Trade of Toolmaking

Module 1:	Induction & Bench Fitting
Unit 9:	Bandsawing
	Phase 2

Published by

SOLAS
An tSeirbhís Oideachais Leanúnaigh agus Scileanna
Further Education and Training Authority

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Document Release History

Date	Version	Comments
25/09/2014	2.0	SOLAS transfer

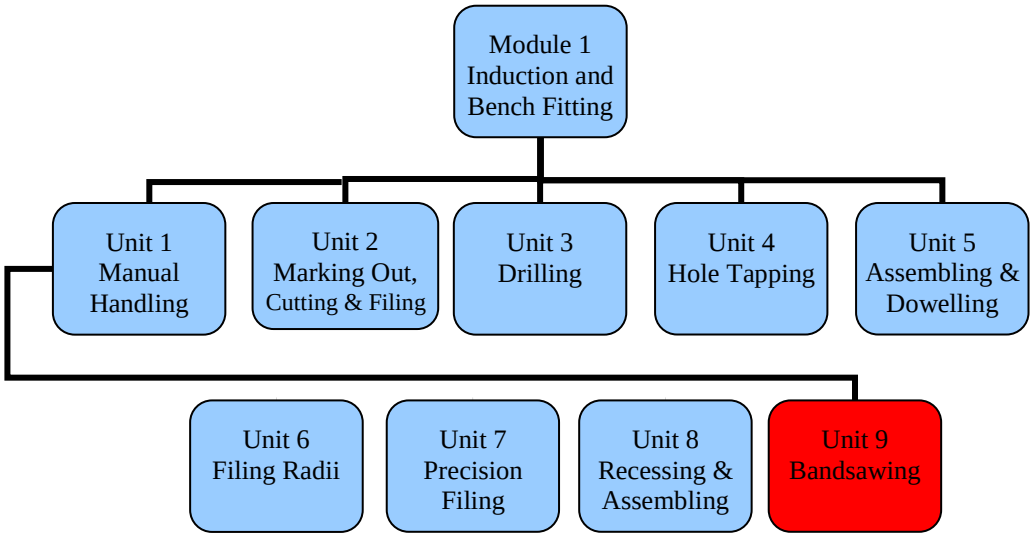
Unit Objective

On completion of this unit you will be able to use a bandsaw, select the cutting blade, cut out shapes in mild steel plates replace bandsaw blades.

Introduction

Module one of this course covers induction and bench fitting. This is the ninth unit in module one and explains how to identify the hazards and safety precautions to be taken while using a bandsaw, select the appropriate cutting blade, cut out shapes in mild steel plates replace bandsaw blades and replace bandsaw blades when required.

In industry, the bandsaw is used in metalworking and woodworking. The bandsaw is held under tension between two large wheels, which are driven by an electric motor. The blade consists of a long, narrow, flexible band with sharp teeth on one side. The band is guided between two wheels, which have a space between them. Bandsaws are useful for cutting irregular shapes.



By the end of this unit you will be able to:

- Identify the hazards and safety precautions to be taken while using a bandsaw.
- Describe the material characteristics and properties of a bandsaw blade.
- Select an appropriate bandsaw blade for a variety of materials.
- Safely operate a bandsaw to cut components with arcs, straight lines and contours to size.
- Remove, repair and install a bandsaw blade to a fully operational state.

1.0 Hazards And Safety Precautions While Using A Bandsaw

Key Learning Points

Personal protective equipment, safety guards, interlocking safety switches. Hand safety, correct use of work pushers.

1.1 Personal Protective Equipment, Safety Guards, Interlocking Safety Switches

When using a bandsaw it is important to wear eye protection. Ensure that safety guards are in place.

Ref: Black, Bruce J 2004, *Workshop processes, practices and materials*, 3rd edn, Elsevier Science & Technology, chapter 1, *Safe practices*, p. 10.
ISBN-13: 9780750660730

1.2 Hand Safety, Correct Use Of Work Pushers

Never place hands directly in front of blade when cutting material. Use pushers to guide work when cutting. Do not wear protective gloves when cutting material. Gloves should only be worn when replacing the saw blade.

2.0 Material Characteristics And Properties Of A Bandsaw Blade

Key Learning Points

Tensile strength, toughness, friction, heat transfer, effect of heat on blade properties. Application of coolants, air jets.

2.1 Tensile Strength, Toughness, Friction, Heat Transfer, Effect Of Heat On Blade Properties

The saw blades are manufactured from steel that have high tensile strength and toughness. The strength of a material is the ability to resist a force without rupture. The saw blade needs to be able to withstand high tensile forces, which occur when the bandsaw is stretched between two large wheels. The blade needs to be tough. The term Toughness is the amount of energy a material can absorb before it fractures. The friction between the cutting blade and the workpiece generates heat, which will soon transfer onto the blade. If the blade is over heated it will cause the blade material to soften and break down, unless coolant is used to draw away the heat.

2.2 Application of coolants, air jets

Coolant is used to remove heat from the blade, which is generated by the high cutting forces involved. Without the coolant, the heat would quickly transfer to the bandsaw and cause the hardened steel cutting teeth to loose their hardness and break down. The use of air jets instead of coolant can cool the workpiece and blade and also blows away swarf.

3.0 Selecting Appropriate Band Saw Blades

Key Learning Points

Blade selection: tooth form, blade thickness, number of teeth, material to be cut, blade kerf.

3.1 Blade Selection: Tooth Form, Blade Thickness, Number Of Teeth, Material To Be Cut, Blade Kerf

To cut non-ferrous metals such as aluminium, brass and bronze a saw blade has a cutting tooth with a large tooth gullet, which provides space for chips to accumulate while the blade is cutting. To cut ferrous materials such as mild steel the saw blade needs stronger teeth, shorter pitches and smaller tooth gullets.

The pitch (distance from one tooth to the next) is referred to as the number of teeth per inch (TPI). When cutting thin sections use a fine pitch blade, when cutting thick sections use a blade with a coarser pitch. As a rule, at least three teeth should be in contact with the material when cutting, but the ideal is to have 6 to 12 teeth in contact at any time during cutting.

Saw blades are also available with constant and variable tooth system. With the *Constant tooth system* the saw band has parallel tooth pitch all over length. This way is suitable for the cutting of solid material. With the *Variable tooth system* the tooth pitch is variable. Variable tooth system is used for profiled materials and bundle cutting. Variable tooth pitch lowers vibration of the saw band and increases service life of cutting area.

Blade width is measured from the tips of the teeth to the back edge of the blade as shown above. For Cut-Off Sawing, the blade should be as wide as the machine will allow. The wider the band is, the straighter the cut will be. Faster feeding can be achieved. For Contour Sawing , the blade should be as wide as the machine allows, but still narrow enough so that it can cut the desired shape (radius).

Blade kerf: this is a slit or notch made by a saw.

4.0 Operating The Bandsaw

Key Learning Points

Cutting speed and feeds for bandsawing: material removal rates. Marking out techniques, arcs in contact, tangent construction, arc centres. Arc cutting, straight line cutting, contouring, safe removal of scrap material. Minimum arc cutting size. Job planning and design of components for bandsawing, optimal use of material.

4.1 Cutting Speed And Feeds For Bandsawing: Material Removal Rates

The bandsaw cutting speed varies depending on the type of material being cut and if coolant is being used or not. For example, a typical cutting speed for mild steel is 20-30 m/min and 70 m/min for aluminium.

Feed: this is the pressure applied to the saw blade by the material being cut.

4.2 Marking Out Techniques, Arcs In Contact, Tangent Construction, Arc Centres

The mild steel plate to be cut is marked out as explained in previous units. The vernier height gauge is used to scribe the vertical and horizontal lines. A scriber and rule are used to scribe angled lines. Centres of arcs are punch marked and a dividers is used to scribe the arcs.

Ref: Black, Bruce J 2004, *Workshop processes, practices and materials*, 3rd edn, Elsevier Science & Technology, chapter 3, *Marking out*, p. 44.
ISBN-13: 9780750660730

4.3 Arc Cutting, Straight Line Cutting, Contouring, Safe Removal Of Scrap Material

The workpiece is normally fed by hand into the saw blade. Power feeds are available on special purpose machines. Cutting curves or contours requires that the workpiece be guided and fed into the saw blade by hand. Take care when removing cut-offs or scrap material, it is safer to switch off the bandsaw first.

When starting to cut the material, start with a light feed and increase pressure when the cut has been established. Hard materials require lighter feeds than softer materials. Also use lighter feeds when cutting curves. Wider bandsaws can be used for heavier cuts.

4.4 Minimum Arc Cutting Size

The correct width bandsaw should be selected when cutting a radius or a circle. If the blade is too wide for the radius being cut, then the back of the blade will press against the outer edge of the kerf (a slit or notch made by a saw). Any attempt to cut a smaller radius will therefore result in the blade twisting, which may cause the blade to break.

Do not attempt to cut circles less than the minimum diameter recommended for the width of the blade being used. When cutting either circles or curves, do not turn the work unless this action is accompanied by feed into the blade, otherwise the blade may be damaged. Charts are available that recommend the correct blade width for cutting a particular radius.

4.5 Job Planning And Design Of Components For Bandsawing, Optimal Use Of Material

Job planning is important prior to starting any task. The drawing should first be studied and understood. The drawing can initially be used to calculate the material requirement, as this will prevent unnecessary material waste and reduce costs. The workpiece is marked out using the dimensions and datums as specified on the drawing.

The workpiece is marked with a vernier height gauge to the dimensions specified on the drawing. The scribed lines should be marked from the same datum edge as specified on the drawing. The *datum* is described as a reference edge or a point from which measurements are made. For angled lines use the protractor or straight edge and scriber. For scribing radii, punch the centre point and scribe the radius using dividers.

5.0 Remove, Repair And Install A Bandsaw Blade

Key Learning Points

Removal of broken blades. Bandsaw repair: blade end preparation, welder settings, safe removal of flash, heat treatment process. Blade installation, tension settings, wheel alignment, blade guides alignment. Safe blade storage.

5.1 Removal Of Broken Blades

It is important to turn off the power before replacing a saw blade. Stand back from the bandsaw until the machine has completely stopped. Put on safety gloves prior to removing the broken blade.

5.2 Bandsaw Repair: Blade End Preparation, Welder Settings, Safe Removal Of Flash, Heat Treatment Process

Bandsaw repair: Many bandsaws have a build-in unit that provides a small grinding wheel for cleaning and squaring the ends of the broken blade. The two ends are clamped in the fixture with the ends facing each other. The welding unit is activated and the electric current passes through the blade to create a high enough temperature to cause the ends of the blade ends to weld. Flash can be removed using the grinding wheel.

5.3 Blade Installation, Tension Settings, Wheel Alignment, Blade Guides Alignment

When installing a new blade, ensure that the bandsaw is switched off. It is important to wear gloves when removing or replacing bandsaw blades. Place the new blade over the rims of the two wheels. Increase the tension in the blade by adjusting the distance between the two wheels, while at the same time rotate the upper wheel by hand in a clockwise direction. The tilt in the top wheel may have to be adjusted so that the blade is running dead center on the wheels. A satisfactory blade tension is achieved when the blade deflects by 2 to 3mm when pressure is applied to the smooth side of the blade.

Set guide blocks to miss the teeth but support the rest of the blade. The back up roller should be set so it does not turn when idling but will support the blade when cutting. The upper guide and guard should be set as close to the work as possible, preferably within 5mm. All adjustments should be carried out when the machine turned off.

5.4 Safe Blade Storage

Gloves should be worn when handling the sawblade. These sawblades are very sharp and can cause injury. They should be stored in a safe place, such as a cabinet or in drawers.

Summary

Hazards and safety precautions while using a bandsaw: When using a bandsaw it is important to wear eye protection. Ensure that safety guards are in place. Never place hands directly in front of blade when cutting material. Use pushers to guide work when cutting. Do not wear protective gloves when cutting material. Gloves should only be worn when replacing the saw blade.

Material characteristics and properties of a bandsaw blade: The saw blades are manufactured from steel that have high tensile strength and toughness. The strength of a material is the ability to resist a force without rupture. The saw blade needs to be able to withstand high tensile forces, which occur when the bandsaw is stretched between two large wheels. Toughness is the amount of energy a material can absorb before it fractures. Coolant is used to remove heat from the blade, which is generated by the high cutting forces involved. Without the coolant, the heat would quickly transfer to the bandsaw and cause the hardened steel cutting teeth to loose their hardness and break down.

Selecting appropriate bandsaw blades: To cut non-ferrous metals such as aluminium, brass and bronze a saw blade that has a cutting tooth with a large tooth gullet, which provides space for chips to accumulate while the blade is cutting. To cut ferrous materials such as mild steel the saw blade needs stronger teeth, shorter pitches and smaller tooth gullets.

Saw blades are also available with constant and variable tooth system. With the *Constant tooth system* the saw band has parallel tooth pitch all over length. This way is suitable for the cutting of solid material. With the *Variable tooth system* the tooth pitch is variable. Variable tooth system is used for profiled materials and bundle cutting. Variable tooth pitch lowers vibration of the saw band and increases service life of cutting area.

Blade width is measured from the tips of the teeth to the back edge of the blade as shown above. For Cut-Off Sawing , the blade should be as wide as the machine will allow. The wider the band is, the straighter the cut will be. Faster feeding can be achieved. For Contour Sawing , the blade should be as wide as the machine allows, but still narrow enough so that it can cut the desired shape (radius).

Operating the saw band and quality of the bandsaw: The mild steel plate to be cut is marked out as explained in previous units. The vernier height gauge is used to scribe the vertical and horizontal lines. A scriber and rule are used to scribe angled lines. Centres of arcs are punch marked and a dividers is used to scribe the arcs. For cutting arcs, a thinner blade is used.

Remove, repair and install a bandsaw blade: It is important to turn off the power before replacing a saw blade. Put on safety gloves prior to removing the broken blade.

Bandsaw repair: Many bandsaws have a build-in unit that provides a small grinding wheel for cleaning and squaring the ends of the broken blade. The two ends are clamped in the fixture with the ends facing each other. The welding unit is activated and the electric current passes through the blade to create a high enough temperature to cause the ends of the blade ends to weld. Flash can be removed using the grinding wheel.

Suggested Exercises

1. What are the two main properties of a bandsaw blade.
2. Define the term blade kerf.
3. Explain how to safely replace a saw blade.
4. What is the minimum number of teeth that should be in contact with the material being cut.
5. Explain how to repair a saw blade.

Questions

1. What safety precautions should you take when using the bandsaw?
2. What are the main characteristics of a saw blade material?
3. Explain the terms ‘strength’ and ‘toughness’.
4. What is the purpose of coolant when using the band saw?
5. When cutting ferrous and non-ferrous materials, what cutting tooth configurations are used?

Answers

1. Never place hands directly in front of blade when cutting material. Use pushers to guide work when cutting. Do not wear protective gloves when cutting material. Gloves should only be worn when replacing the saw blade. Always wear eye protection and ensure that safety guards are in place.
2. The saw blades are manufactured from steel that have high tensile strength and toughness.
3. The strength of a material is the ability to resist a force without rupture. The saw blade needs to be able to withstand high tensile forces, which occur when the bandsaw is stretched between two large wheels. The blade needs to be tough. The term Toughness is the amount of energy a material can absorb before it fractures.
4. Coolant is used to remove heat from the blade, which is generated by the high cutting forces involved. Without the coolant, the heat would quickly transfer to the bandsaw and cause the hardened steel cutting teeth to loose their hardness and break down.
5. To cut non-ferrous metals such as aluminium, brass and bronze a saw blade has a cutting tooth with a large tooth gullet, which provides space for chips to accumulate while the blade is cutting. To cut ferrous materials such as mild steel the saw blade needs stronger teeth, shorter pitches and smaller tooth gullets.

Recommended Additional Resources

Reference Books

Black, Bruce J 2004, *Workshop processes, practices and materials*, 3rd edn, Elsevier Science & Technology.

ISBN-13: 9780750660730

Simmons, Colin H & Maguire, Dennis E 2004, *Manual of engineering drawing*, 2nd edn, Elsevier Science & Technology.

ISBN-13: 9780750651202

Bird, John 2005, *Basic engineering mathematics*, 4th edn, Elsevier Science & Technology.

ISBN-13: 9780750665759