Sawing

Objective

The learner will be able to:

- Identify components of a saw blade
- Describe uses of band saws
- Compare and contrast the types of band saws
- List safety rules for sawing

Orienting Questions

✓ What are the components of a saw blade?
✓ Where are saws applied in machining?
✓ Are saws considered precision machinery?

Helpful Tips

✓ You can select the **HIGHLIGHTED TERMS** to read more about it.
✓ If needed, there are **CLOSED CAPTION** buttons on the YouTube videos that will enable you to read along while you watch. The Closed Caption buttons are located bottom right of the video screen.
✓ Take time and explore about the subject by selecting the **EXPLORE** links in each section of this module.
BAND SAW SAFETY

Basic band saw **SAFETY GUIDELINES** are as follows:

- Never attempt to hold the material by hand while using a horizontal band saw
- Always keep all body parts clear of a moving saw blade
- Keep other moving machine parts clear of a moving saw blade
- Never force material into a moving blade
- When changing blades or performing any maintenance, always lock out and tag out the machine’s power

BAND SAWS

**BAND SAWS** are the most common types of saws that are encountered in industrial environments. The band is a piece of metal that has been welded together. It has a series of teeth cut and ground to a sharp point on its periphery. Large wheels with tensioners hold the band in place and drive the blade. When powered the blade is driven by the wheels and cuts constantly. This results in less sawing time.

**EXPLORE:** [Read about Band Saws](#)

VERTICAL BAND SAWS

**VERTICAL BAND SAWS** have a blade that cuts in a vertical direction. It is useful piece of machinery to have. It has two wheels: upper and lower. These wheels support the blade and act as guides for the saw blade. The blade height can be adjusted so that thicker material can be fed into it. The vertical band saw is primarily used for rough cutting a part close to size so that time machining can be reduced. These saws can cut simple to complex parts.
HORIZONTAL BAND SAW

**HORIZONTAL BAND SAW** have a blade that cuts in a horizontal direction. These saws are capable of cutting large pieces and can accurately hold tighter tolerances. This also produces straighter cuts on the ends of material. Most horizontal band saws are equipped with a work holding device. Most use a vise to clamp material into position. They also come with coolant systems, automatic feed, and parts counter. This enables the machinist to set the saw and walk away. This saves valuable machining time.

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**EXPLORE:** [Click on image below to view video](#)

![Figure 2: Horizontal Band Saw (Video by Ladell Humphries, 2013)](image)

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**PARTS OF A SAW BLADE**

**Blades** for band saws (Figure 3) have specially designed cutting geometry to attain efficiency in cutting and durability. Using an incorrect blade, or one that is badly worn,
will require increased cutting pressure, generate unwanted heat, and reduce cutting speed. The parts of a saw blade are very important to consider when selecting a blade for the job. This can greatly affect the quality of the cut and life of the blade.

**BLADE MATERIALS**

Saw blades are made from different types of materials. Factors to be considered when selecting the right blade for the application are material to be cut, desired rate of cutting, and cost. The types of material available are:

- **CARBON STEEL** – the least expensive but has to be run under slower speeds than other blades that are made of harder materials.
- **HIGH SPEED STEEL** (HSS) – Operate at higher speeds than carbon blades and can also cut harder materials such as alloy steels.
- **BIMETAL** – has a carbon steel body but with a strip of teeth that are made from high-speed steel.

The bimetal blade is used for both horizontal and vertical sawing machines. It provides the best of both worlds. They are less expensive than blades that are made entirely of high-speed steel yet provide the same qualities. These blades are made to cut the tougher materials and operate at faster cutting speeds.

**EXPLORE: What type of circular saw blade do you need to cut metal?**

![Figure 3: Band Saw Blade](Image by Ladell Humphries, 2013)

**TOOTH SET**
Tooth set is the term used to describe the staggered arrangement of the saw teeth. This is a necessary part of the saw blade that provides clearance for the body of the saw blade as it passes through the work being sawed.

The **kerf** is the width of the slot produced by the saw blade. It is important to understand that the kerf will always be slightly larger than the saw blade itself because of the set. There are three common tooth sets:

- **Alternate set** (Figure 5) – has teeth in a pattern that alternate from side to side. This set is considered aggressive and is best applied to softer materials.

![Figure 5: Alternate Set Teeth](image by Ladell Humphries, 2013)

- **Rake set** (Figure 6) – has small groups of teeth that alternate but with a neutral group of teeth between each alternating set. This set is best applied to large round stock, thick steel, and is great for contouring cuts made on a vertical band saw.
Figure 6: Raker Set Teeth (Image by Ladell Humphries, 2013)

- **Wavy Set** (Figure 7) – appears as a wave of teeth with groups that gradually alternate from side to side. Recommended for sawing varying cross-sections such as I-beams and other structural steel.

Figure 7: Wavy Set Teeth (Image by Ladell Humphries, 2013)
EXPLORE: Blade Terminology

BLADE WIDTH

BLADE WIDTH is determined by measuring from the back of the blade to the tip of the tooth. Widths range in size from 1/8” to 3”. The narrow blades are primarily used for contouring in vertical sawing applications. The wider blades are used for sawing thicker material in a horizontal saw and will produce straighter cuts. A blades width will determine the ability to make tight turns in contouring. Charts that detail contouring ability of various sizes of saw blades are usually available on the side of the machine.

GULLET

The GULLET is the curved area of a saw tooth that produces the curled metal chips. This provides strength to the teeth and an open area for the chips to remain while passing through the steel.

PITCH

A BLADE PITCH is defined as the spacing from one tooth to the next. Thinner materials require finer pitched saw blades. It is recommended to always have three teeth of a saw blade engaged in the work at all times. This will ultimately prevent teeth from being snapped during sawing operations. To prevent tooth breakage variable-tooth blades were developed and helped to alleviate problems cutting thinner sections while reducing vibration during sawing operations. Blade pitch can be quantified by teeth per inch, which refers to the number of teeth in one inch of blade length.

RAKE

RAKE is the term that describes the angle of the tooth’s cutting face. For example: A straight or zero rake tooth angle will cut exactly perpendicular to the path of motion. This is most commonly found when sawing structural steel. Positive rakes are commonly used and are best suited for sawing solids. They are generally weaker teeth and cannot be used to cut thin-walled sections because of the aggressive design.
TOOTH PATTERN

TOOTH PATTERNS are described by the shape and pattern of the saw teeth. All patterns have advantages and disadvantages. The best tooth pattern to be chosen will depend on the application. It should be noted that all tooth types can be used in both horizontal and vertical sawing operations. There are three types of tooth patterns:

- **STANDARD/REGULAR FORM** – has large radii in the gullet area of the saw teeth. It is sometimes referred to as the regular tooth form and is the best suited blade for general cutting of steels. It will yield an accurate cut and a good surface finish and has a zero rake angle.

- **SKIP FORM** – is best described as a blade with missing teeth. Every other tooth is skipped and this blade also has a zero rake angle. It is best applied to sawing nonferrous materials such as aluminum and brass.

- **HOOK FORM** – has a large gullet area with a positive rake angle. It is best described as taking on the shape of a hook. This blade is also best suited to cutting softer materials.

Figure 8: Different views of a Hook Form (Image by Ladell Humphries, 2013)

ACTIVITY #2
1. Describe the three sets that are found on saw blades?
2. Name and describe the three tooth forms that are found on saw blades?
3. Describe the three blade materials that are used to make band saw blades.

MAJOR CONCEPTS

KEY CONCEPTS

• Band saws are the most common types of sawing machines that are used in industry. The two basic types of band saws are the horizontal and vertical band saws. Vertical band saws are used to reduce machining time by cutting material close to a finished size. Horizontal band saws are used to make repetitive cuts where tighter tolerances are needed.

• Band saw blades are most commonly made from carbon steel but, depending on the type of steel being cut, can also be made from high speed steel (HSS). A Bi-metal blade that combines both carbon and HSS make a tougher blade which will endure cutting conditions of tougher materials. Selection of any saw blade is dependent on cost and type of material to be cut.

• After a saw blade material has been chosen other factors should be considered such as: tooth set, pitch, tooth pattern, and blade width. If a harder material is being sawed then a finer pitched saw blade should be used. The softer the material is the courser the pitch. The blade width is the material that is cut away during a sawing operation. The blade width can affect how much material is needed to make a specific quantity of parts.

• It is always important to remember safety when using any sawing machines.

KEY TERMS

Saw
Bimetal
High Speed Steel
Tooth Set
Blade Pitch
Kerf
Alternate Set
Raker Set
Wavy Set
Rake
ASSESSMENT

MODULE REINFORCEMENT

True or False: Read the following questions and determine whether the statement is true or false.

1. Leaving the power on to a sawing machine when changing a blade is an acceptable form of practice.
2. Tooth pattern refers to how many teeth can be measured per inch.
3. Band saws are the most common types of saws found in industry.
4. The standard tooth form is best suited for general sawing operations.
5. Skip form can be used to saw aluminum.
6. A zero rake angle will produce an angular cut against the face of the material.
7. Carbon steel blades are the most expensive blades.
8. Positive rake angles have an aggressive design.
9. A saw blade’s width will determine the ability to make contouring cuts.
10. The gullet is a weakened area in the saw blade that usually causes failure.

Multiple Choice: Read the following questions or statements and select the best answer.

1. Using an incorrect blade will ________.
   a. Require increased cutting pressure
   b. Need a faster speed
   c. Not affect the durability of the blade
   d. Not generate unwanted heat

2. Bi-metal blades have a ________ body and teeth made from ________.
   a. HSS, carbide
   b. Carbon, HSS
   c. Carbon, carbide
   d. Stainless steel, carbide

3. ________ is used to describe the arrangement of saw teeth.
   a. Tooth set
b. Pitch

c. Gullet

d. Tooth pattern

4. Horizontal band saws are capable of cutting ________.
   a. Larger diameters
   b. Smaller diameters
   c. Thinner sections
   d. Harder materials

5. ________ rake angles are best suited for sawing solids.
   a. Negative
   b. Neutral
   c. Positive
   d. Aggressive

6. The tooth pattern used in general cutting of steel is ________.
   a. Skip
   b. Hook
   c. Raker
   d. Standard

7. The blade pitch should be ________ when cutting thicker sections.
   a. Courser
   b. Finer
   c. Variable
   d. Alternating

8. Blade pitch is measured as teeth per ________.
   a. Foot
   b. Degree
   c. Inch
   d. Thousandths of an inch

9. Narrow blades are used on vertical band saws for ________.
   a. Perpendicular sawing
   b. Angular sawing
   c. Contouring
   d. Non-ferrous material

10. Selection of saw blades will be dependent on ________ and ________.
    a. Cost, material to be cut
    b. Tooth set, pitch
    c. Tooth pattern, kerf
d. Cost, kerf

Answer Key

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ANSWER KEYS TO ACTIVITIES

ANSWER TO ACTIVITY #1

Parts of Vertical Band Saw

1. On/Off switch – turns blade on or off
2. Blade welder – used to weld saw blades together.
3. Gear selector – sets the range of rpm from High to Low range.
4. Rpm Selector – sets the rpm for the saw blade to be moving.
5. Blade Guide – guides the blade while in motion and can be set to a specific height to ensure that the part is not damaged.

Vertical Band Saw Safety

1. Safety Glasses are to be worn at all times.
2. Only one operator is permitted to run the machine at any time.
3. Always stay in front of the blade pushing the material into the blade rather than pulling from the back.
4. Use a piece of scrap material to push the piece being cut into the blade so that your hands are out of the blades path.

ANSWER TO ACTIVITY #2

1. Alternate – has teeth that alternate from side to side with an aggressive tooth pattern. Best applied to softer materials.
   Raker – has small groups of teeth that alternate but with a neutral set of teeth between alternating sets. It is ideal for contouring cuts and sawing of large material.
   Wavy – has waves of teeth that gradually alternate from side to side. Used primarily for sawing structural steel.
2. Standard – suited for general cutting of steels. Has a large radius in the gullet area of the blade with a zero rake angle.
   Skip – every other tooth on the blade is skipped. Also, has a zero rake angle and is best suited for sawing nonferrous materials.
   Hook – shaped like a hook and has a positive rake angle. It is best suited for cutting of softer materials.
3. Carbon steel – the least expensive and has to be operated at slower speeds than other blades. High Speed Steel – can cut through harder materials, operate at higher speeds, and is the most expensive.
   Bi-metal – has a carbon body with a strip of high speed steel teeth combining the best of both blades, cost and efficiency.

DISCUSSIONS

QUESTION 1

What are the three tooth patterns that are most commonly found? List the advantages and disadvantages of each type of tooth pattern. Your answer should contain at least 3 to 5 complete sentences.
QUESTION 2

What are the parts of the saw blade? Explain the importance purpose of each part and give your opinion on which part is the most important. Your answer should contain at least 3 to 5 complete sentences.

CRITICAL THINKING

COMPARE AND CONTRAST

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<td>Explain how each saw is different and list the differences</td>
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COMPARE AND CONTRAST

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<td>Explain the differences in the saw blades and the material they are capable of cutting.</td>
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<td>Turned in 2 days late and gave reason to instructor on tardiness (3 points)</td>
<td>Turned in 3 days late or Did Not Turn In after day 2 tardiness (2 point)</td>
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