

**National Certificate in Building, Construction and Allied Trades Skills (BCATS)**

**Identify, select, maintain, and use  
portable power tools for BCATS  
projects**

Unit Standard – 24350

Level 2, Credit 6

**Name:** \_\_\_\_\_





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## What you need to do

By the end of this module, you should be able to:

- identify, describe and select portable power tools for construction projects;
- use portable power tools for construction projects; and
- maintain portable power tools.

### How you will be assessed

You will be assessed by a combination of practical and written work.

To achieve this unit standard, you need to complete 2 construction projects where you can identify, select, use and maintain portable power tools. Your teacher/tutor will tell you which project(s) to complete.

For the following portable power tools – **drills, portable planer, portable circular saw, jigsaw, reciprocating saw, sanders, router, biscuit jointer** – you need to show your teacher/tutor that you can:

- describe what tools can and cannot be used for;
- describe how to use tools and how to do this safely;
- choose the right tool for the job;
- choose the right PPE to use;
- use tools correctly and safely;
- keep tools clean and free of rust, and store and maintain them correctly; and
- report any damaged, blunt or faulty tools to your teacher/tutor.

Your teacher will give you an Assessment Record Sheet for Portable Power Tools so you can record the tools you use on your projects, how you use them correctly and safely, and how you maintain them.

Your teacher/tutor will also give you a worksheet that you need to complete, which your teacher/tutor will mark.



**Important note:** *You will not achieve this unit standard if you fail to handle, use or care for portable power tools in a safe and proper manner.*

## Glossary of Terms

Term	Meaning
Alternating current -AC	An electric current that reverses direction in a circuit at regular intervals
Anticlockwise	Rotating in the opposite direction to the path of the hands of a clock. (Left to right)
Bevel	Cut a slanting edge on a piece of timber
Binding	To hold, restrain or cause to stick
Chamfer	A flat surface made by removing the edge or corner of a piece of timber
Chuck	A revolving clamp with adjustable jaws that holds a drill bit
Cladding	The external wall covering material on a building or fence
Clockwise	Rotating in the same direction as the path of the hands of a clock. (Right to left)
Collet chuck	A holding device that forms a collar around the tool to be held and, when tightened, exerts a strong clamping force on the tool
Collets or sleeves	A cone-shaped sleeve used for holding circular or rod-like machine pieces
Depth of cut	The distance that a cutting blade extends into material being cut
Direct current -DC	An electric current that flows in one direction in a circuit
Double insulated	Two levels of protection built into power tools. The primary protection is afforded by the first layer. If that fails protection is provided by a second level
Flutes	The helical grooves of a twist drill that provides the rapid removal of waste material from a cutting surface
Helical grooves	Spiral grooves
Kick back	A sharp and often dangerous reaction that can occur when the material being machined closes on a cutting blade. This closing can cause the material to be projected violently back toward the operator by the momentum of the blade
Masonry	Building work block, stone or brick work
Mode	The method of carrying out an operation or task
Profile	A temporary wooden structure used to set out a construction area and establish levels. String lines are attached to the top to define the set out
Residual current device (RCD)	A safety circuit-breaker that operates if there is a fault in electrical equipment
Revolutions per minute (RPM)	The rating which identifies the speed of a machine
Ripping	Cutting timber with the grain
Side loaded	The application of pressure to the side of the disc when using a portable power tool
To earth	A connection between an electrical tool, device or circuit and the earth
Torque	The measure of a turning force around its axis
Transformer	An electrical safety device which lowers the voltage of an electric current
Tungsten carbide	An extremely hard composite steel used in tools and accessories that require high wear resistant qualities

## Introduction

Portable power tools have become the basic construction equipment of the modern construction industry. Their use has made construction and repairs easier, quicker and more cost effective.

There is a wide range of portable power tools available and these are extremely efficient, versatile and designed to perform a variety of tasks. However, each different tool requires knowledge of its correct and safe use.

## Safety

Students/trainee operators must be adequately supervised by a suitably trained person until they have achieved an acceptable standard of safe operation in the following areas:

- the intended use of the tool;
- the capabilities and limitations of the tool;
- safe operating procedures; and
- maintenance requirements.

To reduce the chances of causing injury to yourself or others in the workplace, it is important that you:

- have effective and conscientious work habits;
- have an understanding of the tools you are using; and
- apply appropriate safe working practices to power tools.

### **Personal safety**

Always use common sense. **If it doesn't look right – don't do it.**

Personal safety starts with an awareness of the equipment that you are using and the environment in which you are using it.

Make sure you understand the operation of tools, equipment and the working qualities of materials.

### **Plan and set up a secure working environment.**

- When working on machining equipment ensure that all work being machined is securely clamped to a stable platform.
- Keeping both hands on the power tool when using it will provide greater control.
- Ensure that there is adequate lighting and maintain good housekeeping practices.

### **Concentrate on the job**

- Ensure that your mind is focused on the job. Know what is required of you and do it to the best of your ability.
- If you are tired, have consumed alcohol or taken sleep-inducing medications, there is a greater risk of mistakes or an accident.
- It requires more concentration to operate a power saw than it does to drive a vehicle.

### **To avoid accidental starting**

- Ensure that the trigger or switch is in the off position before plugging the tool in.
- Always disconnect the tool from the power source before making any adjustments.
- Remove all adjusting tools (chuck keys, etc.) before reconnecting to the power source.

### **Wear the correct safety equipment**

- Flying particles, chips of wood, splinters and chipped or broken cutter heads are all significant eye hazards – wear the correct eye protection and use safety shields.
- Power tools often produce a lot of noise – always wear the appropriate hearing protection.
- Protect your feet – wear safety boots or shoes with non-slip soles.
- Guard against fumes, vapours and dust – wear the correct breathing protection.
- Body protection – wear overalls to protect your clothing and body from dust and dirt.

### **Power sources**

Most portable power tools that you will use will be powered by:

- 230/240 Volt, AC power which comes from the mains outlets.
- Rechargeable batteries, e.g. cordless power tools.
- Compressed air, which is usually run off air compressors, although some tools (such as nail guns) use CO<sub>2</sub> gas cartridges.

# Guard Against Electrical Shock

## Residual current devices and isolating transformers

- Always use an appropriate electrical safety device, such as a residual current device (RCD) or an isolating transformer, when using tools outdoors or in damp conditions.
- The RCD or transformer should be positioned at the socket outlet so that it protects the lead and the operator.

When operating portable power tools, never stand in water or allow electrical leads to lie in it even when an electrical safety device is being used

## Double insulation

Almost all modern power tools are double insulated. This means that they have two types of insulation between the power and the operator.



The symbol for double insulation



**Note:** While double insulation may provide protection from faults in the portable power tool, you must still be careful because extension leads are NOT double insulated:

Special care should be taken to prevent damage to an extension lead. Exposed wiring is extremely dangerous.

- Never unplug the machine by pulling on the power cord.
- Never carry power tools around by the leads.

## Extension leads

Extension leads are available in light or heavy weights.

- Light-duty leads are useful for small drills and lights.
- Heavy-duty leads are used for larger tools requiring a greater flow of electricity.
- Using a light-duty lead with a larger tool will result in a loss of power and excess heating of the lead which could cause a short circuit or fire.
- When a long extension cord is required, use a heavy-duty lead.
- Always uncoil extension leads to prevent heat build up.
- Protect your leads from heat, flame, oils, sharp edges, water and abrasive surfaces.
- It is a good idea to join leads together at their plugs with a simple loose knot. Ensure that the joint is supported off the ground.

## **Cordless power source**

Cordless power tools are more convenient to use because they are not limited by the availability and location of a power source. However, they can only be operated for a limited time before the batteries must be recharged.

### **Operating tips**

- Heavy-duty work requires more frequent recharging than light-duty work.
- Do not overwork the cordless tool.

As the energy is drained from the batteries they are less able to provide the required torque necessary to operate the motor.

As soon as you detect a loss in power, remove the battery for recharging. Most trades-people have spare batteries.

**If a machine overheats, remove the load, ensure that all air vents are clear of blockages, and run it at full speed for a short time so the fan can force air through to cool it.**



## **General Power Tool Safety**

- Let the power tool build up to full speed before commencing the cut.
- Do not force the tool; let it cut at its correct cutting rate to ensure quality and safety.
- Keep tools clean and cutting edges sharp.
- Check power cords and plugs for cracks or damage.
- Position yourself so that you have a comfortable, stable and secure stance and can see what you are cutting.



**Caution:** Do not overreach or allow yourself to become unbalanced or in an awkward position.  
If the machine starts to smoke, turn it off and disconnect it immediately from the power source.

### **Ensure that power leads are out of the line of cut**

Keep out of the line of cut by standing to the side of saw blades, grinding wheels and cutting edges, and behind drills to avoid chips and flying objects.

Stay focused on the job and with the machine you are using. Anticipate binding, kickback or other circumstances that may cause the machine to twist or buck violently in your grip.

### **Pneumatic tools**

Always wear protective goggles when using air tools and never direct compressed air at any part of the human body. The blast can penetrate the body, particularly if directed at cuts or abrasions, and result in an air embolism in the blood stream, often with fatal results.

Eyes can be damaged or blown out and ear drums ruptured.

Disconnect the airline before making any adjustment to the power tool. Always report any damaged hoses, tools or fittings, and do not use them until they are properly repaired.

## **Power Tool Care and Maintenance**

- Ensure that all vents are clear and free from dust.
- Keep the machine clean and lubricated.
- Maintain the condition of the blades. Replace dull or damaged blades.
- Store tools in a clean, dry and secure place.
- Remove and check the carbon brushes regularly.
- Replace them when they wear down to the limit mark.



## Activity 1

1. Describe a range of safe working procedures that are appropriate to setting up a safe working environment.

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2. What are the possible consequences of failing to disconnect a power tool from the power source before making adjustments to it?

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3. Describe the advantages and disadvantages of each of the power sources.

AC mains powered tools

Advantages:

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Disadvantages:

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Cordless power tools

Advantages:

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Disadvantages:

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Pneumatic tools

Advantages:

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Disadvantages:

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4. Why should you never carry a power tool by the lead or unplug it by pulling on the lead?

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5. What hazards are associated with laying extension leads directly on the ground?

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6. The outer casing of an extension lead is damaged. What could this indicate?

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7. What should you do if you find a kink in the lead?

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8. How should leads be wound up and stored?

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9. What is likely to happen if you roll your leads up in a tight knot or ball?

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10. In the space provided sketch the set up required to safely operate a power tool in an outdoor environment over damp ground.

**11.** What could happen if you cut through a live extension lead?

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**12.** What are the hazards associated with using a power tool with a blunt cutter?

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**13.** What does smoke coming from a power tool, or one that smells of burning, indicate and what should be done to remedy the situation?

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**14.** What are the effects of having clogged or blocked air vents on the machine?

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## Portable Electric Drills

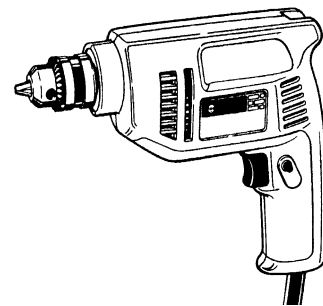
Portable electric drills are among the most versatile of all power tools and are available in a wide range of sizes and power ratings.

They can be used for drilling holes in most materials including wood, plastic, steel, fibreglass, concrete, etc. Attachments can be added to allow for sanding, grinding, polishing, etc.

They can be powered by 240V mains, batteries or pneumatically.

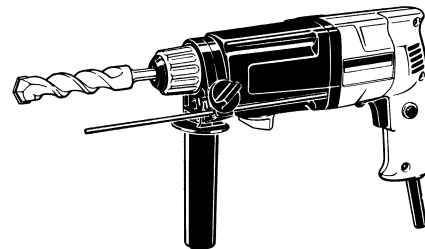
### Basic light-duty drill

A high-speed, basic drill, which is suitable for drilling a hole of up to 6.5mm in steel or up to 9mm in wood. It is lightweight and compact, meaning that it is easy to use and handle in a range of situations.



### Impact or hammer action

A hammer drill is like a standard drill, with an additional hammer or impact action. This increases the tool's ability to drill into masonry. The impact hammer mode is engaged by pressing a button on the drill.

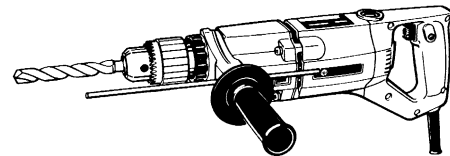


### Medium-duty drill

A common 10mm hammer drill is suitable for use on metal, wood and concrete. Its drilling capacity for wood is 15mm, with an auger bit, and 25 mm with a flat bit and for steel is 10mm.

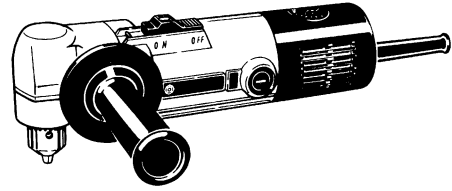
### Heavy-duty drill

A heavy-duty drill allows you to drill larger holes in a range of materials. Reduction gearing allows you to select a range of speeds. Because of its size and power it weighs approximately three times as much as a basic drill. Its drilling capacity is approximately 13mm for steel and 36mm for wood. Be very careful to control the drill when drilling a hole of this size.



## Angle drill

An angle drill is a low-profile drill mainly used by plumbers and boat builders when they need to get into awkward places.

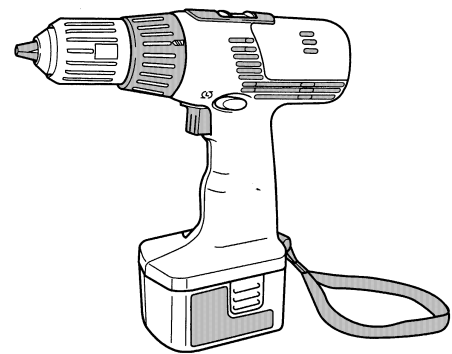


## Cordless drill

The main value of a cordless drill is the convenience of not requiring a power point.

Most cordless drills will not produce the same extreme torque as a cord type drill and will eventually run out of power when the battery discharges.

For light-duty work, the average drill can operate continuously for about a half an hour. Some heavy-duty cordless drills may operate longer on a single charge.



Follow manufacturer's instructions for correct care and charging of the battery to ensure the longest possible life.

## Attachments

There is a wide range of attachments that can be used to convert a drill into a screwdriver, bench grinder, circular saw, hammer unit, jigsaw, orbital sander or lathe.

Most attachments can only be used for light-duty work and have limited efficiency.

The best and safest option is to select and use tools specifically designed for these jobs.

### Prepare the material for drilling

- Smaller objects and materials should be securely held to a stable platform by a vice or clamp.
- Place a piece of scrap timber under the work when you need to drill right through it.
- Allow the drill to work for you. Do not place too much pressure on the drill.
- When a bit slows up or begins to stall, this is a sign that it may need to be sharpened.
- If debris builds up in the flutes of the drill bit, and can't get out of the hole, the bit will bind. The resulting heat that is generated will cause overheating and burning of the bit. The torque of the drill could also snap the bit off.
- When you are drilling a deep hole, pull the drill out of the hole every so often to clear the bit of debris.
- A blunt drill bit will make very slow progress and the top may turn blue in colour from overheating.
- Apply less pressure when nearing completion of the hole to assist a smooth clean exit of the drill bit. Be prepared for the drill bit to bite as it exits hard material.

## Drill bits

The correct selection of drills is important if a quality job is to be produced.

- **Wood** – use twist bits, spade bits and power auger bits.
- **Metal** – use high-speed twist drill bits.
- **Brick, concrete and masonry** – use top-quality, high-impact carbide-tipped masonry bits.

The most commonly used drill bit is the high-speed parallel shank twist bit. It is an all-purpose drill bit constructed out of hardened tool steel, which can be used on materials such as cast iron, steel, steel forgings, sheet metals, plastics, aluminium and wood.

### Drill bits (standard)

Standard drill bits are available in a range of types and sizes for use in portable power tools, including:

- twist; and
- flat.

The chuck size will determine the maximum diameter drill that can be used.

The bit sizes used by carpenters generally range from 1mm to 13mm. Drill bits go up in size in 1mm increments.



Twist bits



Flat bits

#### Use

- Used for drilling holes in a range of materials including timber, metal and concrete.

#### Care and Maintenance

- Keep in drill set case when not in use.
- Sharpen when required. Grinding angle from centre point is:
  - Wood drill bits 40°.
  - Metal drill bits 59°.
- Use the correct drill cutting speed to suit the drill bit and the material being drilled.



### Masonry bits

Masonry bits have ultra-hard tungsten carbide welded to the drill tips so they will cut through concrete, brick and ceramics.

Standard masonry drills should be used at low speed on soft masonry such as brick.

Higher-quality, high-impact masonry bits have larger tungsten tips suitable for faster speeds with hammer drills.



**Note:** When drilling masonry, be sure to use steady pressure at low speed. Take your time!

### Spade or flat bits

Spade bits operate at high speeds and are excellent for boring large holes in wood.

The length of the spade helps the bit run true without any wobbling or drifting.

Spade bits are available in metric sizes from 6mm to 38mm as well as imperial sizes.



### Drilling dowel joints in timber

A centre point (brad point or dowel drill bit) is used for drilling holes in timber, e.g. dowelling. The point will ensure accuracy when starting the hole.

### Auger Bits

Auger bits are available in a large range of sizes and lengths. The bit will run straight and true providing that the drill is held at 90 degrees to the surface being drilled. A slow-speed drill with reversing features is most suited for this bit.



### Hole saws

Hole saws are used for drilling holes larger than 13mm.

The common sizes range up to 64mm in diameter. Use a slow speed.





## Activity 2

1. What materials are the cheapest drill bits made of?

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What is the disadvantage of using this type of drill bit?

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2. What is the most common type of quality general-purpose drill bit?

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Describe the advantage of the centre-point drill bit for drilling in timber.

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3. What type of drill bit is needed to drill into concrete?

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4. What type of power drill do you need to drill through concrete?

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5. You need to drill a hole in a narrow, confined space. What type of power drill would you use?

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6. What are the possible consequences of trying to hold small objects in your hands when drilling?

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**7.** Identify 4 safety rules that should be observed when using a portable power drill.

i)

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ii)

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iii)

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iv)

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**8.** When drilling a hole in a piece of metal using a large-sized bit, what is the possible injury to the operator if the drill jams?

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**9.** Identify 3 common actions that can cause a drill bit to break.

i)

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ii)

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iii)

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**10.** To obtain a tidy finish, what can you do to avoid splintering the exit hole?

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**11.** You have been instructed to drill a 38mm hole through a piece of 10mm MDF. What type of drill and drill bit should you choose? Give reasons for your choice.

Type of bit:

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Reason:

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# Power Screwdrivers

Power screwdrivers and specialised bits are available for a range of tasks, including driving screws into drywall materials, fast self-drilling screws for roofing materials and heavy-duty metal applications.

To avoid injury when using a portable power screwdriver it is important that only variable speed is used.

## Correct use

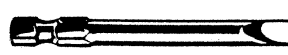
Select driver bits of the correct type and size for the screw. Worn or incorrect driver bits can damage the head of the screw. The work surface can also be damaged if the bit jumps out of the screw slot.

Take care that the driver bit is correctly fitted into the screw head slot before engaging the trigger.

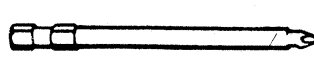
When driving screws into walls, floors or in the vicinity of “live” electrical wires, avoid touching any metal parts of the power tool. Holding the screwdriver by the insulated surfaces will help prevent an electric shock should the screw hit a live wire.

## Types of bits

Slotted insert and power bits



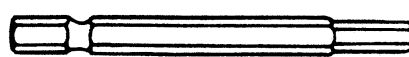
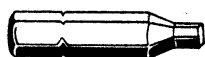
Pozidriv insert and power bits



Phillips insert and power bits



Square and Hex Recess power bits

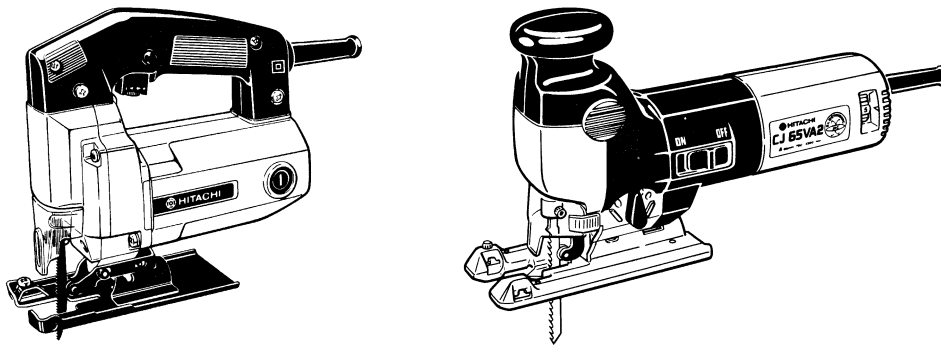


# Saws

## Jigsaws

The jigsaw is used for cutting internal and external curves in a variety of materials. Most saws come with a tilting base to allow for bevel and compound cuts.

By using the correct blade, you can cut wood, manufactured boards, plastics, fibreglass, aluminium and light steel.

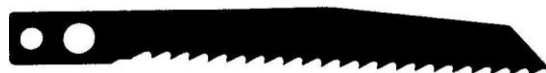


The set of the tooth will have a significant effect on the quality of the cut. The number and type of teeth per 25mm will determine the blade most suited to the type of material. For example, large teeth will cut soft material quickly but leave a rough surface, while fine teeth with less set on the blade will give a smoother but slower cut.

### Saw blade profiles



Suitable for aluminium, plastics and laminates



Suitable for timber



Suitable for metal



Scroll cutting for wood, fibreboards and plastics



Plywood – hollow ground

### **Operating the jigsaw**

Make sure that the area below the intended cut is free of obstructions and that extension cords are well out of the way.

Position the saw with the base plate firmly up against the material to be cut and the blade clear of the work.

Start the saw and wait for the blade to reach full speed before making contact with the material to be cut. Apply gentle pressure.

Place the finished side of the material down and position the baseplate on the unfinished side facing upwards. As the jigsaw blade cuts on the up stroke, this will give the best results for the finished side.

Guide the saw along the cutting path applying gentle pressure while letting the blade do most of the work.

Ease the pressure off the blade towards the end of the cut so that the saw will remain under control when the blade exits the material.

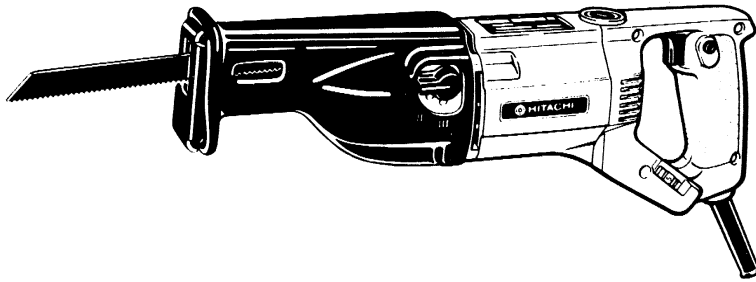
Straight and circular guides are available to ensure accuracy for long, straight cuts and circular cuts.

**Caution:** When operating the saw, do not force the saw or the blade may break.

## **Reciprocating saw (sabre saw)**

The portable reciprocating (sabre) saw is a heavy-duty, powerful and versatile hand held saw which can be used to cut a wide range of materials. It is designed especially to cut spaces for doors and windows, scroll or make circle cuts in sheet materials and cut through plastic, steel and pipes.

The cutting stroke is between 25mm and 30mm with the blade making over 2000 strokes per minute.



### **Types of blades**

Blades come in lengths from 120mm to 375mm.

### **Operating the reciprocating saw**

The operating and safety principles for the sabre saw are the same as those for the jigsaw.

Wear the required eye, hearing and foot protection.

Secure work down before cutting.

Maintain a steady, even pressure.

Ensure that there are no obstructions for the blade during the cutting operation.



## Activity 3

1. What are the consequences of selecting a poorly-fitting screwdriver bit when using a power screwdriver?

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2. Ensuring that the jigsaw is held firmly down on the work helps the operator to maintain control of the saw and keeps the blade in the work.  
When using a jigsaw incorrectly, what is likely to happen if the blade was allowed to come out of the saw kerf on the up stroke?

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3. When cutting with a jigsaw, why is it important to have adequate clearance underneath the work for the blade?

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4. A circular shape needs to be removed from the centre of a 12mm sheet of MDF. Describe how to cut out the shape using a jigsaw.

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5. List 3 items of personal protective equipment that should always be worn when using either a jig saw or a reciprocating saw.

i) \_\_\_\_\_

ii) \_\_\_\_\_

iii) \_\_\_\_\_

6. The finer the set, the smoother the cut. True or False?

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7. A round window is to be fitted into the side of a weatherboard house. What type of saw would be best to cut the opening in the wall?

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## Portable circular saw

Portable electric power saws are used extensively throughout the construction industry. They are extremely versatile and available in a range of sizes and can be used to cut a wide variety of materials.



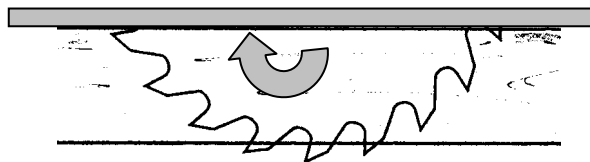
A portable circular saw consists of a circular saw blade geared to a motor with a handle and a non-locking trigger switch. They are available in a range of sizes and are either 240 Volts or battery powered.

A circular saw offers the power and precision to make long, straight ripping cuts and crosscutting cuts. It can also be used for bevelling, rebating, grooving and trenching.

They are most commonly used to cut wood and timber-based manufactured board. With specialised blades, however, they can be used to cut a wide range of materials, e.g. metal, plastic, fibreglass, fibre cement sheet, fibre plank, brick or tile.

Circular saws are measured by the maximum blade diameter they can hold. A circular saw with a blade size of 185mm to 190mm can cut material up to approximately 70mm thick.

To reduce drag and produce a smoother cut on the top side ensure that the blade is cutting the timber at an acute angle. Do this by adjusting and setting the depth of the cut so that only one tooth is exposed on the other side of the material.



### Safety requirements

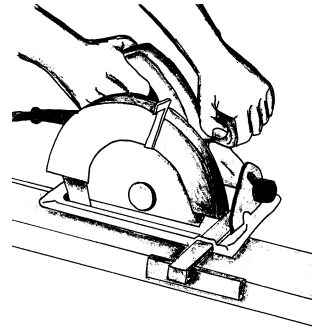
All portable power saws must have these built-in safety features:

- A spring-loaded self-closing retractable lower guard to cover the lower portion of the blade on both sides and to below the bottom of the teeth. Check that this guard works freely and efficiently, especially before commencing work. The guard should never be tied back.
- A fixed-top hood guard, deep enough to cover both sides of the blade to below the depth of the bottom of the saw teeth.

### **Operating the portable circular saw**

To obtain a fine edge cut when cutting, place the finished side of the material face down and mark out and cut from the back. Alternatively, to make a fine-edge cut on the finished side, place masking tape along the line of the proposed cut. This will help prevent splitting caused by the upward cut of the rotating blade.

- Always ensure that the power cord is well clear of and behind the direction of the cut.
- Use an edge guide or ripping fence for long straight cuts.



## Circular saw blades – types and features

Most circular saws are sold with a tungsten-carbide blade, which is suitable for most work. However, to ensure the best cut, it is necessary to use the blade specifically designed for the task. The more teeth on the blade, the smoother the cut.

### Rip saw blades

Chiselling action – very efficient along the grain,

Very rough across the grain.



### Crosscut blades (cut off blades)

Slicing cut – smooth cut across the grain.

Very slow if used for ripping.



### Combination blade

A combination of ripping and crosscut blades, it cuts along and across the grain. Fewer teeth than the crosscut blade for faster cutting.

### Tungsten carbide blades

Very hard tips to the blade; stays sharper longer.

Produces a very smooth cut. Especially suited for manufactured boards.



### Plywood cutting blades

These have small, closely spaced teeth to give a finer, smoother cut and help to prevent damage to the surface laminates.

### Abrasive blades

These are made up of abrasive particles bonded to a mesh.

The two main types are:

- metal cutting abrasive blades; and
- masonry blade.

### Use of abrasive blades

Always cut in a straight line. Discs can shatter when twisted.

Feed the saw slowly. Allow the blade time to cut the material.

Discs wear down as they are used. The smaller the diameter of the disc, the less efficient it is for cutting.

If a disc is cracked or split, change it immediately.



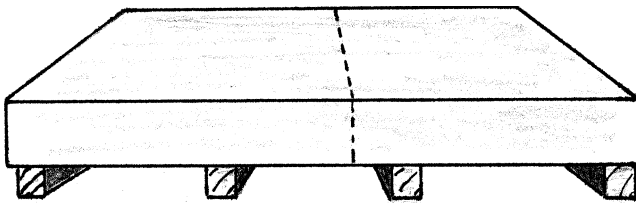
## Activity 4

1. What safety precautions should be taken before replacing a blade or making adjustments to a power saw?

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2. The dotted line on the drawing below indicates the line to be cut.
  - i) Identify the supporting features needed to ensure a clean and safe cut.



- ii) Describe what would happen if any of the supports were omitted.

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Add sketches to enhance your explanation.

3. When in use, why is it necessary to hold a portable circular saw firmly with both hands?

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4. What are the potential consequences of using a saw with a faulty or missing lower guard?

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5. Never force the saw. Let the blade do the cutting. Does forcing the cut speed up your productivity?

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6. How does the portable saw differ from the bench model in this regard?

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7. What are the possible consequences of placing a saw down on an exposed blade?

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8. Identify and list 6 safety rules applicable to the use of portable circular saws.

i) 

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ii) 

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iii) 

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iv) 

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v) 

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vi) 

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## Routers

The portable electric router consists of a high-speed electric motor that drives a spindle with a chuck (collet) attached to one end. The revolutions per minute (RPM) of the motor vary for different machines, from 9,000 RPM to 30,000 RPM. The motor speed of a portable electric router is very high when compared with most other portable power tools.



The router simplifies the task of making complex timber joints like dovetails, cutting decorative edging and rebates and is also invaluable when trimming laminates for bench tops and tables.

The versatility of the router is provided by the wide range of bits and accessories that are available to use with this tool.

The diameter of the cutter shaft and power of the motor determine the size of the router.

### Chuck size

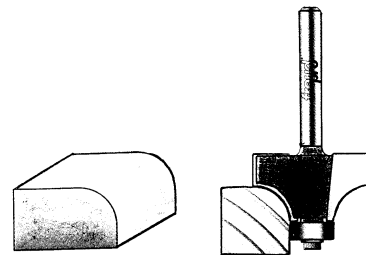
Chuck sizes and cutter shank sizes are most commonly 6.5mm (1/4 inch) or 12.5mm (1/2 inch) for medium to heavy-duty work. Collets or sleeves are fitted to 6.5mm shanks to enable them to fit into the larger router.

### Router bits

A router bit has a shank on one end and the cutting blade and flutes on the other. Some cutters have guides or a pilot bearing at the bottom of the cutting blade. This acts as a guide so edge work can be done.

#### High-speed steel (HSS)

Cheaper bits that are resin bonded so will not hold their cutting edge when used on hardwoods, particle board or MDF.



#### Tungsten carbide tipped router bits

Generally more expensive and better quality bits that remain sharper longer.

#### Laminate bit

A tungsten carbide bit for use on plastic laminates. The pilot bearing is set flush with the cutting blade to allow you to trim off surplus material.

Keep router bits clean by applying solvent or acetone with a coarse cloth, to remove the gummy build-up that tends to accumulate on the blades.

### **Preparation and operation of a router**

Ensure that the router is in the “off” position and that the cord is removed from the power point.

Insert a bit all the way into the collet chuck, then withdraw it approximately 2mm to enable the collet to grip the parallel shank of the bit when tightened down.

Securely tighten the chuck with the correct spanners.

To remove the bit, simply reverse the installation procedure.

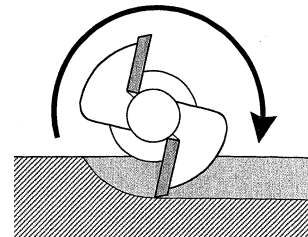
When using smaller shank bits, first insert the appropriate collet sleeve into the chuck with the groove in the collet lining up with the corresponding grooves in the chuck. Then install the bit.

Adjust the depth of cut and ensure that the locking levers are firmly in place.

Move the router in an *anticlockwise* direction (from left to right) when routing on the outside edges.

For an internal profile, move the router in a *clockwise* direction (from right to left).

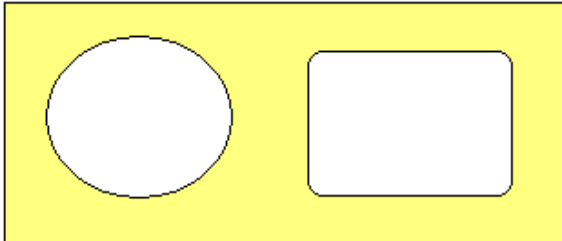
Grip the router firmly with both hands. The router has a powerful *torque* that can twist it out of a careless grip.





## Activity 5

Use arrows to indicate the correct direction of cut when using a router for both external and internal edges on the panel below.





## **Router guides**

### **Straight guides**

An accessory used for straight cuts when chamfering or grooving parallel to the edge of the board.

Clamp a straight piece of timber or metal guide to the job.

### **Trimmer guide**

A roller that attaches to the straight guide and follows the curve of the work.

### **Template guide**

The template guide is a sleeve through which the bit passes. It is fitted to the base of the router. The guides come in several sizes. The bit is always smaller than the ring bushing and allowance for this must be made when making your pattern.

### **A template (pattern)**

This is a smooth-edged pattern of plywood or MDF. The template is fixed or cramped to your work and the template guide follows the pattern.

### **How to prevent splitting**

Wood has a tendency to split at the edges when across the grain.

To minimise this damage, make all end grain cuts first, then finish with the cuts along the grain to eliminate the loose ends.

### **Stationary mounting**

The router can be turned upside down and mounted beneath a special table with the cutter protruding through the table, rotating in a anti-clockwise direction. Always feed stock against the rotation of the cutter.



## Activity 6

1. Explain how you can fit a 6.5mm shanked router bit in a 12.5mm chuck.

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2. What will be the effect on your work if the edge that you are running the pilot bearing along has a dent in it?

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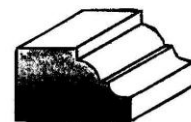
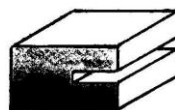
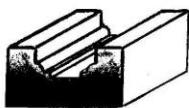
3. Explain the advantage of a tungsten carbide bit over a HSS bit.

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4. Sketch the bits required to obtain the given profiles.



*Example*



5. What are the hazards associated with using a tool that has an incorrectly fitted or loose cutter?

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6. Describe the effect of a faulty cutter head on the router.

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7. What would happen if a router bit struck a nail?

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8. Once the cut is completed, what should you do with the router while you are waiting for the blade to stop spinning?

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9. The surface that you are cutting is producing a charred or burnt finish. What does this indicate and what can be done to remedy it?

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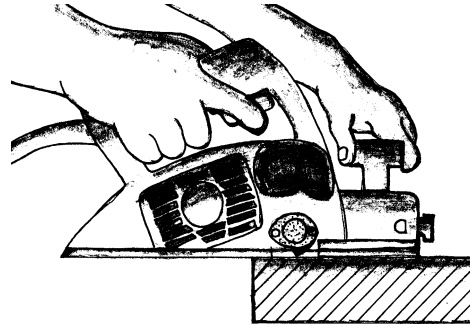
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## Power Planer

Power planers can do any job that a hand plane can do but in a fraction of the time and with a lot less effort.

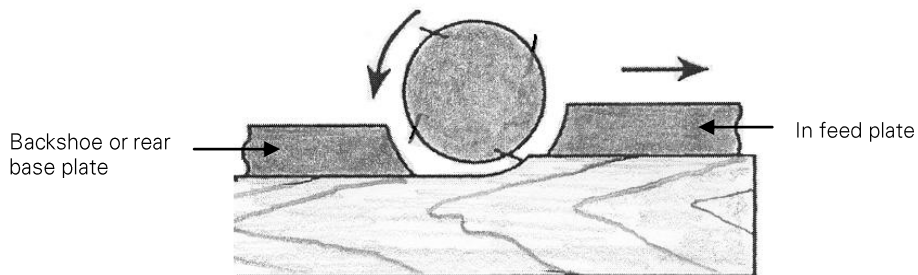
Planers have two full-width blades set into opposite sides of a cutter head that revolves at 12000 to 16000 RPM.

To adjust the depth of cut, turn the knob on the front of the planer.



### Setting of the blades

To ensure that the finished surface is smooth and even, the blades must be mounted so that the tips of the blades are absolutely level with and parallel to the surface of the rear base.



*The Correct Setting*  
Ensure that the tips of the blade are level with the rear base plate

## Operating the planer

- Make sure that the work to be machined is securely fastened down.
- Hold the planer securely with both hands.
- Start the planer.
- Once the planer is running at full revolutions, place it behind the work and commence the cutting operation.
- Use a steady rate of feed and, where possible, plane the surface in the direction of the grain.

**Caution:** Remember that the rotating **cutters are always exposed**. Never place your hand under the planer or try to guide the machine as you would a hand plane.

When the planing operation has been completed, release the trigger and wait for the blades to stop before placing the power tool on its side with the cutters clear of the workbench and facing away from you.

### Chamfering

Planes have a V groove on the front base. Line the groove up with the edge of the board and plane on the angle.

### Rebating

The planer can be fitted with an edge fence to assist in the cutting of a rebate.



## Activity 7

1. How can the depth of cut and rate of feed affect the quality of finish?

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2. List objects sometimes found in timber that will chip the blades

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3. What could be the consequences of placing your fingers under the planer while in operation?

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4. Why should you wait until the blades have stopped before putting the planer down?

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5. Why should you never use your fingers to clean out the chip chute?

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6. Why should you never rest the tool on the blades?

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7. The planer hits a hard object such as the head of a nail or stone in the timber.  
a) What will be the effect on the blades and the work?

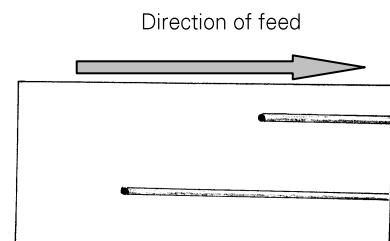
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b) What needs to now happen to remedy the problem?

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**8.** Gouging at either end indicates that your hand is tilting the planer. How do you fix this problem?



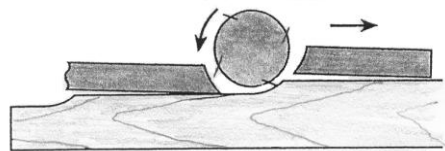
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**9.** Gouging at the start indicates that the blades do not protrude enough in relation to the rear base plate. How do you fix this problem?



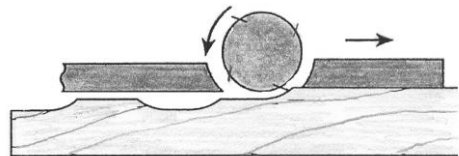
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**10.** Gouging in the middle or end of the surface indicates that the blade is protruding too far in relation to the rear base plate. How do you fix this problem?



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**11.** Unbalanced cutters or incorrect rates of feed cause a rippled or scalloped surface. How do you fix this problem?



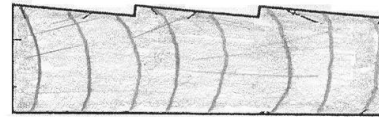
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**12.** One or both of the blades are out of parallel with the rear base plate. How do you fix this problem?



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## **Finishing Sanders**

A finishing or orbital sander is a lightweight power tool that will quickly produce a smooth surface on materials such as wood, metal, fibreglass or paint. It is not, however, designed for fast removal of material.

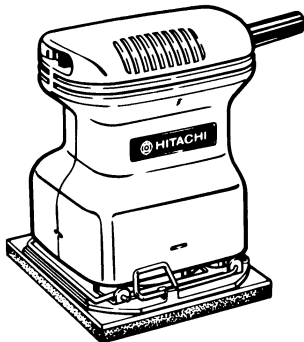
It is probably the easiest and safest of all power hand tools to use.

### **Principle of operation**

The finishing sander operates by moving the attached abrasive in a circular or in back and forth motions. Often, a single job will require several separate sandings with rough, medium and fine abrasives.

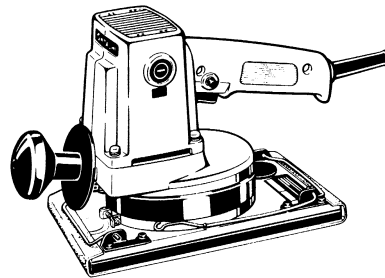
### **Types of sanders**

#### **Small finishing sander**



The palm sander is an efficient, lightweight machine that is easy to use and easily fits into hard to get at spots. This sander is often used to achieve a very smooth finish.

#### **Dual action finishing sander**



A medium-duty sander that features both in-line and orbital sanding strokes. The in-line strokes are used, with the grain, to produce a quality finish.

### **Dust**

Dust is a potential health hazard that should be avoided whenever possible.

Some sanders have bags to collect dust but the best method of dust control is to attach the sander to a vacuum dust-extraction system.

### **Polishing**

By attaching a buffing cloth to the pads of finishing sanders, you can achieve a high polish finish on surfaces.

### **Maintenance**

Clean the sander regularly to ensure that dust has not built up in and around the vents and in between the base and the main body. Blowing the dust out with compressed air is effective.

Unusual noises may indicate that internal mechanical components are worn, damaged or loose.



# Activity 8

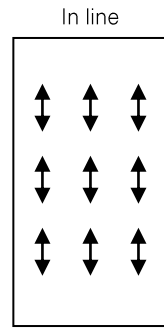
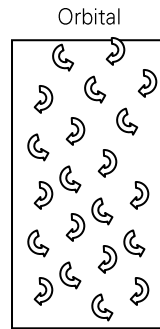
1. Explain the difference between orbital and in-line sanding strokes.

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2. Describe different methods for collecting dust when using these sanders.

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3. What will be the effect of placing too much pressure on the sander?

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4. Why should you only lay the sander on its side once the sanding operation is completed?

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## Belt Sander

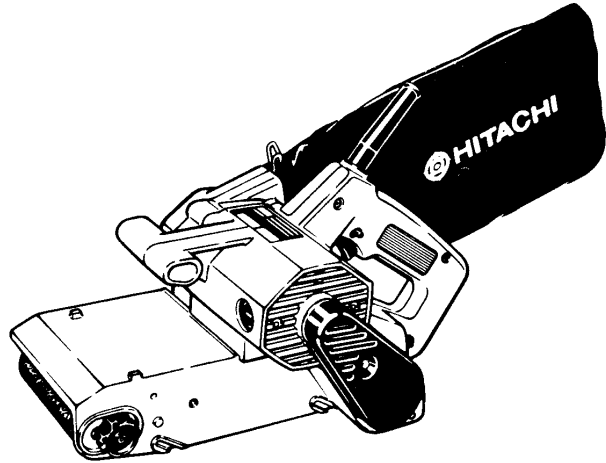
The belt sander is capable of removing material at a faster rate than a finishing sander. Belt sanders use continuous sanding belts, which are available in a wide range of grits to suit various applications.

### Fitting the belt

The rear roller drives the belt. The spring-loaded forward roller controls the tension and tracking of the belt.

When changing the belt, ensure that the overlap of the joint is trailing. Most belts have an arrow printed on the inside of the belt to assist with fitting.

Once the new belt has been fitted, check the tracking of the belt on the rollers by carefully holding the sander upside down on a firm surface.



To achieve perfect tracking, the angle of the front roller can be changed with the tracking adjustment knob. The belt will be tracking correctly when it runs evenly and flush with the outside edge of the base plate.

Belt sanders pull **forwards** when in use. To gain the best finish they must be held firmly with both hands and moved evenly across the surface of the work. Ensure that the belt is always sanding in the direction of the grain.



## Activity 9

1. What is the potential consequence of fitting the belt on back to front?

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2. Describe the effect of failing to correctly adjust the belt when fitting.

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3. What safety equipment should you be wearing while operating the belt sander?

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4. While operating the sander, what are the consequences of holding the sander in one place on the work?

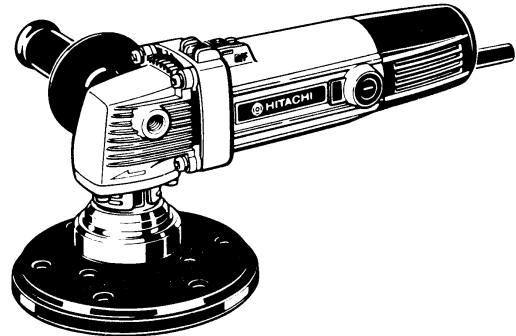
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## Disc Sander/Polisher

Disc sanders can be used for rough sanding jobs and are ideal for fast shaping of wood, fibreglass and for the removal of rust and paint. The speed of removal and quality of finish depend on the coarseness of the abrasive disc. Disc sanders tend to leave scouring marks on the work and are not recommended for finishing projects that require a smooth, flat surface.

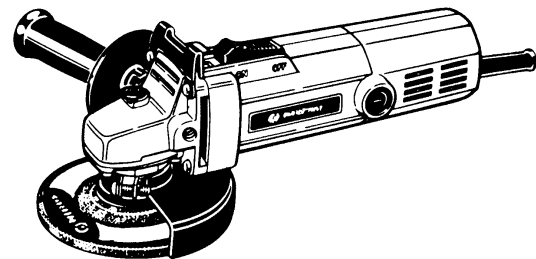


The sander can be converted into a polisher by attaching a wool buff to the disc.

Polishing and buffing involves only a very thin cutting of the surface material using an abrasive cutting compound. Polishing also includes buffing to produce a high sheen after the application of a material, such as car wax. Always keep the polisher moving, as remaining in one place may result in the surface being permanently damaged.

### Portable disc grinders

A portable disc grinder (angle grinder) is a machine fitted with a reinforced vitrified resinoid grinding wheel mounted on a drive shaft.



Disc or angle grinders are used to grind steel and other hard materials. They may be used to remove burrs or for preparing an edge for welding. These grinders operate at very high speeds so special care must be taken when using them. Ensure that all guards are correctly set up to protect the operator and others from sparks and flying particles. Operate the grinder with a two-handed grip at all times.

Grinding discs are made to grind metal or masonry. All discs should be labelled to make identification easier.



**Caution:** Check all discs before use for cracks or damage. Discard any damaged discs.

### Use of angle grinders

During the break-in period of a new grinding disc, the grinder should be drawn back towards the operator to prevent it from cutting into the work. Once the perimeter of the disc has been rounded off, the grinder can be worked in both directions.

Hold the angle grinder at a 15° angle to the work surface to perform the correct grinding operation.

**Using the grinder as a cutter**

With the appropriate cutting disc, the grinder can be used to cut metal and ceramics.

When cutting the material, make several passes along the cut removing a little bit of material with each pass. Do not attempt to cut the entire thickness of the material at once.

Allow the disc grinder's own weight to apply pressure to the job. It should never be necessary to force the tool.



## Activity 10

1. The grinding wheel rotates clockwise. In which direction will this cause the sparks to fly?

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2. When using an angle grinder near thinners, rags and other flammable materials, identify the potential hazards.

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3. When operating an angle grinder, what steps can be taken to manage or control the effects of sparks on other people?

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4. What are the dangers of using excessive force on the disc when using an angle grinder?

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5. Why is it necessary never to apply pressure to the side of cutting discs (side loading) when operating an angle grinder?

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## Plate or Biscuit Jointer

A biscuit jointer is a portable power tool with a fine, circular saw blade used to cut fine crescent shaped slots into the edge of a wood joint to the exact depth and shape required to house a flat wooden biscuit. The biscuit joint is able to provide adequate structural strength to a joint without being visually noticeable.

Biscuit joints are quicker and easier to construct and in many cases stronger than some of the other more traditional methods of joining wood. The tool operates with a plunging action to precisely cut crescent-shaped slots for the placement of flat wooden biscuits. Biscuits are quicker, easier and stronger than dowel joints.

The three biscuit sizes available are #0, #10 and #20. It is recommended that you use the largest biscuit size that will fit into the application.



Set the adjustment to the corresponding size of the biscuit that you are using. Check the depth of cut on a scrap piece of timber.

It is generally recommended that biscuits be positioned on the centre line of the timber, at 150 to 250mm centres with end biscuits being placed 50 to 70mm from the end.

The following joints are commonly constructed using biscuits and the plate jointer:

- widening joints;
- mitre joints;
- frame joints; and
- T-joints.