recommended minimum equals radius 150 times the thickness
- Loosen the blade so that it forms a larger loop, if it is to be stored for some considerable length of time
- Make sure that the joint comes in the part of the blade with the least curvature
- Protect the teeth with a plastic cover
- Store in a dust-free, dry place

When bandsaw blades are transported, they should travel in boxes with proper protective cover of plastic strips.



Follow recommendations for correct storage.

Machines

Depending on the size of the operation, a number of machines are needed. These vary with the work to be carried out; in production of bandsaw blades different machines are used than for example in the workshop of a sawmill.

Machines should be set up in the most practical pattern to follow the production line and maintenance scheme. Make sure there is enough room between machines, and don't forget to reserve ample space for intermediate storing of the blades.

Tools

All tools should be stored as practically as possible with regard to the work on hand. Sensitive instruments such as measuring devices etc., should be kept protected from grinding dust and other particles which might damage their functions.

Size of the workshop

The workshop should be so large as to give ample space for the work to be done. Bandsaw blades should be easy to handle between machines, and other tools should be within easy reach. In a sawmill the workshop should be situated so that access to the sawing machines is fast and simple.

Floor

The floor of the workshop is normally made of wood or woodlike material to protect the blades from damage when moved from one machine to the other or when transporting them to the sawing machines.

Walls and roof

Production as well as repair and maintenance of bandsaw blades produces high-level noises. Make sure that walls and roof are properly insulated to meet the required thresholds of hearing.

Lighting

Good lighting is essential for production of as well as maintenance work on wood bandsaw blades. In North America it is not uncommon that benchwork stations are very dark, to provide better control of the light gap.

Ventilation

Good ventilation is required to make sure that grinding dust is adequately taken care of.



Plastic strip is used for tooth protection.



Wooden floor will protect blades from damage.

Toothing



Punching

Punching tools

Tool clearance

Clearance angle

Punching force

The punching press

Laser cutting

Water-jet cutting

Cut to length

G

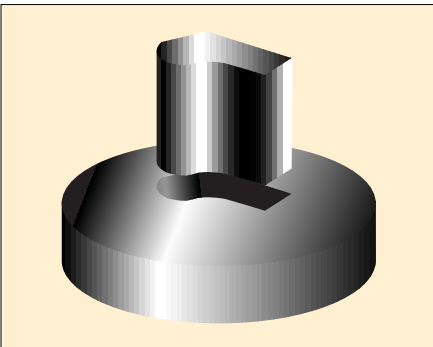
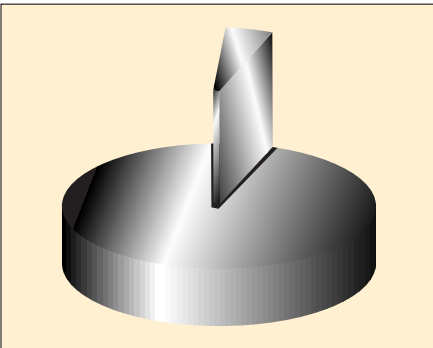
Tothing

There are several methods for tothing band-saw blades. The most common one is punching, but new methods such as laser cutting and water-jet cutting are used to an increasing extent, not least thanks to their flexibility.

Punching

Punching tools

In punching the teeth are blanked with a punch and die. The punching tool can be open or closed. Open tools are normally used for punching small teeth whereas closed tools are recommended for wide bandsaw blades.



Open and closed tools (punch and die).

	C	Cr	Mo	V	W
AISI D2	1.6	12.0	0.80	0.85	
AISI M2	0.9	4.0	5.0	1.9	6.5
W.-Nr. 1.3344	1.3	4.2	5.0	3.1	6.4

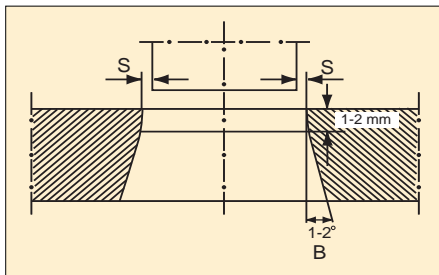
*Recommended steel grades for punching tools.
Hardness HRC 60-63.*

It is important to choose the right tool for the job. The correct tool parameters have to be selected so as not to damage the steel, neither in the sawblade nor in the punch. The table gives a few recommendations what steel grades should be used in punch and die.

In punching each tooth shape needs its own tool. It must be precision ground with proper clearance to avoid punching burrs and deformation. Incorrect clearance may also cause undesired residual stresses which may lead to cracking and bent teeth, resulting in unstable sawing. Remember to resharpen the tools frequently, worn tools may damage the blade and cause cracks.

Tool clearance

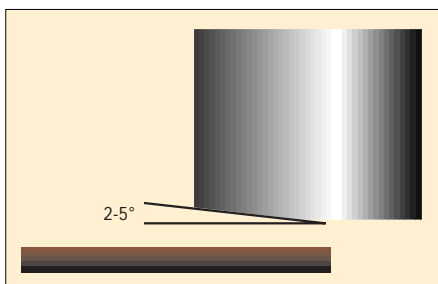
The tool clearance, as indicated in the illustration, is understood as the perpendicular distance (S) between the punch and the die. It should be about 4% of the strip thickness. In closed dies the angular clearance (B) should be approximately 1 - 2° and starting about 1 - 2 mm (0.04 - 0.08 in) below the cutting edge.



Tool clearance (S) and angular clearance (B).

Clearance angle

To facilitate punching, the punching tool should have a clearance angle of 2 - 5°. This reduces the cutting force and the tool wear and, together with the angular clearance in the die, makes sure that no undesired particles from the punched teeth stick to the tool.



Clearance angle in punch.

Punching force

The force to be applied in cutting steel can be calculated according to a specific formula. This will help ensure that the press is not overloaded and that the correct punching force is applied.

$F = A \times K_{sk}$, where

F = punching force in N or lbs

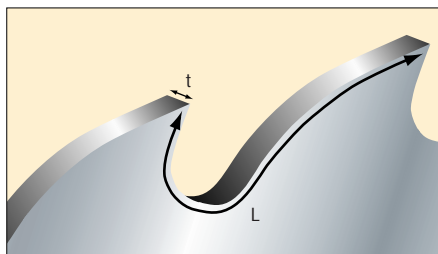
$A = L \times t$, where

A = cross-sectional area, in mm^2 or in^2

L = length of tooth curvature, in mm or in

t = thickness of blade, in mm or in

K_{sk} = shear strength, approx. 80% of tensile strength in MPa or psi.



Length of tooth curvature and thickness.

The punching press

The punching press is fitted with an automatic feed mechanism which adjusts to the correct pitch needed. The most commonly used machines are eccentric presses. Make sure the press is always stable to avoid vibrations, or it may lead to improper punching and increased wear on tools.



Punching of teeth.

Laser cutting

In a laser system, energy in the form of light is focused optically to produce a high-density beam in a small area. Enough energy can be focused and delivered to a spot on a piece of material to actually generate heat to melt through. The laser cutting process requires machine tool platform to support the cutting head.

Normally, when cutting teeth to bandsaw blades, the cutting head is moving in one direction meanwhile the strip is moved in another direction. The two axles are controlled by computers.

The main advantage of laser cutting is its flexibility. No tools for different tool shapes are needed, the shapes are programmed and easy to change if need be, all you have to do is to choose a new program. An added benefit is the possibility to cut complicated tooth shapes, such as variable pitch.

With its high heat density, laser cutting causes a heat-affected zone (HAZ) where the structure and the hardness of the steel changes. The layer of HAZ has a very hard zone of untempered martensite, which must be removed to avoid damages in the steel during the sawing operation, when the blade bends over the wheels.

Laser cutting is applied in manufacturing of bandsaw blades where many different tooth shapes and often complicated ones, are used.

Water-jet cutting

Water-jet cutting is a technique where materials are cut using a jet of water forced from a nozzle at very high speed and pressure. In cutting steel, an abrasive medium is often used together with the water when it hits the workpiece.

The cutting nozzle is normally mounted on a saddle on the cross axis of a twin-motion system. When cutting bandsaw blades the strip is fed in another direction.

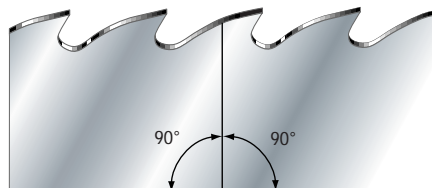
The greatest advantage of water-jet cutting in the manufacture of bandsaw blades, is the flexibility to cut complex tooth curvatures and the fact that the steel in the cut zone will be free from thermal and mechanical stresses.

The cut surfaces are somewhat rough and must be ground to eliminate the risk of cracking.

Like in laser cutting this method is suited for manufacturing wide bandsaw blades which call for many different and often complicated tooth shapes.

Cut to length

The bandsaw blade is normally cut to length after toothing. When cut, the ends have to be at an angle of exactly 90° to the back, to avoid that the blade twists. The actual length of the blade is defined as number of teeth and pitch.



The steel must be cut at a 90° angle against the back edge of the blade.

Normally the blade is cut and welded at the back of the tooth, as the welding operation creates zones where the mechanical properties are lower. In flash-butt welding, where the influence is lower, the joint can be made at the bottom of the tooth, which will give better current distribution during welding to produce a more homogenous joint.

The strip is cut to length with powerful shears. The cutting edges must be sharp to avoid cutting burrs, tearouts and other deformation. If burrs form, they should be filed away to make sure the surface is well prepared for homogenous welding. In laser and water-jet cutting, tothing and cutting of the strip is carried out in the same operation.



Cutting to length is made in powerful shears.

Welding



MIG welding

Equipment

Feeding device for wire

Welding gun

Filler metal

MIG-welding machine

TIG welding

Flash-butt welding

Gas welding

Treatment of the weld

H

Welding

Welding is the most common method to join bandsaw blades. Normally four different methods are used:

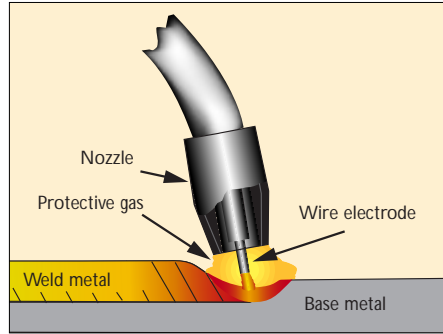
- MIG welding
- TIG welding
- Flash-butt welding
- Gas welding

Welding influences the properties of the strip material in a negative way. During the welding operation the material first melts and then solidifies very fast. The blade will rapidly carry off the heat and the surrounding material will be heat-treated in this process. The result is a structure in a heat-affected zone consisting of untempered martensite, pearlite and bainite on the side of the weld. The untempered martensite in the weld is very brittle as this is a casting structure.

One way to lower the hardness of the steel is to heat the sawblade to approximately 400°C (750°F) after welding. There is a risk, however, that cracks may have appeared already before the annealing. This is the reason why we recommend annealing to be carried out right after the welding sequence.

A better way is to heat the strip edges to a temperature of 400°C (750°F) during the entire welding process. The weld does not cool off so fast as to produce e.g. pearlite and bainite in the weld and in the heat-affected zone. This procedure may well be applied also for the repair of cracks, when the blade material should be heated until it has reached a blue-gray shade.

It is important to have good control of annealing times and annealing temperature so that the weld does neither become too hard, nor too soft.



The MIG welding technique.

MIG welding

The most commonly used method to join bandsaw blades is by MIG (Metal Inert Gas) welding. It is carried out in a gas-shielded atmosphere which surrounds an electric arc. In MIG welding an electric arc is struck between a continuously fed, consumable wire electrode and the workpiece, the bandsaw blade, all enclosed by the protective gas. The electric current to the electrode is produced via a relay in the welding gun. It is connected to the plus pole of a continuous-current circuit. The electrode is fed mechanically, melts in the arc and changes into larger or smaller drops to be deposited at the welding point. A gas protects the arc, the melt and the filler metal from being affected negatively by the oxygen and nitrogen in the surrounding air. It is fed concentrically to the welding point around the electrode.

Equipment

The main elements of the MIG-welding equipment is the power source and the feeding device for the electrode and the welding gun.

MIG welding is carried out almost exclusively by direct current and with the electrode attached to the plus pole of the power source.



MIG welding of wood bandsaw blade.

The most common power source is a rectifier, although sometimes a welding converter is also used. The machine is adapted by controlling the speed of the electrode and the arc current, in this way the current intensity can be controlled to stabilise the arc at the point between the welding gun and the welding point.

Feeding device for wire

The feeding device shall continuously transport the electrode to the arc. The electrode is fed by a wire guide. In relation to the electrode bobbin and the welding gun, the feed motor is placed in a position where the electrode is fed through the wire guide.

Welding gun

The welding gun is the tool by which the electrode is guided along the joint. It supplies the current needed for the electrode, it forms the necessary gas shield and it starts and interrupts the welding sequence.

The electrode, the protective gas as well as current for welding and operation, is fed into the gun from a special package of tubes.

Filler metal

We recommend as filler metal a wire grade corresponding to the strip steel (normally 0.75% C) or a low-carbon, un-alloyed welding wire such as ESAB OK 12.51.

MIG-welding machine

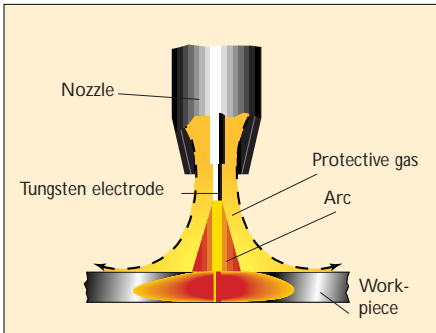
The standard equipment for MIG welding is normally constructed for semi-automatic welding. The method is, however, most suitable for automated welding.

A thermostat-controlled equipment for pre-heating and annealing will eliminate the risk of cracking. The annealing is automatic, it is sufficient to leave the sawblade in the machine for 5 to 10 minutes after pre-heated welding 400° C (750°F).

The welding wire is fed automatically by the welding gun. Through this is also fed the gas which protects the melt during the welding process. A recommended mix of protective gas is 80% argon and 20% carbon dioxide.

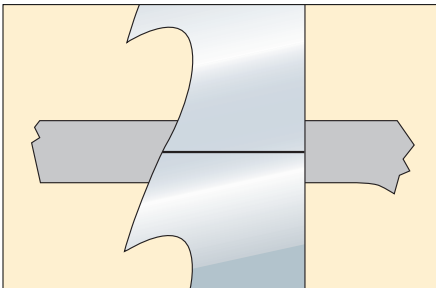
TIG welding

TIG (Tungsten Inert Gas) welding is another method suitable for welding bandsaw blades. Contrary to MIG welding the current is not fed via the welding wire but via a special tungsten electrode, where argon gas is blown at the welding point to prevent oxidation. This is a faster process than gas welding, and the heat-affected zone is narrower.



The TIG welding technique.

Welding is carried out in one passage. Place a few small pieces of identical blade material closest to the edges and let the weld continue into these. In this way the cracks and melts at the end of a weld can be avoided and the weld will be very clean and homogenous.



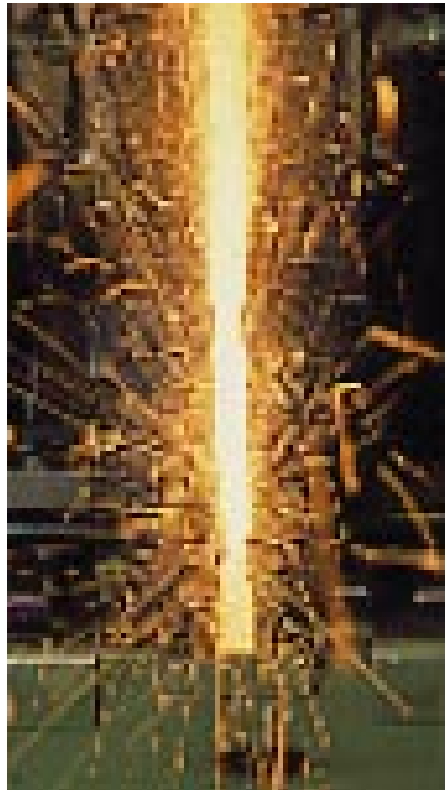
Using small pieces of identical blade material will prevent weld defects.

TIG welding is basically an automated welding method, although it can be carried out manually as well.

TIG welding of bandsaw blades normally uses filler metal. We recommend wire of a grade corresponding to the strip steel (normally 0.75% C) or low-carbon, un-alloyed electrodes such as ESAB OK 12.51.

Flash-butt welding

This method is mainly used in the production of new bandsaw blades. In certain cases it may also be used for repair work.



Flash-butt welding.

The carefully cleaned blade ends are brought into contact under controlled feed and a low-voltage current with high intensity is passed through the weld point. The points of contact melt until the joining surfaces have been raised to the preset temperature. The blade ends fuse and are then left to cool under pressure while they are annealed at intervals according to pre-set annealing programmes. All processes are automatic.

The hardness of the weld is more homogenous in flash-butt welding as compared to other welding methods, as no filler metal is used.

The diagram shows the various hardness profiles in flash-butt and MIG-welding joints.

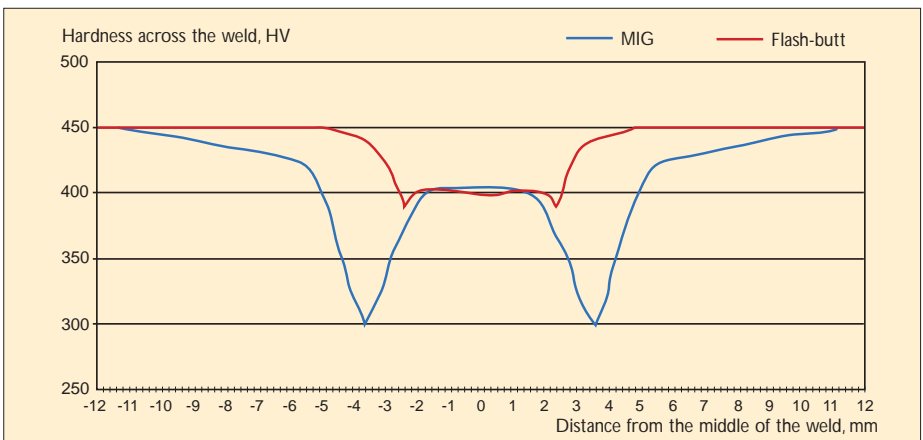
Gas welding

In gas welding the required heat is generated by burning acetylene in oxygen. Gas welding is a commonly practised method, but its best application is for repairs in small sawmills.

Because of the lower penetration capacity of gas welding, a gap of up to 1 mm (0.04 in) is generally used, or else the band ends are bevelled to 60 - 70°. This applies to welding by stages from the centre of the band. When welding is done straight across from one edge to the other, there is no gap at the starting end and the gap at the finishing end is varied to suit the thickness of the blade.

In order to prevent weld defects at the beginning and end of the weld, small pieces of band should be placed against both edges of the blade where the welding work can be started and ended. We recommend that you use the forehand technique and that you start welding at the edge of the tooth.

In gas welding the blade is heated to 450°C (840°F) and then kept at that temperature for five to fifteen minutes to temper the weld. The exact time is determined by the blade thickness.



Flash-butt and MIG-welding joints show varying hardness profiles.

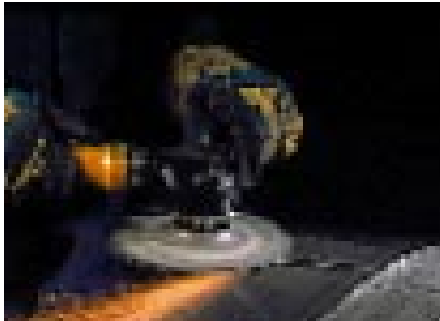
Treatment of the weld

After welding the joint must be ground and polished. This is carried out in a special grinding table, where the blade is fastened to the curved "bed".

The joint should be placed on the highest point of the table during grinding. Make sure that grinding dust is effectively taken care of by the dust extractor, which should be placed as near to the grinding location as possible. Use an elastic grinding wheel in grinding the joint. This is an efficient way to control the removal of excessive material.

The joint should be ground to be absolutely level on both sides of the strip. Make sure that the weld is not thicker than the strip after grinding. We recommend that the joint should be a few hundreds of a millimetre, 0.03 - 0.04 mm (0.001 - 0.002 in) thinner than the strip itself. Do not forget to grind carefully also the gullet and back of the blade. Finish the operation with the help of a rotary polisher, which will give the joint its final, smooth surface.

After welding the joint must be levelled and tensioned. Carry out the rolling in a tensioning bench and make short rolling passes over the weld to make it flat.



Grinding of the weld to make both sides of the strip absolutely level.



Polishing the weld with a rotary polisher will give the joint a smooth surface.

Bench work



The bench

Levelling

Tensioning

Straightening

Other tensioning methods

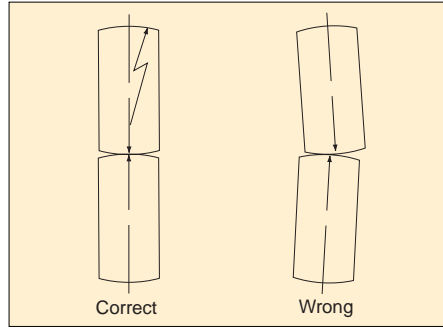


Bench work

Levelling, straightening and tensioning are three interconnected operations which have to be performed alternately when a blade is being prepared. To make straightening and tensioning possible, levelling must always be one step ahead.

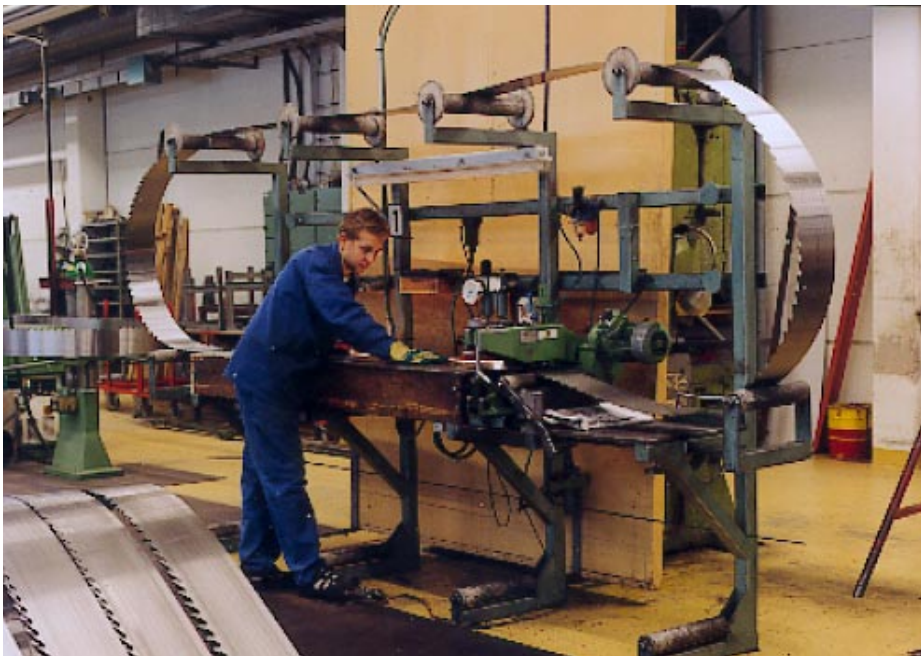
The bench

All three operations are normally carried out in a tensioning bench, where the strip is rolled between two symmetric rollers. The condition and position of the rollers should be checked continuously for the best tensioning result. The rollers must have exactly the same radius and be correctly centered to achieve uniform rolling.



The rolls must have exactly the same radius and be correctly centered.

During the operation the blade is fed by the rollers. The sideways position of the blade is adjusted manually. The rolling pressure is adjusted as called for during the operation in question, and normally by a shaft and screw.



Tensioning bench.



Rolling of bandsaw blade.

The bench should be well lit to get a proper feed-back about flatness etc. It is normally equipped with a light table to facilitate the checking of the blade's straightness. It should further have a back light to check the light gap in the tensioning process.

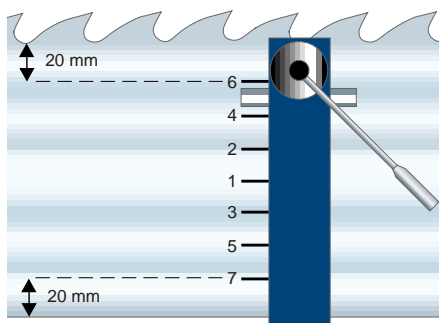
Levelling

In levelling the blade is rolled to become absolutely flat before the operations to follow. After sawing, lumps and bulges may have appeared in the blade, which have to be levelled out to ensure good stability and to obtain an optimum sawing result.

Levelling should be carried out in a bench by rolling. In certain cases, such as when the lumps are very small or when rollers are not available, levelling could be made by hammering.

During the levelling operation several tracks are rolled lengthwise in the blade. The first rolling passage is made in the middle of the blade, the next two passages on either side of the first track and so on.

The rolling result should be checked with a straight rule. The blade should not be rolled closer than 20 mm (0.8 in) from the edges.

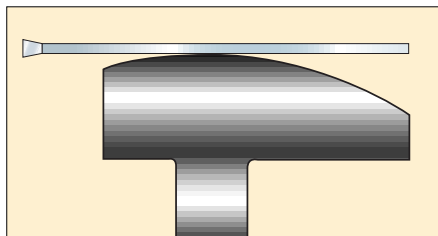


Rolling is made from the centre of the blade outwards towards the edges.

Tensioning

The purpose of tensioning is to elongate the middle of the blade so that when bending the blade, its crosswise profile corresponds to the crown of the wheel properly over its entire width during sawing. The wheels are normally crowned to prevent the blade from wandering backwards and forwards.

If the middle of the blade has not been stretched sufficiently, it will make contact with the wheels only at the highest point and will be quite free to move laterally. The toothed edge will then have no stability; the blade will not cut true, and cracks will occur easily.



A blade which makes contact with the highest point of the wheel only, will travel laterally.

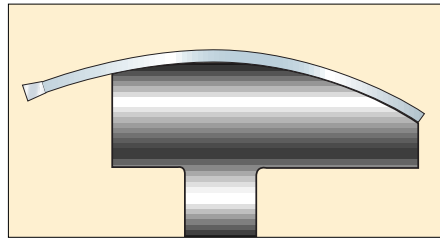
Compared to the toothline and back edge, the centre is elongated by rolling.

Tensioning is carried out by rolling several tracks lengthwise, starting in the middle of the blade as in the levelling process. As the middle of the blade will be stretched more than the edges, the higher rolling pressure is applied here, to gradually decrease towards the edges (see illustration under Levelling). The rolling pressure should not be too high, as the blades will then become wavy and difficult to level afterwards.

The tension is normally measured by checking the light gap with a straight rule. The light gap is formed when lifting up the blade from the bench. The amount of light varies with the blade size and the shape of the crown of the wheels. The table shows the approximate recommended values in a number of cases.

Blade width		Light gap	
mm	in	mm	in
100	4	0.3	0.01
150	6	0.6	0.02
200	8	0.9	0.03
250	10	1.4	0.05
300	12	1.7	0.07
400	16	2.7	0.11

A correctly tensioned blade should fit on the wheel as described in the illustration.



Correctly tensioned blade on wheel.



Checking the amount of tension.

If the tensioning is insufficient and the light gap is not large enough, the blade will be in contact only with the middle of the wheel and result in unstable sawing. If tensioning is too hard, the light gap will be too large, in which case the blade edges will tighten too much and increase the risk of cracking.

Straightening

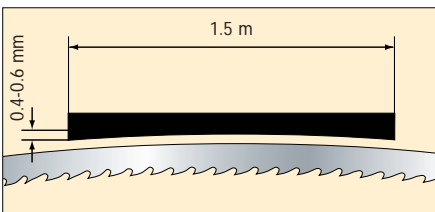
The purpose of straightening is to elongate the back edge of the blade to make it more stable during the sawing process. When the blade is set up in the machine, the tension will be concentrated to the toothline because of the curvature of the back edge. This gives the toothline the rigidity and stability needed to keep the blade from crooked sawing.

When the blade is cutting, it will heat up primarily in the teeth and in the region below them. This elongates the toothline and has to be compensated for by straightening the back edge somewhat.

When the blade is sharpened it becomes narrower, and the back edge comes closer to the middle of the wheel. Consequently the tension of the blade tends to move away from the toothline towards its back edge. This tendency is counteracted by lengthening the back edge of the blade to a corresponding degree.

Straightening is made by a few rolling passes at the back edge of the blade using low rolling pressure. Do not roll closer than about 20 mm (0.8 in) from the back edge, because the back of the blade is liable to crack if it gets rolled too hard.

The desired curvature will be produced more rapidly the closer to the back edge the pressure is applied, or the heavier the pressure on the rolls. But proceed slowly and check frequently.



Straightening the back edge of the blade.

Automatic levelling, tensioning and straightening machines

In modern benching machines levelling, tensioning and straightening operations are carried out automatically.

Contact sensors or no-contact probes measure the deviation over the entire length of the blade at selected intervals, and indicate deviation in flatness and straightness as well as lumps and bulges which may have appeared in the steel. Based on the measurement results, the pair of rollers work to correct the deviations. Measurement and rolling is continued until deviations fall within the chosen tolerances.

In machines for automatic tensioning and straightening, the program measures the actual level of tension over the entire blade width. The rolling station is activated, and remains active for so long as it takes to achieve the correct tension level. Tensioning and straightening procedures can be pre-programmed as regards the blade dimension as well as the required amount of tension and straightness.

Automatic machines carry out all the functions they are programmed for without supervision and come to a stop on completion of the programme. This makes it possible for the workforce to concentrate on other duties.

To get a good result in benching, which incorporates the correct programming schemes for the benching operation, it is vital that the steel has correct, narrow tolerances with regard to its various properties. The most important of these are flatness, straightness, hardness and surface finish.



Benching centre.

Other tensioning methods

There are a few other methods used in tensioning bandsaw blades, however they are not widely used. Among those are the use of gas flames or high-frequency techniques, methods not commonly used but in certain cases still suited for tensioning.

Hammering

Hammering is not recommended as it causes point-formed stresses in the sawblade which in turn give the blade undesired properties. It may result in unstable sawing and increases the risk that cracks appear. Where hammering might be the only possible method to choose, here are a few hints and recommendations to get the best result.

Hammer against an anvil with a piece of leather between anvil and blade, or use a wooden base. Together with an intermediate piece of leather, this will have the same resilient effect and makes it easier to press down lumps and bulges.

Hammer as little as possible. If you have to, use a hammer with highly polished and slightly convex faces to avoid marking the blade. Beat out the irregularities with light but firm and correctly aimed blows.

Make it a rule never to strike too long at one point. Strike a few blows where necessary, check the result and hammer again if called for.

Saw setting



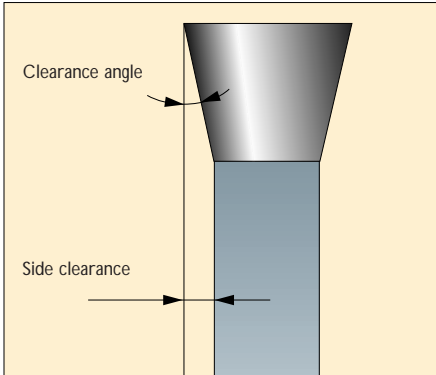
Spring setting

Swage setting

K

Saw setting

The object of spring setting, swage setting or stellite tipping is to provide clearance for the saw in the cut. The aim is to reduce the friction from the sawn timber on the blade, so that the blade can pass through the kerf without excessive heating.



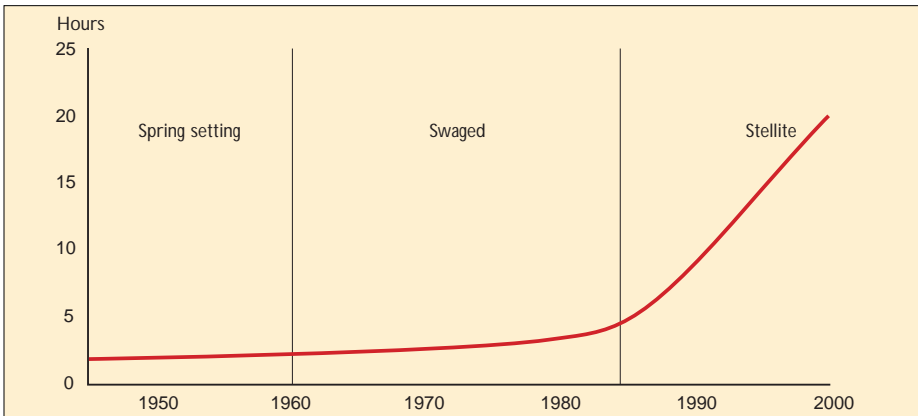
Correctly set teeth provide enough clearance for the kerf.

The amount of clearance depends on the nature of the timber. The softer and more fibrous the timber, the greater must be the set of the teeth in order to reduce friction from wood fibres projecting from the newly cut surface.

Soft timbers give coarse, long fibres, whereas close-grained types give hardly any. The latter remark also applies to frozen softwoods, which can be cut with very little set on the saw as the sides of the cut are perfectly smooth in this case. Experience has shown that swage-set teeth, and stellite-tipped all the more so, produce more efficient sawing. As the swage-set and stellite-tipped tooth points have little opportunity of sideways deflection, they always cut straighter at high rates of feed than do spring-set teeth.

With spring-set teeth there is a gap between one side and the timber, and they naturally tend to follow the line of least resistance when under load. This tends to produce crooked cuts, as the teeth are squeezed together and the blade heats up and expands.

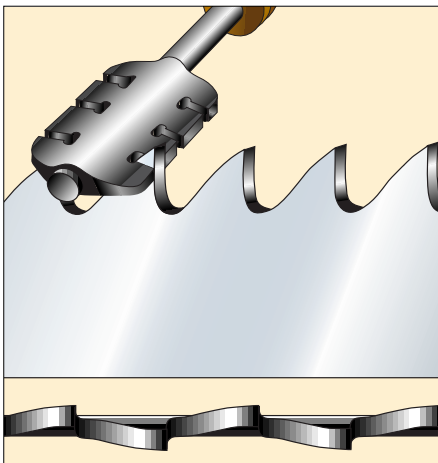
The diagram shows how the sawing time has developed over the years. From sawing times of approximately two hours with spring-set teeth in the 1950s we manage today to saw for 15 to 20 hours with stellite-tipped sawblades in un-interrupted sawing. It should be noted, however, that the techniques in themselves are not the only reason sawing times have increased, a continuous development of



Development of sawing times during the latter half of the 20th century.

the properties of the steel have a very positive impact on bandsawing. New materials and new techniques are likely to help increase sawing times considerably also in the future.

In this chapter we concentrate on spring setting and swage setting, whereas stellite tipping is outlined in a special section.



Spring setting with set pliers.

Spring setting

Spring setting is a common method where narrow-sized bandsaws are concerned and where the quality of the sawn goods is of minor importance. It is a rather simple method and cheaper than swage setting. Normally teeth cannot be swaged with a smaller pitch than 18 - 20 mm (0.7 - 0.8 in).

Spring setting is achieved by bending the teeth aside with a saw set, set pliers or setting machine. The set should be applied as close to the points of the teeth as possible, about one third of the tooth height, otherwise the teeth can easily be forced back during sawing.

As a rule the teeth are sprung alternately left and right. The set of the blade should be checked after every shift on the saw at the same time as the teeth are sharpened. A setting gauge should be used for measuring the amount of set.

In order to achieve a straighter cut, some sawyers recommend that every second or third tooth should be straight. The unset teeth stay firmly in the middle of the cut and cannot give sideways: this guides the blade.

Swage setting

The main advantages of swage-set teeth as compared to spring-set ones, can be described as follows:

- longer operational time as the wear resistance is improved thanks to the higher hardness (cold deformation)
- better sawing accuracy and surface finish thanks to the symmetry

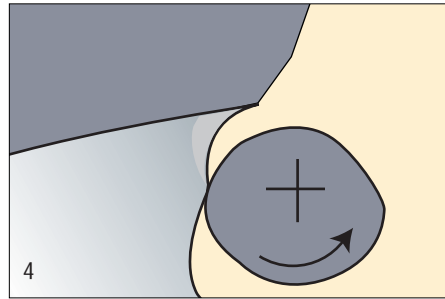
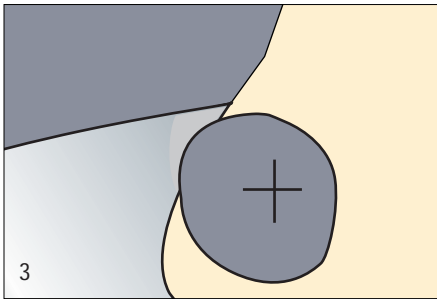
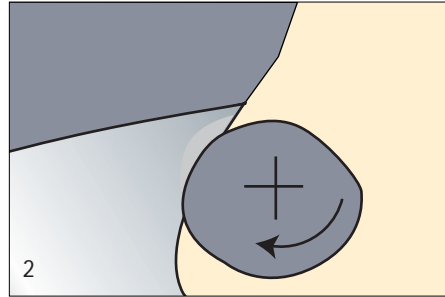
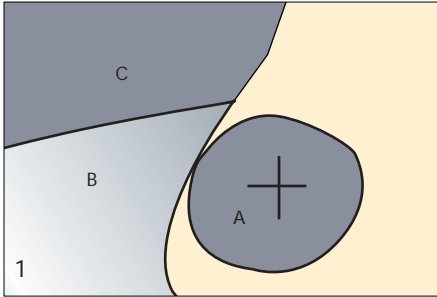
On new blades the teeth should be ground to remove possible defects resulting from the toothing and to create the proper tooth shape before swaging. Take care not to burn the steel in this process, as it may cause cracks during the swaging, and check that the teeth have not been bent because of improper punching.

The points of the teeth can be swaged with a hand swaging tool or by machine.

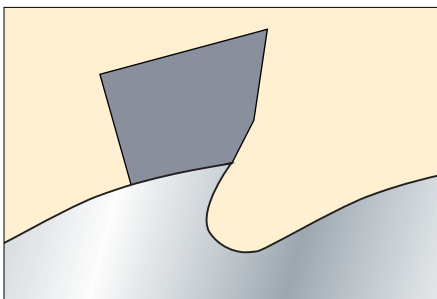
Swaging is done in two stages - upsetting and side dressing.

In the upsetting process the material on the upper front edge of the tooth is pressed backwards and outwards. This is done with a specially ground swage bar which is rotated.

The swaging anvil must butt against the back of the tooth all the way to the point. Lubricate the tooth with a wax crayon or with molybdenum disulphide (Molycote).



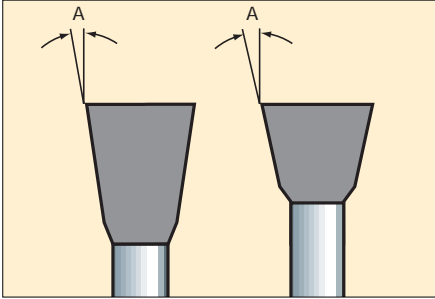
The swaging process in practice. A = the swage bar, B = the tooth point and C = the anvil.



Location of the swaging anvil.

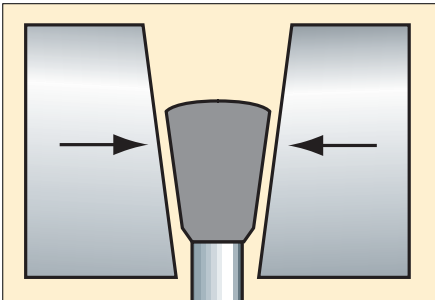
The tooth is then side-dressed to its final shape, either by shaping or by grinding. In shaping, the swaged tooth is pressed into its elevated hardness. Swaging increases the hardness of the tooth point by 7 - 8 HRC.

You can make a deep swage or a swage at the point. Deep swaging is done with a heavy swage bar. The advantage of deep swaging is that the blade can be resharpened several times before it has to be reswaged. The advantage of swaging at the point is that the tooth does not rub on the wood to the same extent as a deep-swaged tooth.



Deep swage and swage and at the point. The side clearance angle, A, is determined by the shaping dies.

We recommend that the old swage is fully ground off before re-swaging. This will remove the cold-deformed steel from earlier swaging, which is important as excessive cold deformation is likely to result in cracks when you re-swage.



The two shaping dies or grinding wheels must have the same setting and angle during swaging or grinding.



Upset tooth point, side-dressed tooth point and finished tooth point.

Improper swaging may be due to the following:

- worn swaging bar, anvil or side-dressing tool
- swaging bar or anvil inaccurately set
- incorrect size of swaging bar compared to strip thickness
- asymmetric grinding
- failure to remove all traces of previous swage set
- friction martensite (burnt steel) due to too heavy grinding
- insufficient lubrication

Note that swage and spring set clearance gradually decrease as the blade is resharpened.

Guiding figures for the amount of set, valid for spring-set and swage-set teeth:

- | | | | |
|-----------------------------|--------------|--------------------|--------------|
| • very soft wood (poplar) | 0.5 - 0.7 mm | (0.020 - 0.028 in) | on each side |
| • soft wood (pine) | 0.4 - 0.6 mm | (0.016 - 0.024 in) | on each side |
| • hard wood (oak, mahogany) | 0.3 - 0.5 mm | (0.012 - 0.020 in) | on each side |
| • frozen or dry softwood | 0.3 - 0.5 mm | (0.012 - 0.020 in) | on each side |

Stellite tipping



Stellite for wood bandsaw blades

Tipping methods

Plasma welding

Resistance welding

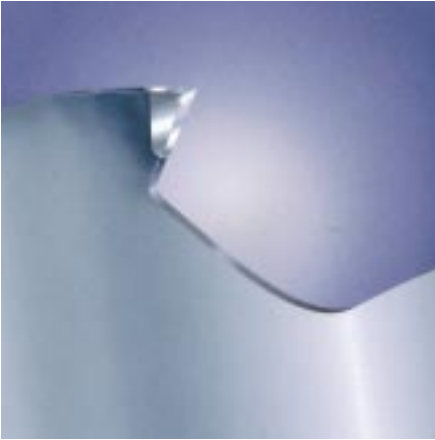
Manual tipping

Annealing

Grinding

Side grinding

L



Stellite tipping gives the tool better wear resistance.

Stellite tipping

The operational time of a wood bandsaw blade can be increased considerably by tipping the teeth with wear-resistant alloys such as stellite. This is especially evident in sawing hard woods, but is today also used in the processing of softer woods like fir and pine.

The stellite-tipped teeth give better surface finishes and considerably longer operational times. It is vital, however, that the grinding work is carried out correctly, preferably by using wet-grinding machines and suitable grinding wheels.

To utilise the properties of stellite in full, the basic steel material for the bandsaw must be of the highest quality to achieve a longer uninterrupted sawing operation.



Plasma welding.

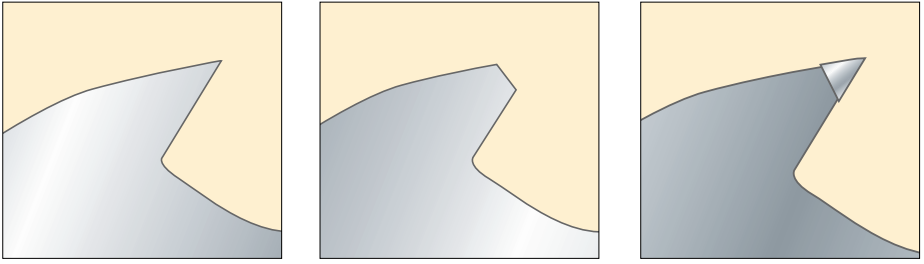
Stellite for wood bandsaw blades

Stellite is an alloy which consists mainly of cobalt. According to the composition of the alloy there is a number of different stellite grades with varying mechanical properties.

For sawing wood, the stellite grade No. 12 has proved the best solution. It consists of 52% cobalt, 30% chromium, 9% wolfram and 1.8% carbon, with a hardness of 47 - 51 HRC.

Although stellite has a lower hardness than cemented carbide (70 - 80 HRC), stellite grade No. 12 is very wear resistant, not very brittle and it can be ground without problems. In some cases stellite grade No. 1 is used, a very hard stellite which is preferred for sawing wood with extremely high silicon compound contents such as some exotic wood types in Africa and South East Asia.

Stellite tipping of bandsaw blades is today carried out almost exclusively by automated machines, notably in Europe and North America, but manual stellite tipping is still preferred in many other parts of the world.



Preparation of tooth points for stellite tipping.

Tipping methods

Plasma welding

Plasma welding is an electric-arc welding method which takes place in controlled atmosphere with high conductivity. An electric-arc is created between two poles where the arc functions as the source of heat.

With the help of the electric arc and the plasma-gas flow, a very high energy density is created. The high temperature forces the stellite material to melt and makes sure the heating zone, through the density and the strong concentration, is kept within required limits.

By means of the concentrated electric arc during stellite-tipping, it is possible to gain full control of the size of the stellite drop to be applied and its exact location. Argon is used as protective gas, a gas which is not toxic, will not burn and which creates very good arc stability. The gas not only forms the plasma, but will also keep the stellite as well as the basic material away from the air and a consequent oxidation.

The stellite is melted and formed in a forming tool. This results in a "raw" tooth, with little and uniform excess stellite material, creating optimum prerequisites for the subsequent grinding process.

With forming tools it is possible to create various tooth shapes with large or small stellite tips, thus minimising the consumption of stellite. The same stellite rod dimension (diameter = 3.2 mm, or 0.13 in) can be widely used but we recommend to use smaller rods for smaller stellite-tip dimensions, such as e.g. diameter = 1.6 mm (0.06 in) for strip thicknesses below 1.0 mm (0.04 in).

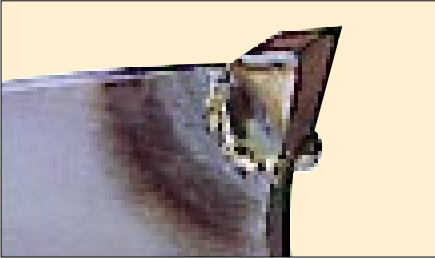
To achieve a stellite tip of constant length and thickness, the tooth points should be cut before they are stellite-tipped. This cutting operation can be carried out in various ways, depending primarily on the needs of the stellite-tip shape. It may vary according to tooth form and type of saw, as well as the material to be processed. For this purpose the tooth tips are ground out in a grinding machine.



Plasma-welded tooth point.

Resistance welding

In this process, contrary to that in plasma welding, the stellite is applied by means of an electric resistance process carried out on the basic material. The melting will only take place on the tangent surfaces of the basic material and the stellite respectively. At the same time the two materials are welded together under low pressure.



Resistance-welded tooth point.

With this method the stellite will not melt entirely in the area which is to become the tooth point, the stellite material is thus only affected in the area of contact.

In flash-weld operations the following parameters have to be carefully decided with regard to the actual blade quality and thickness (machine manufacturers' recommendations should be followed):

- strength of current
- flash-weld time
- pressure

The adaptation of the stellite dimension to the thickness of the blade and the size of the tooth is of great importance. Too large differences may cause the basic material and the stellite to melt differently, in which case the binding between the two materials will not be homogenous.

Depending on the type of stellite-tipping machine used for this method, the process can be carried out either by using pre-formed pieces of stellite or pieces cut from a stellite rod. In the latter case the rod is cut with an approximately 1 mm (0.04 in) thick cutting disc.

To achieve the required tooth point geometry a final grinding operation is needed, regardless of which method is used.

Manual tipping

Manual stellite-tipping uses ordinary gas welding equipment.

A torch with a flow of 100 litres per hour and using a 0.9 mm (0.03 in) nozzle, has proved the best solution. The gas pressure must be very low. The mixture of oxygen and acetylene must be regulated so that the flame is about three times as long as the white inner part. The latter should be held in contact with the tooth-line.

In this operation it is extremely important to achieve the correct temperature in the tooth and also to obtain stellite drops of the correct size.

If the temperature of the steel is too low, the stellite will not flow out properly, it will form a lump and fail to cover the entire surface of the tooth point.

If the temperature is too high, the steel will melt and the point of the tooth will be ruined.

The teeth can be swaged prior to tipping with stellite to form a small hollow in the front of each tooth. The tooth can also be ground down towards the point to a hook angle of about 0°, the stellite tipping can be applied without swaging.

Annealing

All stellite processes, whether carried out manually with a welding burner or automatically using plasma or resistance welding, call for annealing of the tooth points after stellite-tipping. Due to the carbon contents of the saw steel a re-hardening of the tooth point will occur through the heat influence of the stellite, developing untempered martensite. A part of the tooth point behind the stellite tip will become brittle and the risk of breakage will increase. Annealing will lower the high hardness of the steel in the heat-affected zone and minimise the breakage risk.

Annealing can be carried out by different methods, using

- plasma burner
- high-frequency annealing unit
- gas flame

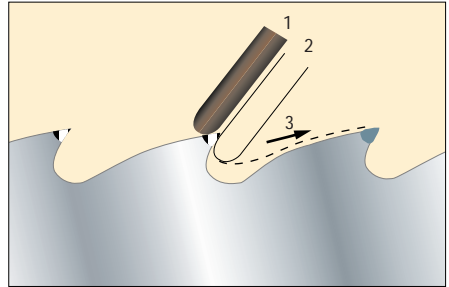
Whichever way is used to carry out the annealing, it is important that it is done in a reproduceable and controlled way. This is necessary to be able to apply the same temperature and the same annealing time to each tooth.

Grinding

Stellite-tipped bandsaw blades can be ground using conventional grinding machines, but to achieve better dimensional tolerances and better surface finish, wet grinding with CBN (Borazon) wheels is strongly recommended.

Ceramic grinding wheels give a rougher surface finish and the cutting edges lose their sharpness quickly when rough corners break.

Ceramic grinding wheels could be used in wet grinding when larger stock removal is needed. More material could then be removed and the surface finish will be better



Precision grinding of stellite.

than that achieved by dry-grinding.

To obtain the best precision and surface finish with stellite-tipped teeth, wet grinding should be carried out with CBN grinding wheels. When the teeth are to be reground, it is recommended to only grind the stellite, as CBN grinding wheels may cause friction martensite in the gullets.

Tooth gullet treatment with a rotary cemented-carbide deburrer is recommended to minimise the risk of cracking.



Finished stellite-tipped tooth point.

Side grinding

To achieve high precision in the teeth they have to be side-ground, especially where stellite-tipped bandsaw blades are concerned. In this case the teeth must be side-ground, the operation may, however, well give better precision also in swaged sawblades. Precise symmetry in side clearance and in clearance angles is a pre-requisite for high sawing accuracy.



Precision side grinding.

The operation is carried out in side-grinding machines where two grinding wheels, one for each side of the tooth, work synchronously. They are adjusted to the correct clearance angles, in the tooth back as well as the tooth breast. Modern machines will grind the sides of the tooth either on the downwards or the upwards movement of the wheels, or both.

The teeth must be well supported during grinding. If there is more molten stellite on one side of the tooth, it has a tendency to bend when ground, due to the asymmetrical side forces. This is also an important reason why the distribution of stellite in stellite tipping must have the correct symmetry.

We recommend to grind in several cycles, instead of one, heavy grinding passage. Side grinding of the stellite-tipped teeth should be carried out with CBN wheels, as these will give better surface finish and accuracy in the tooth tips.

Note:

Stellite contains cobalt. As cobalt could be hazardous to your health as well as to the environment, you should take care not to inhale it and make sure it does not get in contact with your skin!

Grinding



The grinding machine

The grinding wheel

CBN (Borazon) grinding wheels

The design of the grinding wheel

The cutting fluid

The grinding operation

M

Grinding

General

Grinding is a chipforming machining method. The grinding wheel has a very large number of sharp grains which cut chips out of the workpiece in the same way as do other cutting tools.

Two methods dominate in grinding, traditional dry grinding using ceramic wheels and wet grinding, a method which has increased significantly in later years, especially where stellite is used.

Grinding of bandsaw blades is normally carried out with the help of ceramic grinding wheels or wheels made of CBN, cubic boron nitride. As these wheels are used at high rotation speeds (peripheral speed 30 - 45 m or 100 - 150 ft per second), it is vital that selection, setting and maintenance of the grinding equipment is made with the utmost care.

The grinding machine

You should maintain your grinding machine continuously, there should be no play in bearings and guides. A vibrating wheel and play in the feed mechanism can have disastrous effects on the saw teeth. Many older types of grinding machine are often inadequately protected against the entry of grinding dust, which in turn causes rapid wear on the moving parts and the surfaces in contact with them.

In wet-grinding machines it is important that cooling and lubricating functions are kept clean and that they are working properly in order to let the fluid jet pass freely to the grinding point.

The grinding wheel

The denomination of grinding wheels

Grinding wheels are denoted according to ISO standards. The marking of the wheels include the following basic elements: abrasive, grain size, hardness, structure and bonding agent. The following system is used:



Grinding machine.

Norton	38A	60	K	-	VS
SlipNaxos	43A	60	K	-	VX
Manufacturer	Abrasives	Grain size	Hardness	Structure (normally not indicated)	Bonding agent

Denomination of grinding wheels.

Abrasive

A grinding wheel with aluminium oxide is recommended for bandsaw steel.

Grain size

Wheels of grit 40 - 80 are normally used for grinding bandsaw blades. We recommend, however, that you use the 50 - 60 range, as finer-grained wheels remove the metal less efficiently and are therefore more liable to burn the gullets due to the heavy feed pressure. This in turn may cause gullet cracks and other difficulties during sawing.

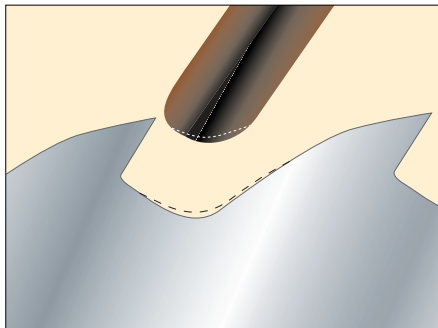
Hardness

The hardness of a grinding wheel is indicated alphabetically. The further on a letter in the alphabet, the harder the wheel it represents.

Use hardnesses L - M - N for grinding bandsaw blades. A harder wheel lasts longer, but is more liable to burn the gullets. On a harder wheel, new, freely cutting particle edges are less easily brought into play as the wheel wears down, with the result that it is liable to clog.

CBN (Borazon) grinding wheels

CBN (Borazon) grinding wheels are used to an increasing extent in precision grinding, for better accuracy and finer surface finishes at the cutting edge. CBN wheels are also favoured thanks to their longer life expectancy and, obviously, their ability to maintain the



Worn grinding wheels give incorrect tooth shapes.

grinding profile for a longer period of time. They are used in wet-grinding machines and they are recommended for grinding of stellite.

It is normally not possible to change the shape of a CBN wheel (ceramic wheels can be re-shaped to their original form by means of a special tool). They must therefore be exchanged before their form has changed too much, to avoid differences in the shape of the grinding wheel and the tooth curvature.



Dry grinding.

The design of the grinding wheel

The shape of the grinding wheel and the combined feed of wheel and blade, must match exactly the profile of the teeth to get the required tooth shape. This is also important in order to avoid friction martensite in various parts of the tooth, and especially so in the tooth gullet.

Keep the wheel well rounded and sharp, that is, free from any impurities or deposits on the cutting surface. Otherwise the abrasive particles will not cut freely, but will burn the saw steel.

Certain machines are fitted with a thin, 5 - 10 mm (0.2 - 0.4 in) wheel to be used irrespective of pitch. In this case the machine is designed to give the required grinding results.

The cutting fluid

The cutting fluid has three different tasks. It should conduct heat away and it should also prevent heat from accumulating. The cutting fluid thus has a cooling as well as a lubricating effect. In addition to this it should also flush the chips away.

Various types of cutting fluid

Water-soluble fluids consist of water with certain additives to increase the wettability and to protect against corrosion etc.

They contain no oil.

An emulsion is a cutting fluid consisting of water with a mix of 1 to 5% oil. The oil forms drops of a few thousands of a millimetre in size, spreading evenly in the water. Additives of sulphur and chloride compounds, will improve the lubricating effect and facilitate the forming of chips.

Cutting fluids are most often based on mineral oils.



Wet grinding.

How to apply the most suitable cutting fluid

It is important to choose the correct cutting fluid for the grinding operation. To achieve the best result, however, it is also necessary to make sure it is applied correctly. The flow must be large enough, at least one litre a minute per each millimetre of the grinding wheel width, should be chosen. If both the feed and the speed of the wheel is high, larger flows will be needed.

A sufficient flow of cutting fluid is vital. It is, however, equally important that the flow is arranged in such a way that the fluid reaches the right point. It should be aimed at the contact surface between the workpiece and the wheel, as this is the point where heat is accumulated. The design and location of the nozzle is of great significance.

It is also important to clean the cutting fluid in a satisfactory way. The cleaning device must be properly maintained. Clean the space between the blasting protection of the grinding wheel and the surrounding machine parts at intervals!

The grinding operation

The feed speed and the grinding speed in combination with the depth of the grinding, must be carefully adjusted to avoid friction martensite in the tooth gullets, so called burnt gullets. The grinding feed, as set out in the machine and wheel manufacturers' recommendations, should be followed.

Adjust the shape of the grinding wheel to match exactly the form of the tooth curve. Then adjust the depth of grinding to avoid grinding burrs on the clearance side of the tooth.

After grinding the gullet must have no dark zones. Dark zones indicate that the steel has been overheated. This in turn results in friction martensite, which is extremely hard and brittle and forms a good starting point for gullet cracks when the blade is turned over the wheel. It is advisable to grind several times, using a small grinding depth instead of using very hard grinding. To repair cracks would take very long and the time saved by faster grinding may thus very well be lost many times over.

Gullet treatment

Treatment of gullets is discussed in detail in a special chapter, Gullet treatment.

Gullet treatment



N

Gullet treatment

The most common reason why cracks appear in gullets is that untempered friction martensite builds up because of too hard grinding. What, then, is friction martensite? It could be described like this:

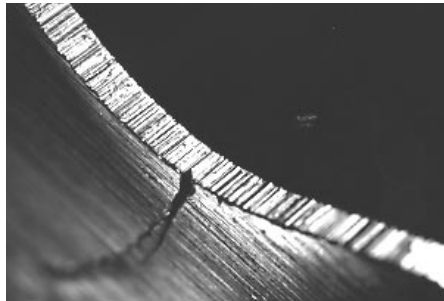
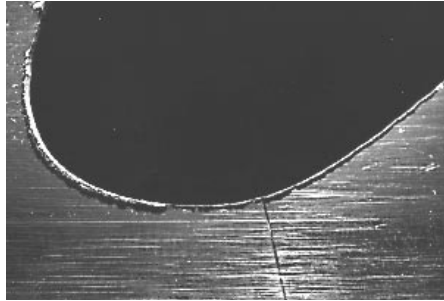
“Friction martensite is a result of too hard grinding of the teeth. The friction between the grinding wheel and the saw blade increases the temperature drastically in a thin layer of material which is hereby transformed into untempered martensite when it cools in room temperature. Friction martensite has a very high hardness and is very brittle, almost like glass.”

The amount of friction martensite could be decreased by choosing the right kind of grinding wheel and by adjusting the grinding parameters, such as grinding speed, grinding depth etc. After too hard grinding the result appears in the tooth gullets in the form of deep grinding scratches, grinding burrs and dark zones, as shown in the illustrations.

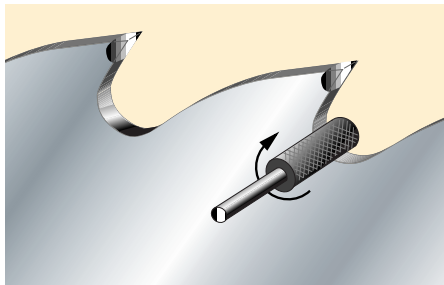
To minimise the risk of gullet cracking, we recommend that the gullets are polished with a cemented-carbide deburrer. This removes crosswise grinding scratches and grinding burrs, if correctly applied.

The deburrer is operated by a machine at a rotation speed of more than 28,000 rpm, which produces adequate chipping without burning the steel. Make sure the deburrer is always kept at the correct angle to polish the entire surface of the gullet bottom.

The two illustrations show the gullet bottom after ordinary grinding and the same gullet bottom after deburring with a cemented-carbide deburrer. In the first picture friction martensite can be seen as a white layer on top of the rough gullet surface. The martensite is removed with the deburrer to produce a smooth surface.



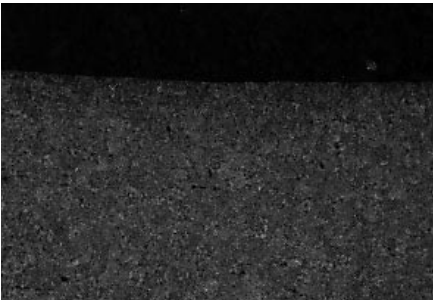
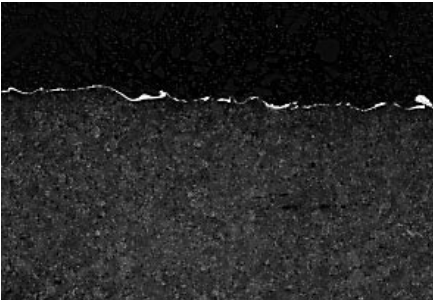
Grinding burrs causing cracks and grinding scratches are due to too heavy grinding or use of the wrong grinding wheel.



In deburring it is important that the entire surface of the gullet bottom is polished.



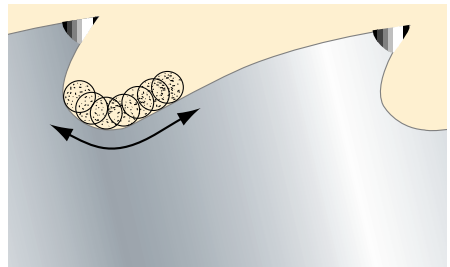
The deburrer should always be kept at a correct angle to produce the best result.



Friction martensite (white layer) is removed with a cemented-carbide deburrer to produce a smooth surface.

As the highest stresses are concentrated to the lowest point of the gullet, it is not necessary to polish the entire toothline, it will suffice to polish the gullet bottom where the cracks normally initiate.

Make sure the deburrer has sharp edges, as a dull tool will cause friction between the steel and the deburrer. This, like too hard grinding, will also form friction martensite.



The highest stresses are concentrated to the gullet bottom.

Inspection of blades



Cleaning and inspection of bandsaw blades

0

Inspection of blades

Cleaning and inspection of bandsaw blades

Basic rules to keep your bandsaw blade in good shape after it has been engaged in sawing:

- Clean the blade
- Check the following details for possible damages
 - gullets
 - tooth points
 - blade body
- Check the tension
- Check the tooth symmetry

During the sawing process the bandsaw blade will be subjected to a number of different stresses which influence the properties of the blade. Also resinous particles will affect its performance, and it is therefore important that good care and maintenance is observed to get the best sawing result.

When the blade is changed, clean it properly from resin and other dirt particles. Use a piece of cloth and a suitable dissolvent. Brushes or fine abrasive paper could be used to remove tighter layers. A clean surface reduces the friction between the blade and the wheels as well as the blade guides. Cleanliness is also a basic requirement to make sure the rest of the maintenance operation can produce the desired results.

Inspect the blade after each sawing period and observe if it has been damaged. Look for gullet cracks, bent teeth, broken tooth points, body cracks etc.

Minor damages can be repaired, while it may not be economical to attend to larger defects, such as several gullet cracks.

The blade should always maintain its tension. This is seen as a light gap when the blade is lifted up. If the light curvature has changed, the blade must be relevelled and retensioned to restore the original light gap. Retensioning is carried out in the same way as when the blade was tensioned during its manufacture. It is often sufficient to make just a few rolling passages to correct the lost tension. Remember to also check the straightening of the back of the blade.

The symmetry of the tooth points should be checked before grinding. If some teeth protrude from the original toothline, they will be ground more on one side and on the other side not at all. This grinding will cause an asymmetrical toothline producing a bad sawing result, as well as premature wear of the teeth. Check the angles of each tooth to keep up the desired tooth geometry.



Checking the tooth symmetry.

The Sandvik Multishift™ Concept



A unique bandsawing concept

The steel base

The teeth

The treatment

Economy in operation

Comprehensive testing

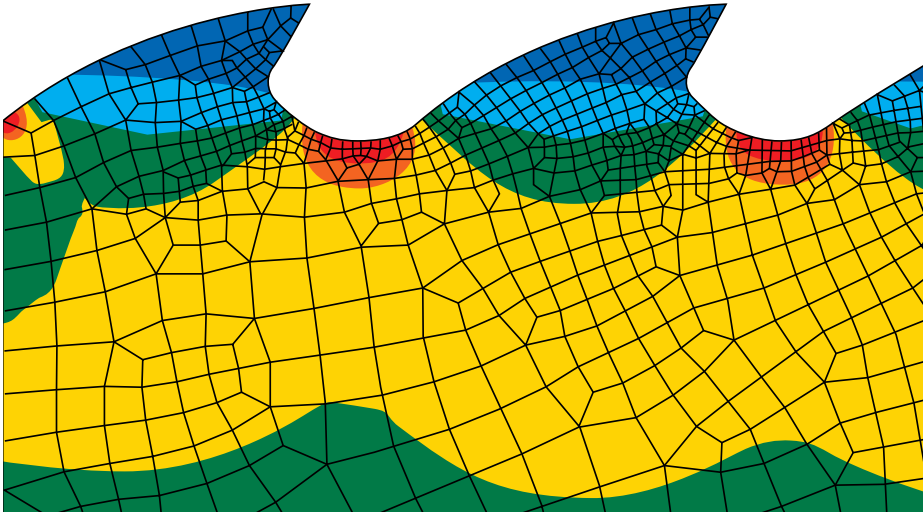
Efficiency

Higher blade reliability means less maintenance

Calculation of blade costs

Production, use and maintenance

P



The Sandvik Multishift™ Concept

A unique bandsawing concept

A combination of features make up the Sandvik Multishift Concept.

The steel base

The steel we have developed has a number of required properties.

- Higher tensile strength permits higher blade strain and thus gives better stability in the sawing process.
- Higher relaxation resistance maintains the blade tension longer.
- Higher fatigue strength allows longer operational times.
- Closer dimensional tolerances and better flatness ensure advantages in both sawblade manufacture, sawing performance and maintenance.

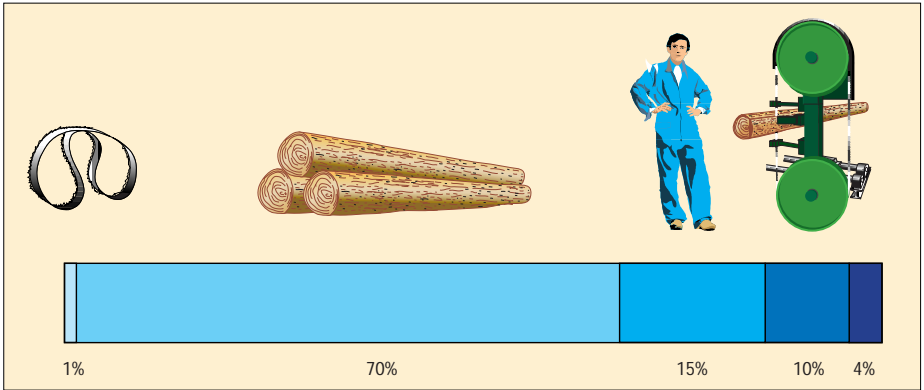
The teeth

We recommend that the teeth are stellite tipped to provide extra high wear resistance. Stellite will increase operational times between blade changes and means less maintenance. The basic Sandvik Multishift strip steel is, however, also suited for producing swaged sawblades; as it is also harder it increases the wear resistance and narrower tolerances improve the tooth point symmetry.

Stellite tipping is outlined in a special chapter in this handbook.

The treatment

To get the most out of this unique combination, correct treatment of the teeth is of vital importance to make full use of the higher fatigue strength. Correct care and maintenance of your bandsaw blade is a safe and secure way to achieve better yields.



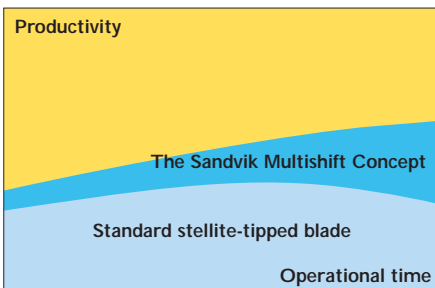
Economy in operation

In the Economy chapter we have outlined the spread of costs in the sawmill, showing that the cost of the tool makes up about a mere percent of the total cost.

A table showing how to calculate blade costs for Multishift as compared to standard saw blades, is included at the end of this chapter

Comprehensive testing

Tests under authentic conditions in a number of sawmills proved that the Sandvik Multishift Concept indeed presents some remarkable results in increased productivity and longer operational times.

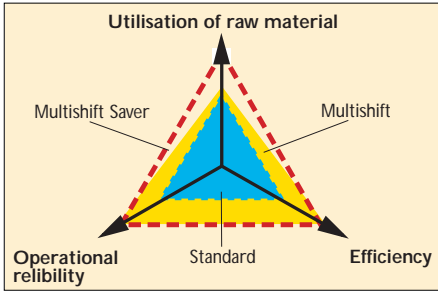


Sandvik Multishift will achieve longer operational times.

The tests have been carried out in different parts of the world and under varying but normal operating conditions for the market in question. Due consideration has been taken to the type of raw material used, e.g. soft or hard wood, and varying grades of material cleanliness, as well as to weather conditions and fluctuations in summer or winter climate, daily operational times etc.

The graph shows that the stellite-tipped standard blade at a certain point in the sawing operation will start losing in productivity. This is also where the risk of damage will increase.

The Sandvik Multishift Concept shows a stable and more productive development. Its greater efficiency at the same point in the operational-time curve is mainly due to the improved characteristics of Sandvik's Multishift steel, which allows more efficient use of the overall sawing time.



The three-leg philosophy in practice means overall savings.

Efficiency

By increasing operational times the sawing mill could drastically improve its productivity. Traditionally, breaks are common in connection with blade changes. In applying Sandvik Multishift we create conditions to increase the operational time and eliminate breaks. The result is higher productivity.

The illustration shows how efficiency will increase considerably.

Higher blade reliability means less maintenance

The improved properties of the steel in combination with stellite tipping and correct tooth treatment makes it possible to dramatically minimise maintenance needs.

In the example we have illustrated what happens when operational time is increased from four to eight and sixteen hours respectively. The decreasing need for blade changes and regrindings will result in a subsequent increase in productivity.

Blade utilisation - Sandvik Multishift Calculation	
Number of shifts	2
Hours per shift	8
Production days per week	5
Production weeks per year	48
Number of bandsaws	4
Blade hours per year	15360

Sawing time between blade changes	Number of blade changes per year
4 hours	3840
8 hours	1920
16 hours	960

Calculation of blade costs (indexed)

Today's standard
Swaged tooth points

Sandvik Multishift Concept
Stellite-tipped tooth points

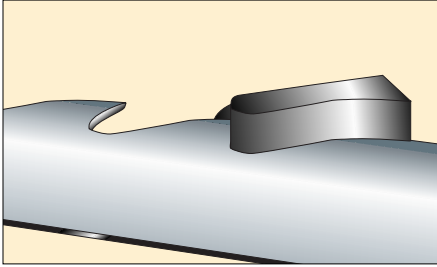
Sawing time, hours	4	8	16
Cost of			
- new blade	100 (Toothed, welded)	150 (Ready to saw)	150 (Ready to saw)
- grinding (1 round)	5	7,5	7,5
- swaging/tipping	10		
- levelling/tension	2,5	3,8	3,8
- blade change	3,5	3,5	3,5
Regrindings after	4 hours	8 hours	16 hours
Regrindings	5 /swage	15 /stellite	10 /stellite
Reswagings/retipping	14 /blade	/blade	/blade
Grindings			
- before reswaging/ retipping	3 times	times	times
- after reswaging/ retipping	3 times	times	times
Costs			
New blade	= 100	= 150	= 150
Grinding (rounds)	165 x 5 = 825	15 x 7,5 = 113	10 x 7,5 = 75
Swaging/tipping	15 x 10 = 150	0 x 0 = 0	0 x 0 = 0
Levelling/tension	90 x 2,5 = 225	16 x 3,8 = 61	11 x 3,8 = 42
Blade change	90 x 3,5 = 315	16 x 3,5 = 56	11 x 3,5 = 39
Other costs	_____	Deburring _____	Deburring _____
Total cost	1615	379	305
Maintenance, %	94	60	51
Total sawing time, hours	360	128	176
Blade costs per hour	4,5	3,0	1,7

Production, use and maintenance

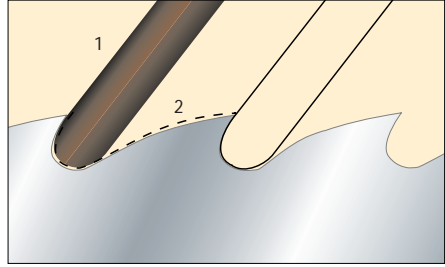
Proper handling and care of your Multishift blade will produce the best results. These are our recommendations where production, use

and maintenance is concerned, based on a lot of practical experience and test sawing under different conditions and in various markets.

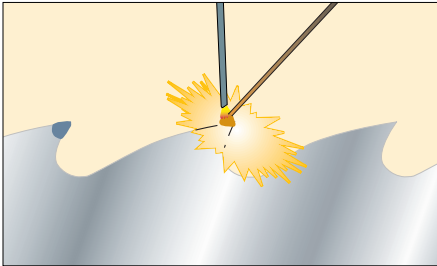
Production



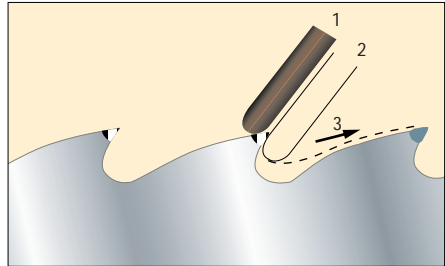
1. The teeth are blanked out of the steel strip.



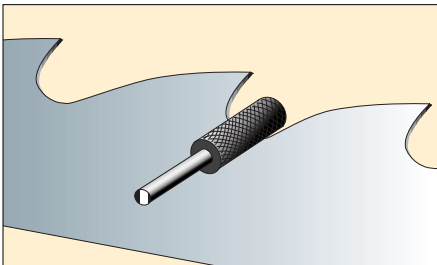
2. Grind with aluminium-oxide wheel, adjust shape and remove notches.



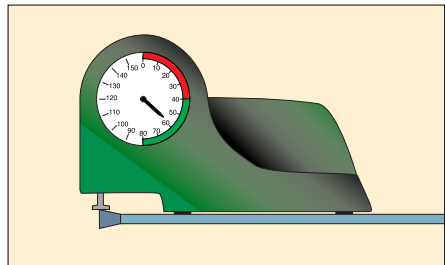
3. Stellite tipping.



4. Precision wet grind stellite with CBN wheel. Make sure the gullet bottoms are not touched by the wheel.



5. Deburr gullet bottoms carefully with a cemented-carbide deburrer, $\geq 28,000$ rpm.



6. Inspect the teeth and measure the side clearance. The saw is now ready for operation.

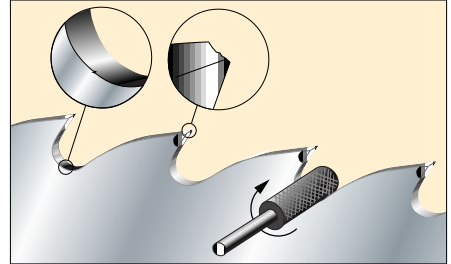
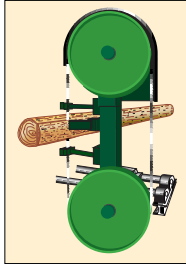
Use and maintenance

The higher tensile strip steel permits a higher blade strain. A general recommendation is a strain of 200 - 230 MPa to achieve higher stability and better sawing results. In this

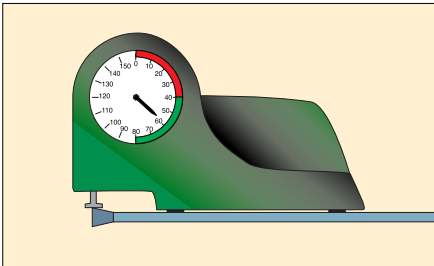
context the maximum capacity of the band-saw is naturally of vital importance. To measure the actual blade strain Sandvik has developed a special strainmeter, available from our Finnish subsidiary.

7. After sawing retension the blade at intervals as necessary. Note that retensioning a Multishift blade can be different compared to a standard-steel blade.

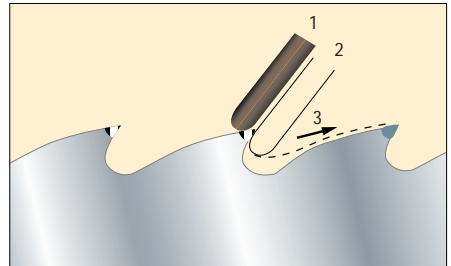
The Multishift blade is harder and therefore needs higher rolling force.



8. Inspect the saw blade. If tooth gullets are damaged, it is normally sufficient to clean the bottoms with a cemented-carbide deburrer.



9. Inspect the teeth, measure the side clearance and symmetry. If at this point the side clearance is insufficient, the stellite has been worn down and the blade should be scrapped.



10. Precision sharpen the stellite tips. Wet grinding with CBN wheel is recommended. Gullet bottoms must not be touched by wheel.

7-10. You can repeat the cycle until the stellite has been worn down. If the blade shows no damage to tips or gullet bottoms, the stellite may normally be reground ten to fifteen times.

Note:

We want to stress that scrapping of the blade according to our experience will in the end produce the optimum economy. Although in some cases there is sufficient steel material to renew the sawblade and perhaps stellite-tip it again, fatigue stresses in the blade and other stresses caused by wear and extended use, will shorten the life of the blade.

Tests show that the costs for renewal do not add up to the economical yields achieved by applying a new blade. See also the special chapter on Economy.

Sandvik Multishift™ Saver – thin-kerf sawing



A thinner blade increases productivity

More finished material

Applications

A different approach

Loss of blade stability

Loss of tooth stability

Lower gullet capacity

R

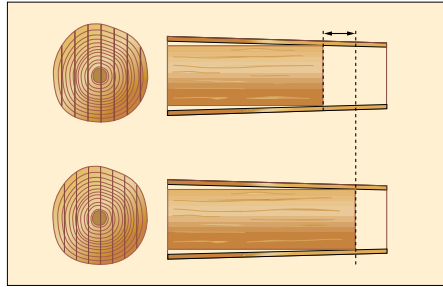
Sandvik Multishift™ Saver – thin-kerf sawing

A thinner blade increases productivity

The ongoing development of the Sandvik Multishift Concept is a continuous process, where the aim is to increase the productivity in sawmills. This is where the Multishift Saver, a thin-kerf sawing technique, comes in. The Multishift Saver is a thinner sawblade which produces a narrower kerf. This narrower kerf would allow more sawn material to be taken out of each log.

The illustration shows what happens in practice when you saw with a thinner blade.

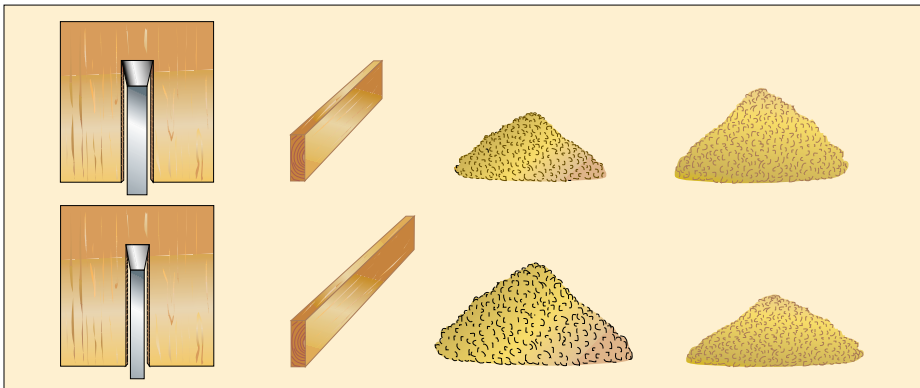
The kerf produced by a normal bandsaw blade, will produce a certain amount of board out of one log. It will also produce an amount of chip and a pile of sawdust.



A narrower kerf will produce more board out of the log.

The thinner sawblade produces a narrower kerf, which means a larger number of boards will now be produced from the same log. It will, eventually, produce a somewhat larger amount of chip, but a significantly smaller pile of sawdust.

If you look at the cost structure of boards, chip and sawdust respectively, the use of the thinner sawblade will thus have a great influence on the economy of the total sawing operation.



The thinner sawblade produces more boards and more chip, but less sawdust and will improve the economy of the sawing operation.

More finished material

Applying a thinner sawblade in the sawing process thus produces more board out of one log. Let's take a look at what happens further on in the processing chain as a result of this.

We assume that the logs are being processed to manufacture boards. First, the board is rip-cut into smaller sections.

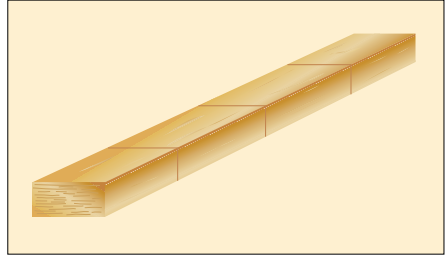
They are then cut up into blocks, which in turn will be rip-cut into the final boards.

The comparison shows that considerably more boards will be produced out of each block when we engage the thinner sawblade in the process.

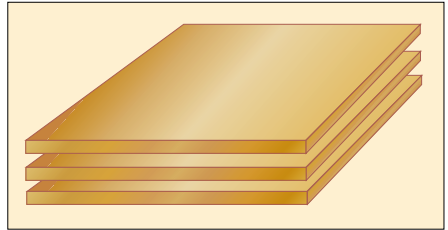
Applications

The main purpose of thin-kerf sawing is to get more sawn goods out of the raw material. This is especially important for planing mills and for manufacturers of the following products:

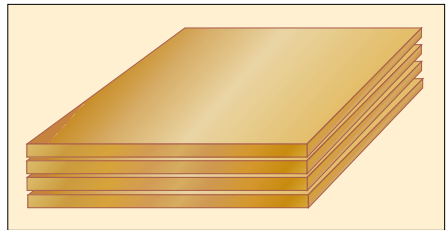
- parquet floors
- solid wood floors
- furniture
- doors and windows
- cupboards, sideboards, wardrobes and cabinets
- panels



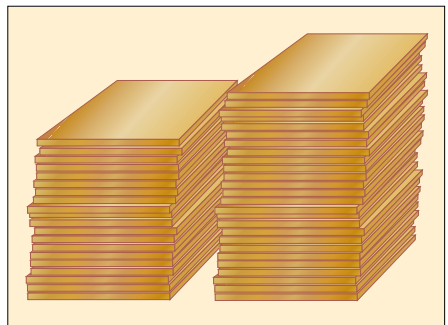
Cutting the blocks into boards...



... using a traditional sawblade will produce a certain number of final boards...



... whereas a thinner sawblade will increase the output ...



... and raise the productivity.

A different approach

In thin-kerf sawing, where a thinner sawblade is applied, a number of factors influence the sawing process and due consideration has to be taken to varying parameters as compared to sawing with conventional sawblades.

These considerations have been duly noted where the Sandvik Multishift Saver is concerned. Sandvik has developed computerised programs to secure optimum performance in the blades, they have thus been tailored to suit the specific application they are intended for.

Here are some of the main issues which should be taken into account when a thinner blade is used.

1. Loss of blade stability

⇒ Higher strain force

2. Loss of tooth stability

⇒ Other tooth shape with better side stability or lower tooth

3. Lower gullet capacity

⇒ Higher cutting speed

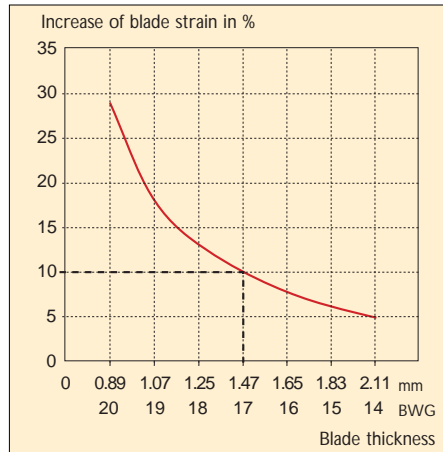
1. Loss of blade stability

The thinner blade makes it less stable than a thicker one. A higher strain force therefore has to be applied.

Thanks to the improved properties of the Multishift Saver, the strain can, in fact, be increased even further, which means a considerably higher stability can be achieved. The lower bending stresses which are due to the blade's reduced thickness, also allows for

higher tensile strain while the total stresses are kept on approximately the same level. To measure the actual blade strain Sandvik has developed a special strainmeter, available from our Finnish subsidiary.

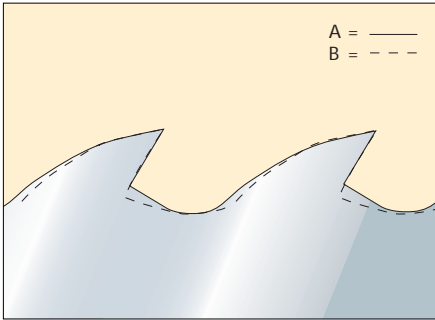
The graph illustrates the recommended increased strain needed when the thickness of the blade is reduced one step. In the example stepping down from 1.47 mm (17BWG) to 1.25 mm (18BWG) calls for a 10% increase in order to maintain the same blade stability. It should be noted that the information in the graph is based on the assumption that the standard or original width of the blade is approximately 150 times its thickness.



Recommended increase of strain when using thinner blades.

2. Loss of tooth stability

The thinner blade also, naturally, results in loss of tooth stability. Two different possibilities exist to solve this problem.



Tooth shape A has lower gullet capacity but better side stability.

To achieve the same stability in the blade, *another tooth shape* may be chosen. Based on available tooth data and existing tooth stability, the optimum tooth form for any application will be selected with the help of computerised programming.

The *same tooth shape* is kept, but the height of the tooth is slightly lowered. This provides better stability to the tooth.

3. Lower gullet capacity

The amount of sawdust in the gullet area has a strong influence on the sawing operation. If the gullet area is made smaller, this has to be compensated for by allowing less sawdust to gather during sawing.

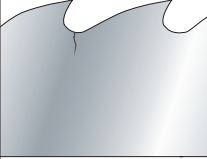
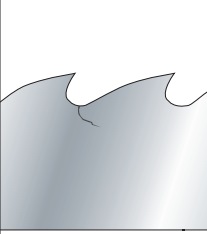

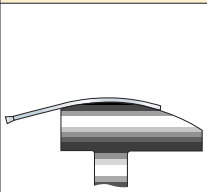
One way to do this is to increase the cutting speed of the blade. Relevant tooth data in combination with data on gullet capacity will calculate the cutting speed versus the feeding speed and produce an optimum solution. The higher cutting speed will thus also give the optimum amount of sawdust.




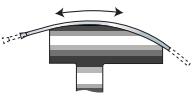
Inspection checklist



S

Inspection checklist

Type of fault	Cause	See chapter
Cracks in gullet		
	<p><i>Maintenance</i> Incorrect grinding, “burnt” tooth gullets Incorrect swaging, asymmetric swaging Asymmetric stellite tipping Incorrect tension Tooth edge tensioned excessively Blade too thick for the wheels</p>	<p>Grinding Saw setting Stellite tipping Bench work Bench work Choosing blade</p>
	<p><i>Machine</i> Too high blade strain Too low blade strain Worn wheels Vibration in bandsaw machine Worn blade guides</p> <p><i>Sawing</i> Blade clogged with resin, sawdust etc.</p>	<p>Bandsawing Bandsawing Bandsawing Bandsawing Bandsawing</p> <p>Inspection of blades</p>
Cracks in body		
	<p><i>Maintenance</i> Incorrect tension</p> <p><i>Machine</i> Worn wheels Blade guide too tight</p> <p><i>Sawing</i> Blade clogged with resin, sawdust etc. Chips or sawdust between blade and wheels</p>	<p>Bench work</p> <p>Bandsawing Bandsawing</p> <p>Inspection of blades</p> <p>Bandsawing</p>
Blade operates steadily, but runs too far forward, despite reduction of tilt		
	<p><i>Maintenance</i> Hook angle too large Back edge of blade too long</p> <p><i>Machine</i> Worn wheels</p>	<p>Choosing blade Bench work</p> <p>Bandsawing</p>

Type of fault	Cause	See chapter
Blade operates steadily, but runs too far back, despite maximum tilt		
	<p><i>Maintenance</i> Tooth edge too long Incorrect crown profile Blade guides incorrectly installed</p>	Bench work Bandsawing Bandsawing
Blade operates unsteadily, blade travels sideways when loading		
	<p><i>Maintenance</i> Uneven tension Insufficient tension in relation to crown Wrong hook angle Blade has lost tension</p> <p><i>Machine</i> Wheels not identical Wheels not parallel Vibration in bandsaw machine Too low blade strain Worn blade guides</p>	Bench work Bench work Choosing blade Bench work Bandsawing Bandsawing Bandsawing Bandsawing Bandsawing
Blade operates steadily, but does not saw straight		
	<p><i>Maintenance</i> Blade gulleyed Teeth have been ground at an angle Blade with irregular swaging Incorrect stellite tipping Asymmetric side grinding/dressing Dull tooth points</p> <p><i>Machine</i> Blade guides incorrectly set Feed equipment not parallel with blades Worn wheels Worn blade guides</p>	Bench work Grinding Saw setting Stellite tipping Grinding Grinding Bandsawing Bandsawing Bandsawing Bandsawing
Blade travels rapidly to and fro on the wheels		
	<p><i>Maintenance</i> Bad straightening Uneven tension Blade has lost tension</p> <p><i>Machine</i> Worn wheels Too low blade strain Wheels unbalanced, sawdust clogged Wheels not parallel</p>	Bench work Bench work Bench work Bandsawing Bandsawing Bandsawing Bandsawing

Data and recommendations in The Handbook
may be changed without prior notice.



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