CON1010

Construction Tools and Material Fundamentals

Before you begin, here is what you need to complete for full marks in this credit:

1) Stationary Machinery Questions 15%
2) Hand Tool Questions 15%
3) Night Stand 70%

Carpenter

Stationary Power Tools

Apprenticeship
and Industry
Training

NOTES

Stationary Power Tools

Rationale

Why is it important for you to learn this skill?

Stationary power tools are found on many job sites and in wood product manufacturing shops. As a carpenter, you must become familiar with them and their use in order to work safely and proficiently.

Outcome

When you have completed this module, you will be able to:

Use stationary power tools.

Alberta Course Outline Objectives

1. Identify stationary power tools.
2. Describe the uses of stationary power tools.
3. Maintain stationary power tools.

Module Objectives

1. Describe the operation and maintenance of stationary saws.
2. Describe the operation and maintenance of stationary planing tools.
3. Describe the operation and maintenance of stationary drilling, grinding and sanding tools.

Introduction

Carpenters use power tools every day. Although stationary power tools are not always available on every job site, it is important that you understand how to use them safely and effectively. This module, in conjunction with shop practice, provides you with basic knowledge of stationary power tool use and applications.

NOTES

Objective One

When you have completed this objective, you will be able to:

Describe the operation and maintenance of stationary saws.

Table Saws

The *table saw* and its smaller cousin, the *bench saw* are the most commonly used stationary power tools (Figure 1). The table saw blade is typically belt driven, although many new light-duty table saws are available as direct drive units.

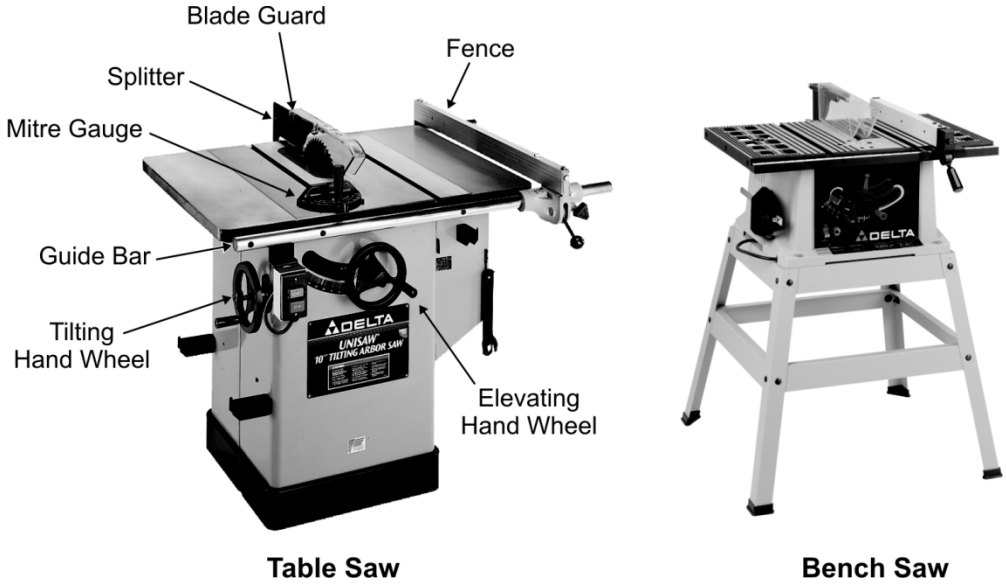


Figure 1 - Table saw and bench saw. (Courtesy Porter-Cable • Delta)

The saw blade is held in place on a shaft between the arbor flange and an arbor washer (Figure 2). The arbor washer and nut hold the saw blade in place on an arbor shaft (threaded shaft/spindle). The thread on the arbor is normally left hand thread and is opposite the blade's rotation so that the nut does not loosen while the arbor and saw blade are rotating.

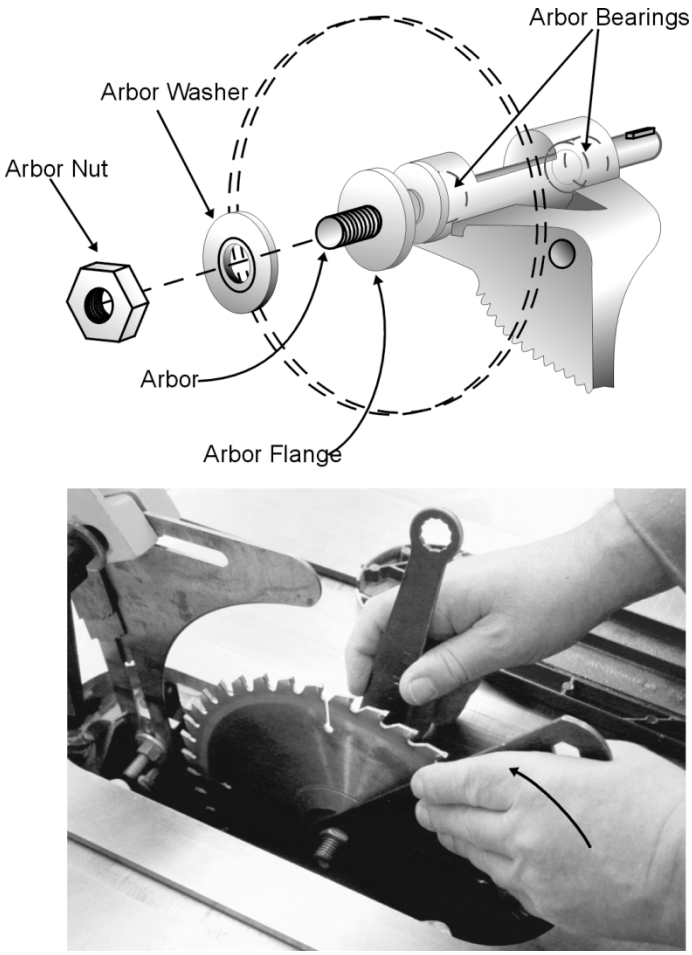


Figure 2 - Table saw arbor shaft.

Table saws are available with a variety of motors that are rated by horsepower and power (voltage/amperage) requirements. 110 - 220 volt single-phase and multiple-phase motors are common. The saw blades for table saws typically range from 7¼ inch to 12 inches. The ability of a table saw to rip or bevel cut 50 mm (2") nominal stock is a minimum expectation for a professional or contractor's table saw.

NOTE
The size of a table saw is an indication of the largest diameter circular saw blade that can be used safely. A 10-inch saw is capable of using a 10 inch diameter saw blade (250 mm).

NOTES

The blade projects through a slotted insert in the table called the *throatplate*. Ensure the surface of the throat plate is flush with the table top. For safety reasons, the blade's height should project no more than 6 mm (¼") above the stock being cut. The blade is raised or lowered by turning the hand wheel that is typically located at the front of the saw. Most table saws have a tilting arbor that adjusts from 0° to at least 45°, allowing the saw to make bevel cuts (Figure 3). Tilt the blade by turning the tilting hand wheel typically located at the side of the saw.

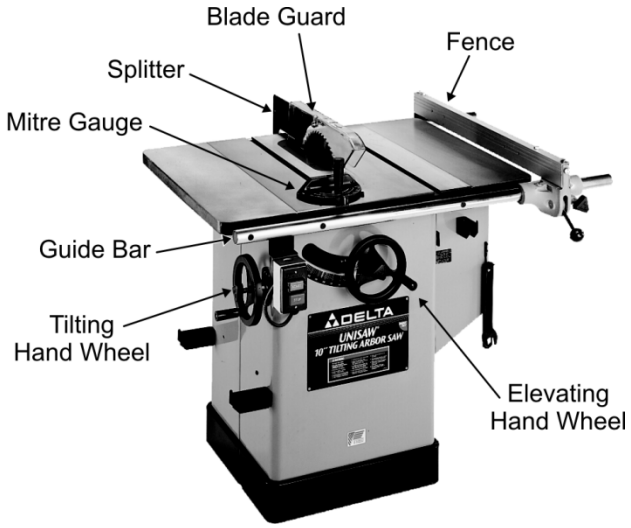


Figure 3 - Tilting arbor table saw.

Standard Accessories

Blade Guards

With the exception of a few special operations, the saw's blade should be guarded when you are using the table saw. Most saws come with a splitter style guard (Figure 4). The splitter part of the guard is a piece of metal positioned directly behind the blade and serves to keep the kerf open. The splitter prevents the wood from binding on the back of the saw blade and causing a kickback.

Splitter and Anti-Kickback Fingers

Many splitters have anti-kickback fingers attached (shown in Figure 4). These fingers provide added protection from kickback by digging into the wood preventing it from moving back towards you if the material being cut binds on the blade.

These devices should only be removed when cutting dadoes, rabbets and plows.

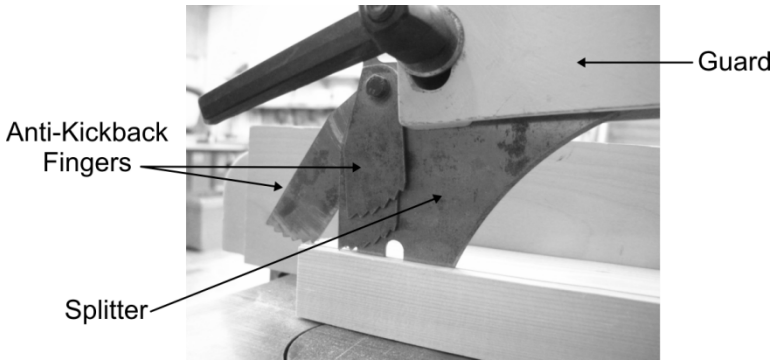


Figure 4 - Splitter guard with anti-kickback fingers.

Rip Fence

The metal rip fence, which can be faced with plywood, clamps to the front guide bar parallel to the saw's blade and acts as a guide when cutting stock to width (Figure 5). The width of the desired cut is determined by setting the distance between the saw's blade and the fence.

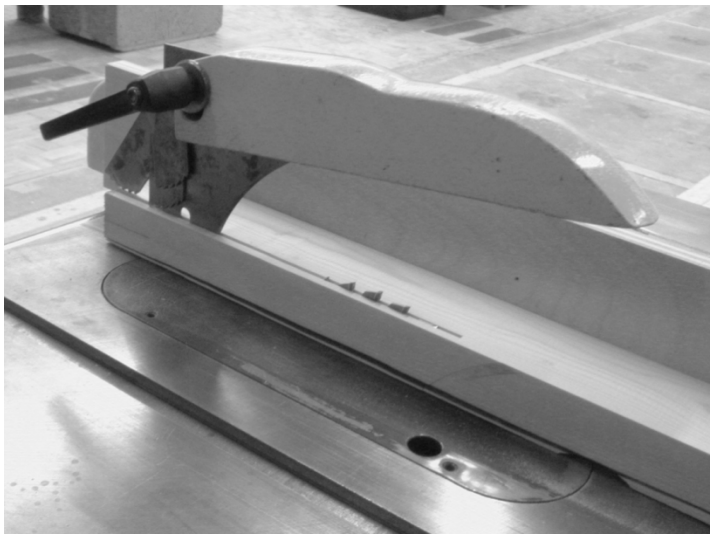


Figure 5 - Rip cutting with the fence.

For safety purposes, a push stick should be used whenever the width of the cut (the distance between the saw's blade and the fence) is less than 100 mm (4").

NOTES

It is only safe to remove the push stick from the material during a ripping operation when the material has completely cleared the blade (Figure 6).

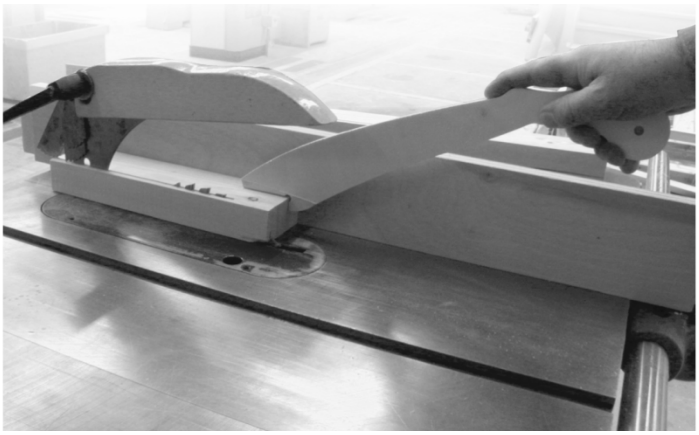


Figure 6 - Using a push stick.

DANGER
Avoid backing material out of the blade while the saw is running. If you need to remove material, hold it down to the table, turn the saw off and wait until the blade has stopped.

NOTES

Mitre Gauge

The mitre gauge fits into precision-machined slots parallel to the blade in the table surface.

When crosscutting or cutting stock to length and the distance from the fence to the saw's blade is greater than the length/depth of the stock being cut, the mitre gauge (Figure 7) should be used rather than the fence.

The mitre gauge is adjustable from 0° to slightly more than 45° and allows the operator to hold the stock in the required sawing position. A setting of 0° is used when making square cuts across the face of the stock. When making flat mitre cuts, the gauge is set to the required angle and moved together with the stock firmly held towards the rotating blade.

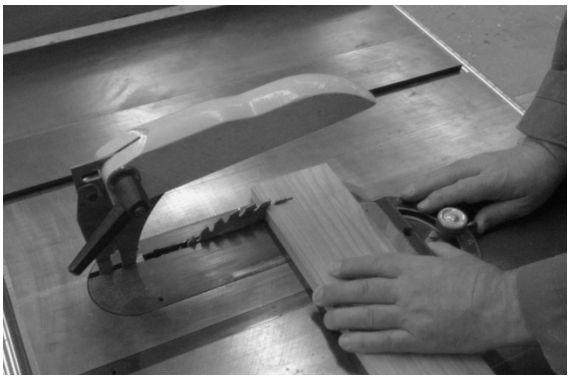


Figure 7 - Crosscutting with the mitre gauge.

When making compound mitre cuts, the procedure is the same as for square cuts across the face, except that the saw's blade is tilted and the mitre gauge is set to the required angles (Figure 8).

Figure 8 - Cutting a compound mitre.

DANGER
Never attempt to cut freehand on a table saw; that is, without the aid of at least one of the table saw's two standard accessories: the rip fence or the mitre gauge. Cutting freehand is extremely dangerous and the cause of many serious accidents.

NOTES

Basic Maintenance Checks

Blade Square with Table

Being able to accurately cut a square edge is an important feature of using the table saw. The procedure for checking accuracy is very straightforward.

With the saw unplugged and the blade raised to the maximum height, adjust the tilt angle hand wheel until it hits the positive stop with the blade at 90 degrees to the table (Figure 9). Place a try square on the table next to the blade and determine whether the blade is actually 90 degrees to the table. The positive stop may periodically need to be adjusted so that the blade will stop exactly at 90 degrees to the table each time it is returned to that position.

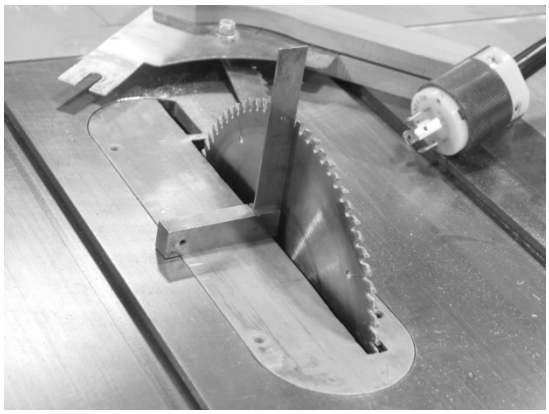


Figure 9 - Checking blade square.

Rip Fence Parallel with Blade

Cutting parallel strips of material accurately is another operation the table saw does very well when the rip fence is set parallel to the blade. Most table saws come from the factory with the blade set parallel with the mitre gauge grooves in the tabletop. If the blade and the mitre gauge grooves are parallel, checking the accuracy of the rip fence is as simple as measuring from the face of the locked fence to the mitre groove at the front and back of the saw table. If the two measurements are the same, the fence is parallel with the blade and will accurately guide your cut (Figure 10).

Figure 10 - Checking rip fence.

NOTES

Band Saws

The band saw can make straight cuts, but its primary purpose is to make curved or irregular cuts (Figure 22).

Figure 22 - Bandsaws.

The flexible steel blade has teeth on one edge. The ends are welded together to form a continuous band. The band saw blade is supported by two rubber-rimmed wheels, the diameter of which usually designates the size of the saw (Figure 23). The wheel diameter usually also determines the throat measurement, which is the distance from the blade to the machine's vertical support member. Some band saws have three wheels, which provides for a much wider throat measurement relative to the wheel size. The throat measurement determines the maximum width of material that can be cut with the band saw.

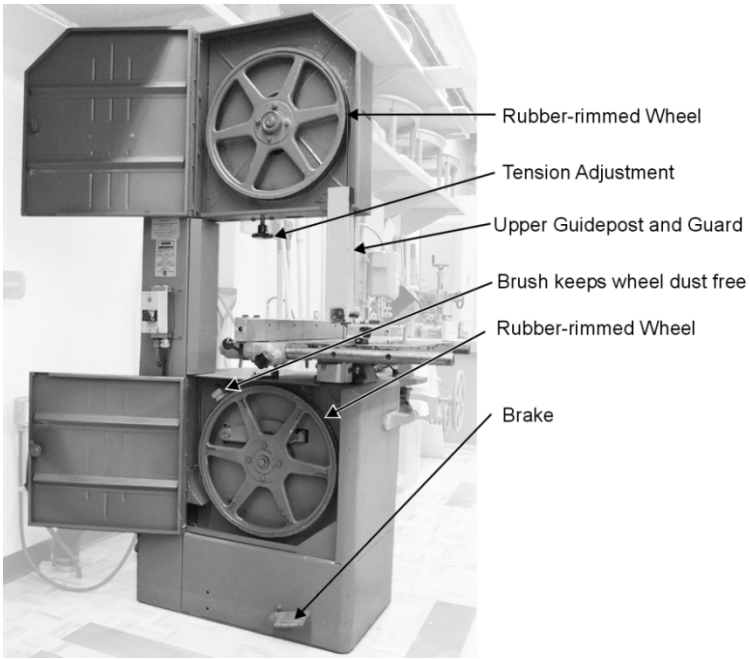


Figure 23 - Two-wheel band saw parts.

NOTES

Band Saw Wheels

The lower wheel's axle is held in a fixed position and is driven by the saw's motor. The upper wheel is a free-running idler wheel that is adjustable in two directions. It moves up and down to accommodate slight differences in blade lengths. The upper wheel is raised or lowered to adjust the tension on the blade, and the upper wheel tilts forward and back to adjust the tracking of the blade.

Blade Tracking

The blade is normally tracked properly when it rides in the centre of both the upper and lower wheels. However, the tracking adjustment allows the blade to be adjusted to run towards the front of the wheel or further back.

Blade Tension

Most band saws have a saw tension indicator that corresponds to the blade width (Figure 24). For example, a 10 mm (⅜") blade is correctly tensioned when the pointer indicates 10 mm (⅜"). In the absence of a saw tension indicator, you must judge the correct tension by pressing on the sides of the blade. Light finger pressure should move the blade approximately 3 mm (⅛").

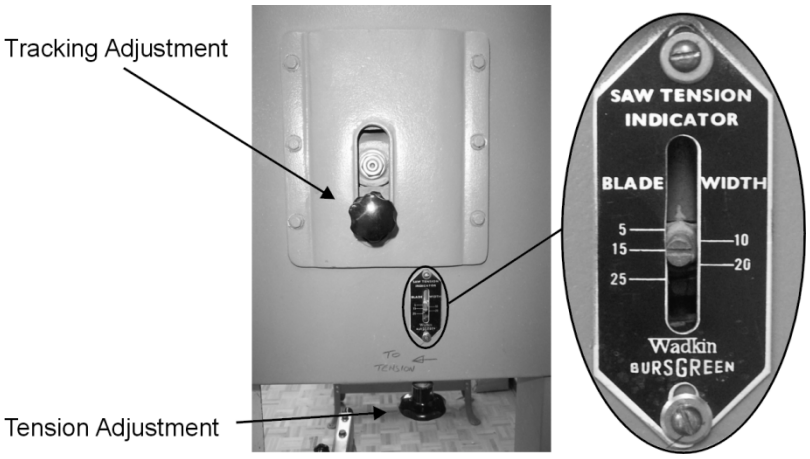


Figure 24 - Tracking and tensioning controls.

Band saws have two pairs of blade guides. One pair is attached to the upper guidepost and the other pair below the table. These blade guides maintain lateral (side) alignment and prevent side twisting of the blade. Guide bearings support the back of the blade, preventing it from being pushed off the wheels. Guide bearings are found on the upper guidepost and below the table (Figure 25).

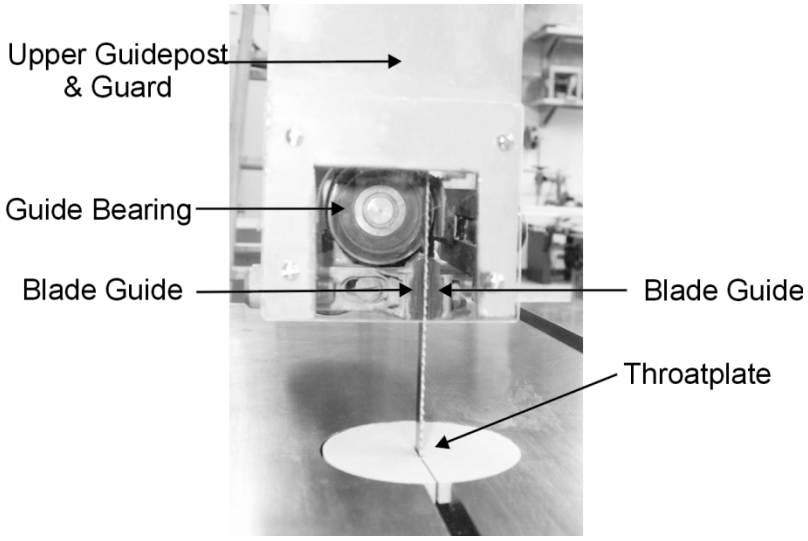


Figure 25 - Band saw upper guidepost.

The saw's blade is well guarded, being completely enclosed, with the exception of the exposed section of blade between the upper guidepost and the table. The distance between the upper guidepost when fully raised and the table determines the maximum depth of cut that can be obtained with a band saw. It can be very tempting not to adjust the upper guidepost before starting to make a cut, but for safety reasons, this adjustment should be made every time. The setting should be about 6 mm (¼") higher than the thickness of the stock being sawn.

DANGER
To reduce the potential for accidents and to properly guide the blade, the clearance between the stock being cut and the guidepost should be adjusted to within 6 mm (¼").

It is also important to maintain the circular throatplate in good condition. Always replace a worn throatplate because small chips can fall through it and become wedged between the blade and lower wheel, causing the blade to snap.

NOTES

Band Saw Operations

Resawing

Resawing is the process of cutting thick or wide material into thinner or narrower pieces (Figure 26). The capacity of the band saw to cut much thicker material than table or radial arm saws, without the risk of kickbacks, makes it the obvious choice for this operation.

By using a fence and a wider blade (to reduce deflection) you can accurately cut thinner strips off of a larger piece of material. The relatively thin band saw blade means that less material is lost (due to the smaller kerf).

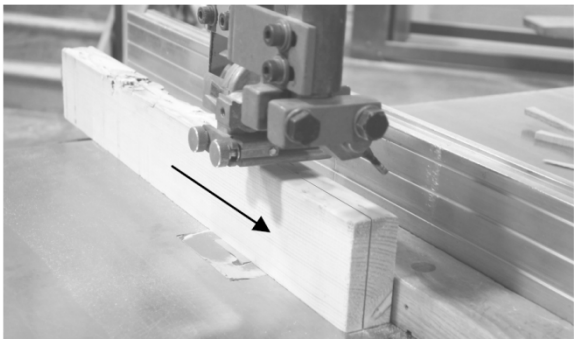


Figure 26 - Resawing material.

Cutting Curves

Band saw blades are available in a variety of sizes (widths), allowing this saw to be used for cutting curves and irregular shapes. The smaller the blade width, the tighter the radius that can be cut without binding (Figure 27).

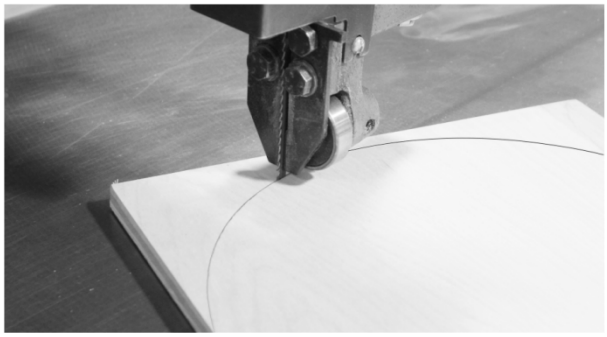


Figure 27 - Cutting curves with a band saw.

CAUTION
Forcing a blade around too tight a curve can cause the blade to break. If a blade breaks, do not open the wheel guards until all wheels have come to a full stop. Backing out of a cut with the saw running can pull the blade out of the guides and cause the blade to break.

Bevel Cuts

The table on most band saws can be tilted 45° to the right and 5° to 10° to the left, allowing bevel cuts to be made (Figure 28).

Figure 28 - Tilting the table for bevel cuts.

Basic Maintenance Checks

Blade Square with Table

With the band saw unplugged and the blade guard raised to the maximum height, loosen the table tilt angle locks and adjust the table until it hits the positive stop with the table at 90 degrees to the blade (Figure 29). Place a try square on the table next to the blade and determine whether the blade is actually 90 degrees to the table. The positive stop is adjustable so that the table will stop exactly at 90 degrees to the blade each time it is returned to that position.

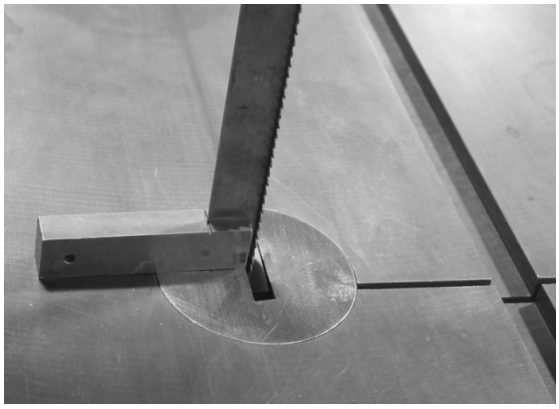


Figure 29 - Setting the table square with the blade.

NOTES

Objective Two

When you have completed this objective, you will be able to:

Describe the operation and maintenance of stationary planing tools.

Jointers

A jointer is a machine used to produce a true and flat surface on a piece of wood. The length of the knives and the cutterhead determines the size of a jointer. This size also indicates the maximum width of board that can be dressed and jointed. Jointers are manufactured in sizes from 100 mm (4") and up. The cutterhead typically has from two to four knives.

Jointers are equipped with spring-loaded safety guards that cover the knives (Figure 30). These guards move aside horizontally, then return automatically to cover the knives after the wood has been fed over the cutterhead.

On most models, the front and rear tables are adjustable up and down by the use of hand wheels. The infeed (front) table is raised up and down to regulate the depth of cut, which varies depending on the width and hardness of the stock to be cut. The outfeed (rear) table adjustment is critical to ensure accurate jointing. During normal use, the outfeed table should be level with the knives at the top of their rotation.

Jointers are most commonly used to create a flat surface and remove surface defects. With the aid of the fence, jointers can also be used to create square or bevel edges. The jointer can be used to form common woodworking shapes, such as rabbets and tapers.

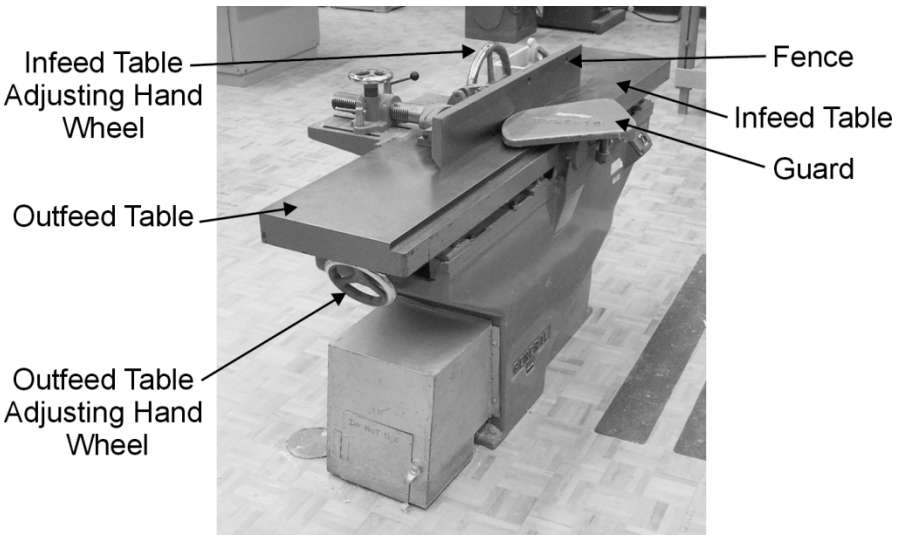


Figure 30 - Jointer parts.

Jointer Operations

For safety reasons, it is important to set the adjustable fence on the jointer so that only the required part of the cutterhead is used. Setting the fence to a wide position when working with narrow stock only increases the chances of accidental injury. Safety hazards increase as the size of the workpiece decreases, because your hands are brought closer to the cutterhead. Push blocks or push sticks should be used whenever your hands will come within 150 mm (6") of the cutterhead. The recommended minimum length of material is 300 mm (12").

Jointing a Surface

Used to remove surface defects and distortions, jointing a surface is the first step in dressing solid materials to the required sizes for your project (Figure 31).

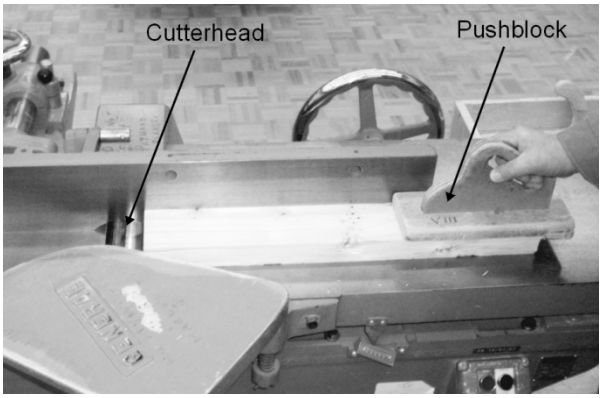


Figure 31 - Surface jointing with a push block.

Jointing an Edge

The next step in sizing material is producing a square edge. By placing the jointed surface against the fence, the edge can be jointed straight, smooth and square with the surface (Figure 32). When edge jointing narrow stock, care should be exercised and a narrow push block designed specifically for that purpose should be used.

Figure 32 - Edge jointing with a specially designed push block.

DANGER
Do not attempt to use a jointer to surface the end grain of solid lumber or boards.

Basic Maintenance Checks

Guard Operation

The blade guard (spring guard) is attached to a spring-loaded pivot that returns it to its position over the cutterhead after the material has passed by. With the jointer turned off, check the operation of the blade guard by pulling it away from the fence. When you let go, it should return quickly and smoothly into place. If it does not return or returns slowly, the spring can be tightened to increase the speed or the pivot may need to be cleaned to allow smooth movement (Figure 36).

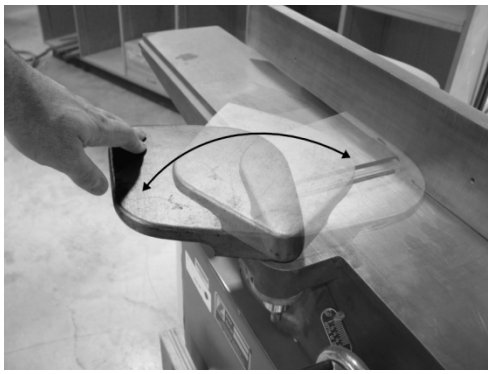


Figure 36 - Checking the guard for proper movement.

NOTES

Fence Square with Tables

One of the main uses for jointers is producing a square edge.

With the jointer turned off, loosen the angle lock for the fence and adjust the angle until it is near 90 degrees to the table (Figure 37). Place a try square on the table and against the fence and determine whether the fence is actually 90 degrees to the table. Tighten the angle lock to ensure that the fence does not move during use. The positive stop is adjustable so that the fence will stop exactly at 90 degrees to the table each time it is returned to that position.

Figure 37 - Setting the fence square with the table.

Outfeed Table Setting

The outfeed (rear) table adjustment is critical to ensure accurate jointing. During normal use, the outfeed table should be exactly level with the cutting edge of the knives at the top of their rotation (Figure 38).

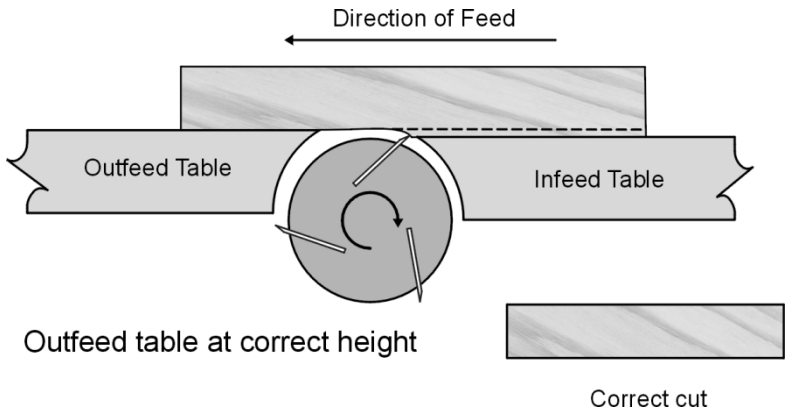


Figure 38 - Outfeed table at correct height ensures a correct cut.

Improper alignment of the outfeed table can cause problems and poor results when cutting with the jointer.

NOTES

Outfeed Table Setting Too Low

If the outfeed table is lower than the knives, the end of the stock being jointed drops as it leaves the infeed table, causing a snipe (Figure 39).

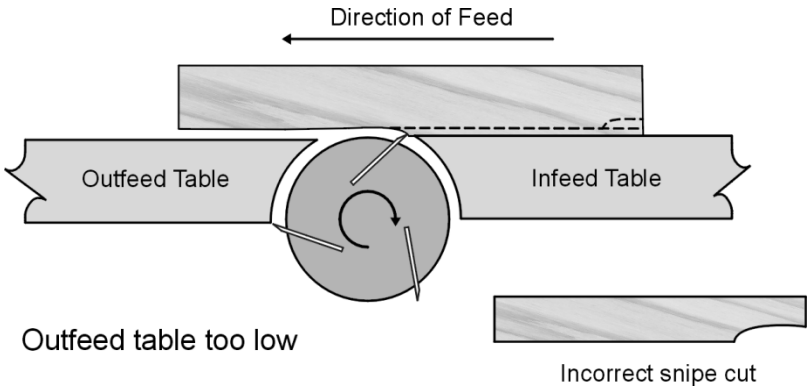


Figure 39 - An outfeed table that is set too low causes a snipe.

Outfeed Table Set Too High

If the outfeed table is higher than the knives, the stock being jointed is gradually raised out of the cut and a taper forms (Figure 40).

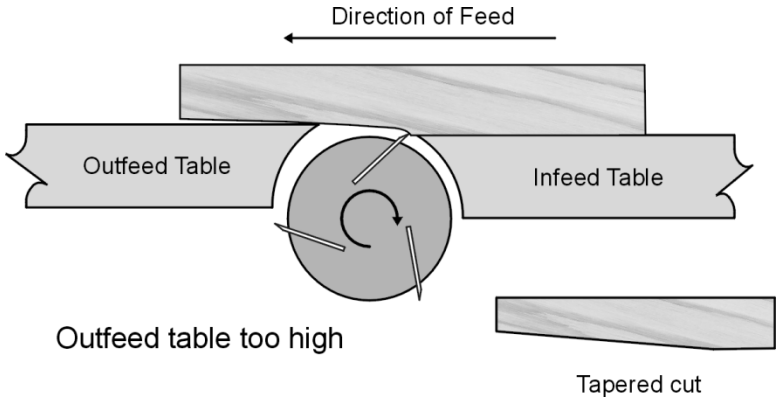


Figure 40 - An outfeed table that is set too high causes a taper.

NOTES

Thickness Planers

Thickness planers are designed for one specific operation: to machine wood to a smooth and uniform or parallel thickness.

The size of the thickness planer and the maximum width of board that can be dressed by it is determined by the length of the planer's knives. Although there are double surface planers that machine the top and bottom surfaces at the same time, the single surface planer is more common in woodworking shops (Figure 41).

Figure 41 - Single surface thickness planers. (Courtesy Porter-Cable • Delta)

Before feeding wood into the planer, one surface of the wood must be machined flat and true on a jointer. If possible, determine the grain direction and feed with the grain (Figure 42). Because the cutterhead and knives are usually above the wood to be planed, the material being fed into the thickness planner should be placed jointed side down against the table.

The minimum length of the wood that can be safely planed to thickness is equal to the distance between the outsides of the *infeed* and *outfeed* rollers. In other words the wood must be long enough for the leading edge to be gripped between the outfeed rollers before the trailing edge is released by the infeed. This length varies from machine to machine and should be determined before use. The minimum thickness that can be planed is determined by stops inside the planer that prevent the cutterhead from being lowered into the table.

NOTE
Twisted or warped material fed directly into a thickness planer will only become thinner; it will not become flat or true.

NOTES

Thickness Planer Parts

The planer is constructed in such a way as to enclose all the moving parts, which practically eliminates all danger, with the exception of a tendency for kickback should the material being cut splinter or be too short (Figure 42).

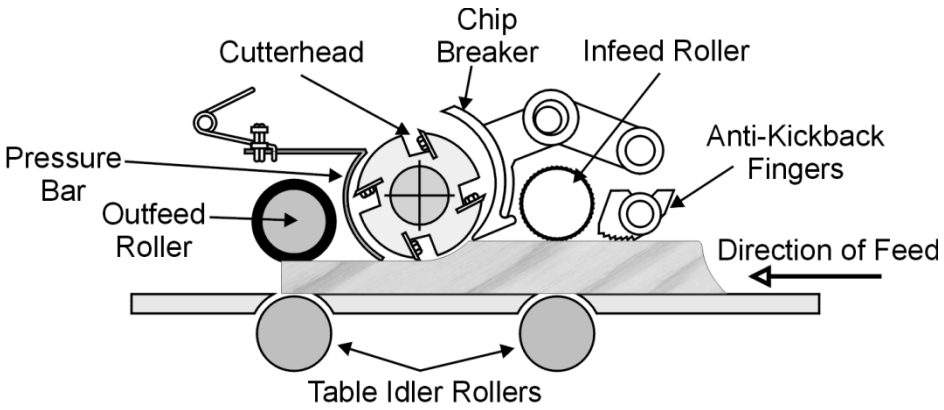


Figure 42 - Parts of a single surface planer.

Table with Idler Rollers

The idler rollers relieve friction between the stock and the table, allowing the stock to feed evenly and consistently into the cutterhead. The table is adjusted up or down, depending on the thickness of the material and the amount of cut required.

Infeed Rollers

The infeed roller pushes the material into the cutterhead and is usually made up of sections of spring- or rubber-loaded serrated steel collars (Figure 43). A sectional infeed roller allows several pieces of slightly different thickness to be fed into the machine at the same time. Some machines have rubber-covered infeed rollers, which tend to not mark the surface like serrated metal infeed rollers.

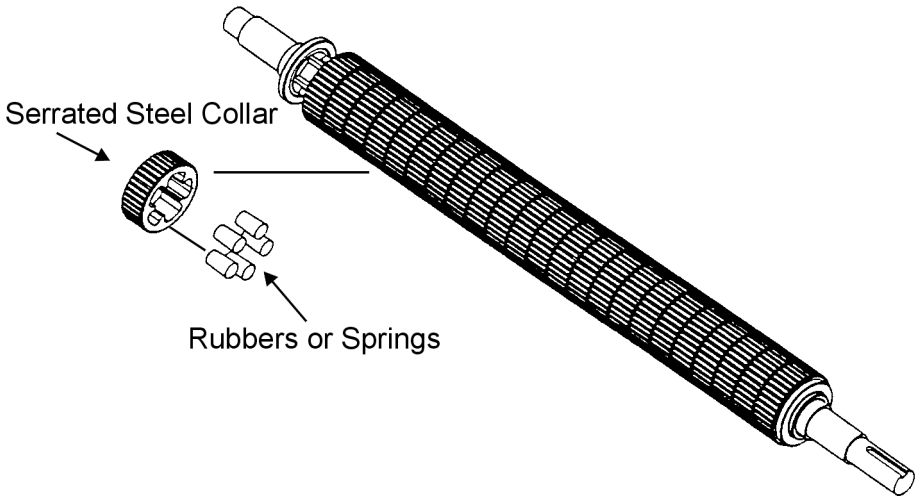


Figure 43 - Serrated sectional infeed roller.

NOTES

Chip Breakers

The chip breaker is mounted between the infeed roller and the cutterhead. It rests on the stock facing the rotating cutterhead and breaks the wood shavings as they are lifted from the surface by the knives. The chip breaker exerts pressure on the wood close to the cutterhead, keeping it down on the table and preventing the wood from chattering and tearing off in long slivers as it is being cut.

Cutterhead

The cylindrical cutterhead holds two or more knives and is mounted horizontally above the table. The length of the knives determines the size of the planer and the maximum width of stock that can be cut.

Pressure Bar

The pressure bar presses the stock firmly down onto the table on the outfeed side of the cutterhead, keeping it away from the knives and preventing the stock from vibrating up into the knives. After the stock passes under the pressure bar, it passes between the smooth upper and lower outfeed rollers that help to move the stock out of the machine.

Objective Three

When you have completed this objective, you will be able to:

Describe the operation and maintenance of stationary drilling, grinding and sanding tools.

Stationary Drilling, Grinding and Sanding Tools

Drill Presses

The drill press consists of a drive motor and head attached to a column with a table. Contained within the head is a heavy steel tube called a *quill*, which is moved up and down through levers and with spring assistance. Centred within the quill is a spindle with an attached chuck (Figure 44).

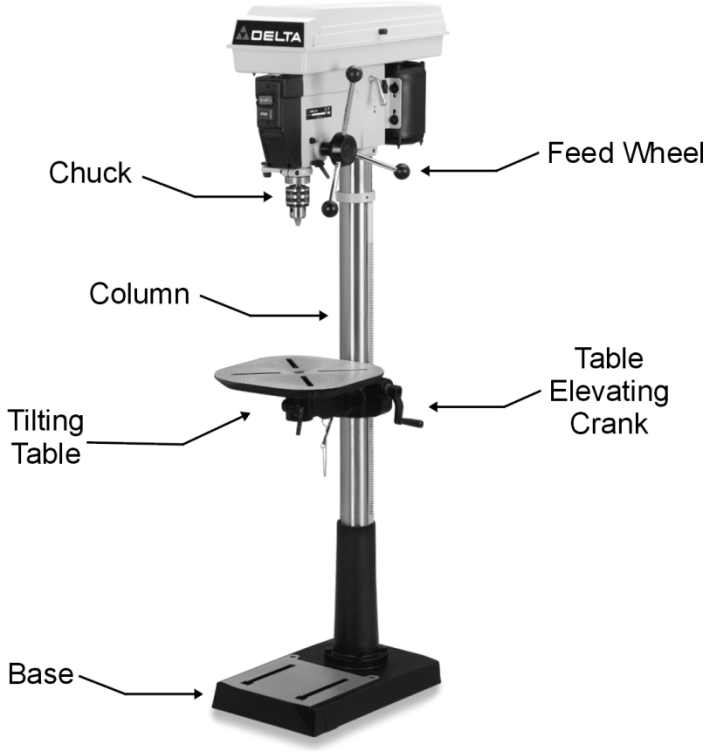


Figure 44 - Drill press parts. (Courtesy Porter-Cable • Delta)

NOTE
The size of the drill press is designated as *twice* the distance from the drill's chuck centre to the column. In other words, a 380 mm (15") drill press is only capable of boring a hole with the centre of the bit 190 mm (7½") from the column.

NOTES

Another important consideration with regard to the size of the drill press is *quill or spindle travel*. A drill with 100 mm (4") spindle travel can bore a hole 100 mm (4") deep.

The two common types of stationary drill presses are the floor model and the bench model (Figure 45).

Figure 45 - Floor and bench model drill presses. (Courtesy Porter-Cable • Delta)

Speed Adjustments

Generally, drill presses can be adjusted to run at different speeds either by changing a V belt on step pulleys or through the use of variable speed pulleys. The speed of a drill press must be adjustable to meet the requirements of varied materials and bits. The speed of the drill should vary depending on the kind of wood, type of bit and size of the hole to be bored. In general terms, the smaller the bit and the softer the wood, the higher the speed.

Step Pulleys

On the step pulley arrangement, while the drill press is stopped, the tension is released on the V belt, then the V belt is moved manually to different positions on the pulleys. The various possible combinations of small and large pulleys provide the various speeds to the chuck (Figure 46).

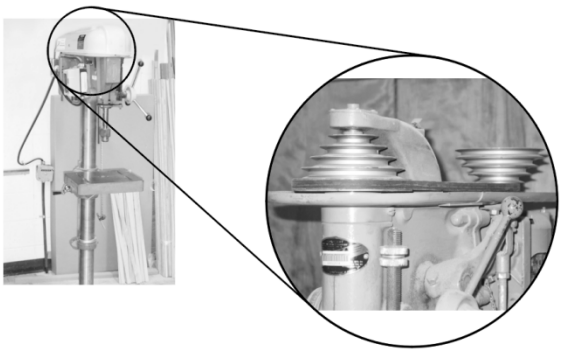


Figure 46 - Floor model drill press with step pulleys.

Variable Speed Pulleys

When changing the speed on a drill press with a variable-speed pulley arrangement, the speed is adjusted while the machine is running. As the distance between the two sides of the variable speed pulley is adjusted by turning the speed hand wheel, the path the belt travels changes, producing an infinite variety of speeds between the maximum and minimum available (Figure 47).

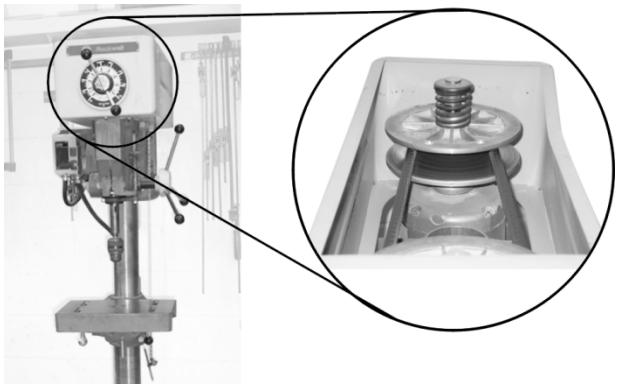


Figure 47 - Variable speed drill press with pulley.

CAUTION
Always clamp material that is to be drilled. Clamp the long end of material to the left of the operator so that if it comes loose while drilling the rotation of the chuck will carry it into the column and not into the operator.

Drill Press Operations

Boring Holes

A drill press is particularly well suited to repetitive drilling. Each hole can be made the same size and depth by using the *depth stop*. Holes can also be drilled at various angles by tilting the table (Figure 48).

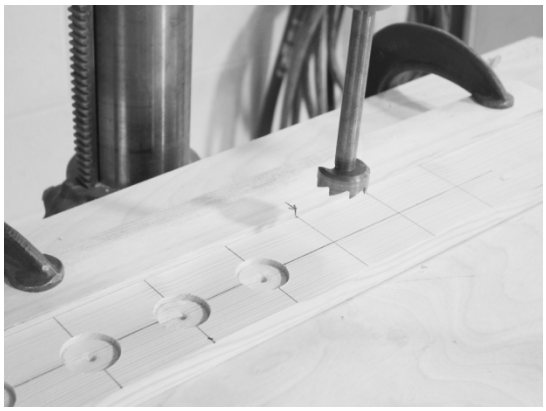


Figure 48 - Repetitive drilling with a drill press.

NOTES

Sanding

By installing a drum sander in the drill press, the press can be used to sand the inside curves of various projects (Figure 49).

Figure 49 - Drill press with drum sander in use.

Basic Maintenance Checks

Smooth Quill Operation

The quill should travel down smoothly and return on its own when the feed handle is released. If it does not return easily, the return spring may be adjusted to increase the tension and/or the quill should be lubricated with a dry lubricant, such as graphite, so that it moves freely (Figure 50).

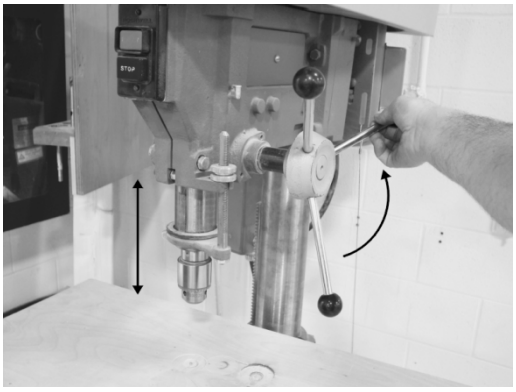


Figure 50 - Checking quill operation.

Setting the Table Square to the Bit

The 90 degree positive stop on most drill press tilting tables is usually accurate (Figure 51). If you need to check the accuracy of your set-up, simply clamp a heavy wire, bent in the shape of a Z with the back straightened, into the chuck. With the table raised to barely contact the end of the wire, rotate the chuck. If the table is square with the chuck, the end of the wire will be the same distance from the table throughout its rotation.

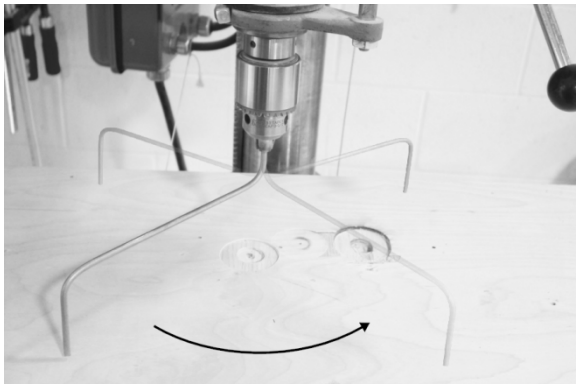


Figure 51 - Checking the drill press table for square.

Stationary Sanders

Disc Sanders

The disc sander consists of a metal disc attached to a motor shaft. Abrasive paper is glued to the disc surface. A cast metal table mounted in front of the disc can tilt to 45º and has a slot for a mitre gauge. Disc sanders are used primarily for quick end grain sanding and shaping outside curves (Figure 52).

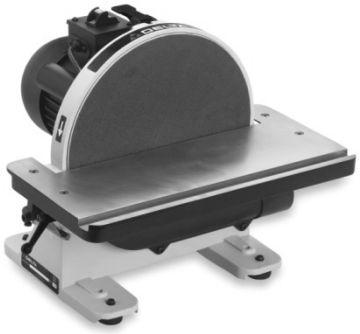


Figure 52 - Disc sanders. (Courtesy Porter-Cable • Delta)

CAUTION
Only the portion of the disc rotating down should be used for sanding.

NOTES

Belt Sanders

The belt sander is mainly used for smooth finishing and surface sanding of components before assembly. It consists of an abrasive belt mounted over two rollers: one an idler and the other attached to a motor-driven shaft. On the top side, mounted between the two rollers is a *platen* (plate) that supports the belt while the work is being sanded. The platen can be tilted and used in horizontal, vertical and intermediate positions.

All belt sanders have a metal ledge or tilting table on which you can rest your work to prevent material from being pulled from your grasp (Figure 53).

Figure 53 - Belt sanders. (Courtesy Porter-Cable • Delta)

NOTE
When installing sanding belts check inside the belt for an arrow indicating the required direction of travel.

NOTES

Combination Disc/Belt Sanders

The *combination disc/belt sander* is a very common type of stationary sander. Mounting both sanders together means that only one motor is needed (Figure 54).

Figure 54 - Combination disc/belt sander. (Courtesy Porter-Cable • Delta)

Spindle Sanders

A *spindle sander* has a round rotating abrasive sleeve in the middle of a flat work base, making it easy to sand inside curves on your material and to keep the curved edges square with the surface. Many spindle sanders also oscillate up and down while sanding, which uses a greater area of the abrasive sleeve (Figure 55).

Figure 55 - Oscillating sander. (Courtesy Porter-Cable • Delta)

NOTES

Basic Maintenance Checks

Cleaning

The life span of abrasive belts, discs and sleeves can be greatly increased by regularly cleaning off the embedded sawdust. To do so, gently hold a crepe rubber block against the downward rotating side of the abrasive while the machine is running (Figure 56).

Figure 56 - Using a cleaning block on the sander.

Setting the Tilting Table

With the sander turned off, loosen the tilting table locks and adjust the table until it hits the positive stop with the table at 90 degrees to the abrasive belt or disc. Place a try square on the table next to the belt or disc and determine whether it is actually 90 degrees to the table. The positive stop is adjustable so that the table will stop exactly at 90 degrees to the belt or disc each time it is returned to that position.

In addition the tilting table should be set 6 mm (¼") or less from the belt or disc (Figure 57).

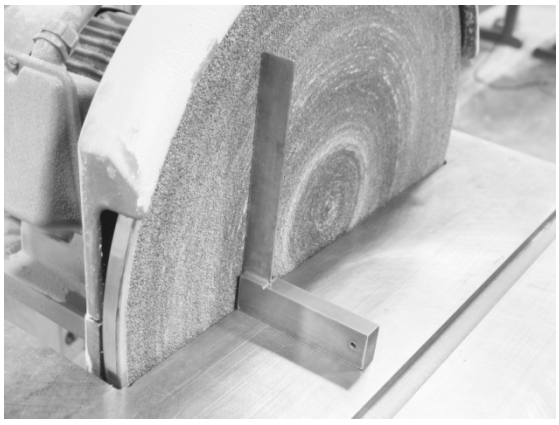


Figure 57 - Setting the tilting table.

Grinders

Two wheel grinders are used to remove small amounts of metal, such as when grinding to make a new bevel on the edge of a tool after the angle has been lost due to repeated honing or when the tool's edge has been nicked or damaged. There are two basic models: the floor model (Figure 58) and the bench model (Figure 59).

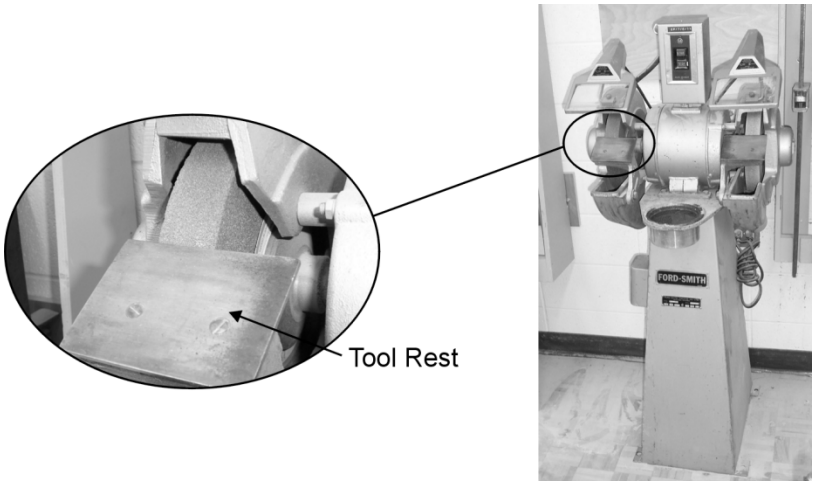


Figure 58 - Floor grinder.

Figure 59 - Bench grinder.

The tool is supported on the tool rest when grinding. For safety purposes, the tool rest should be positioned no further than 3 mm (⅛") from the edge of the abrasive wheel. A water pot filled with water or some form of tool coolant should always be kept in close proximity to the grinder.

While grinding, cool the tool by dipping it in water. Watch the little beads of water at the edge of the tool as you grind. When the beads of water begin to boil and evaporate, dunk the tool again. All your grinding and honing will be wasted if you overheat the edge of the cutting tool and destroy its temper. No matter how sharp you get the edge it will not last. If the edge turns blue, the edge has been heated beyond its original tempering temperature. The only way to salvage the cutter is to grind beyond the blue area to good steel.

For tool sharpening, a motor speed of 1400 to 1800 rpm is desirable. General-purpose grinders have a motor speed of 3000 to 3600 rpm and can be used for tool grinding, but greater care must be taken to keep the edge cool because the faster speed quickly burns the tool's edge.

CONSTRUCTION 1010 STATIONARY MACHINE QUESTIONS

1) The threaded shaft/spindle on the table saw that supports the saw blade is called a/an :
    a) Rabbet
    b) Arbor
    c) Rounder
    d) Spline
2) A common accessory used with the table saw is the
    a. Bevel
    b. Taper
    c. Fence
    d. Gauge
3) What should be used while cutting on the table saw when the distance between the saw blade and the fence is less than 100 mm (4")?
    a. Miter gauge
    b. Crosscut box
    c. Fence
    d. Push stick
4) Which basic accessory fits into the slots machined into the table saw table running parallel to the saw blade?
    a. Rip fence
    b. Miter gauge
    c. T-bevel
    d. Blade guard
5) What measurement on a band saw determines the maximum width of material that can be cut?
    a. Blade guard
    b. Blade tension adjustment
    c. Throat distance
    d. Wheel diameter
6) Keeping the blade running in the centre of the band saw's wheels is accomplished by adjusting what?
    a. Wheel distance
    b. Blade guard height
    c. Throat plate
    d. Blade tracking

7) A reason a bandsaw is a good idea to be used to resaw material is which of the following?
    a. It has blade guards
    b. It has a thin blade
    c. It has high horse power
    d. It cuts very fast

8) The size of the jointer is determined by the length of the what?
    a. Knives
    b. Infeed table
    c. Outfeed table
    d. Depth adjustment
9) Which part of a jointer is raised up and down to regulate the depth of cut?
    a. Depth indicator
    b. Infeed table
    c. Outfeed table
    d. Fence angle
10) A jointer is capable of producing flat surfaces and square edges. What other operations can it do?
    a. Make a crosscut
    b. A roundover
    c. A bevel
    d. An endgrain cut
11) If the outfeed table is set higher than the knives, what is the result?
    a. A bevel
    b. A taper
    c. A rabbet
    d. A rip cut
12) What is the minimum length of material that can be jointed on a 6” wide jointer?
    a. 6 inches
    b. 12 inches
    c. 18inches
    d. 24 inches
13) Thickness planers are designed for one reason. What is it?
    a. Create tapered material
    b. Make smooth, parallel thickness
    c. Cutting end of material uniform
    d. Creating a beveled cut

14) What must your material have before you can plane it, and which machine should you use to prepare your material for the planer?
    a. Both faces uneven and jointer used
    b. One face machined flat and the miter saw used
    c. Both sides machined flat and the table saw used
    d. Once face machined flat and the jointer used
15) How do you determine the shortest length of material that can be planed on a specific planer?
    a. The length of the cutting knives
    b. The distance from the back to the front of the planer table
    c. The distance between the infeed and outfeed rollers
    d. The horse power rating of the planer
16) Why would you clamp the long end of material to the left of you when using the drill press?
    a. Works well for right handed people
    b. Work cannot spin past the column
    c. Easy to hold with the left hand
    d. The bit spins in a counter-clockwise direction
17) What is the benefit of cleaning the abrasive belts and discs on your sanding machines?
    a. Looks cleaner
    b. Sandpaper will last longer
    c. It will resharpen the sanding grit
    d. Will prevent excess dust
18) The tool rest on a grinder should be positioned how far from the abrasive wheels edge?
    a. 3mm
    b. 4mm
    c. 5mm
    d. 6mm

Carpenter

Portable Power Tools

Apprenticeship
and Industry
Training

NOTES

Portable Power Tools

Rationale

Why is it important for you to learn this skill?

Portable power tools are used every day by carpenters and are present in nearly every task in the construction industry. These tools help you quickly perform tasks that would be difficult or time consuming with hand tools.

However, portable power tools can be hazardous and can cause severe injuries if they are not used or maintained properly. Selecting the correct tool and following the safety guidelines for each tool greatly reduces or eliminates the safety hazards.

Outcome

When you have completed this module, you will be able to:

Use portable power tools.

Alberta Course Outline Objectives

1. Identify portable power tools.
2. Describe the uses of portable power tools.

Module Objectives

1. Describe the operation and maintenance of portable saws.
2. Describe the operation and maintenance of portable planing and shaping equipment.
3. Describe the operation and maintenance of portable drilling and fastening equipment.
4. Describe the operation and maintenance of portable abrasive tools.

Introduction

Portable power tools improve efficiency and reduce the effort required to complete a task. There is a huge selection of portable power tools used in the construction industry. This module identifies the portable power tools typically used by carpenters and provides a basic understanding of their intended use and safety considerations.

NOTES

Objective One

When you have completed this objective, you will be able to:

Describe the operation and maintenance of portable saws.

Portable Power Tool Safety

When used and maintained properly, portable power tools can greatly enhance the amount and quality of carpentry work. The safe use of these tools is essential to avoid injury to yourself and your co-workers.

General Safety

General safety considerations are covered here; safety issues specific to each tool are noted with that tool.

- Before using the tool, read the safety guide and the user's manual supplied with the tool.
- Wear eye protection when operating power tools.
- Hearing protection is recommended when using most power tools
- Always disconnect the tool from the power source before servicing or changing blades.
- Avoid painful surprises - make sure the switch is off before you plug in the tool.
- Corded power tools must have a three-prong grounded cord or be double insulated with a two-prong cord.
- Do not cut the power cord - check the location of the cord and your cutting path before starting.
- Inspect the tool before use - if you find frayed cords, broken or loose switches, inoperative guards or other obvious problems label the tool "Do Not Use" and send it for repair.
- Do not use electrical power tools in damp or wet conditions - the risk of shock is high.
- Do not disable or remove safety guards.
- Keep your finger off the trigger switch when the tool is not in use or when you are carrying the tool.
- Ensure that you have good footing and balance before and while operating the power tool - do not overreach.
- Never modify the tool or use it for a job it was not designed for.
- Never carry the tool by the cord.
- Do not plunge cut into walls or areas with unknown hazards.

All of the possible safety issues cannot be covered in any list, but the use of common sense can eliminate many safety concerns that are not listed here.

NOTES

Extension Cords

To effectively use portable electric tools, you must use extension cords. Not all extension cords are created equal; undersized or poorly maintained cords can be a fire hazard and can reduce the life or even burn out your tools.

There are two items to consider when selecting an extension cord: wire size and cord type. In general, you must consider the electrical draw from the tool and the distance away from the power source. The longer the cord, the greater the resistance. A heavier gauge of wire (smaller number) may be required. A 15 metre long cord on a 110-volt circuit can easily drop below 100 volts if an undersized cord is used.

The amps or current that the tool uses should be noted on the specification plate (Table 1). If it is specified as watts instead of amps, divide the number of watts by the voltage (normally 110 volts) to determine the amps.

Wire Gauge	Amps @ 15 Metre Cord	Amps @ 30 Metre Cord
18	10	7
16	13	10
14	15	13
12	20	15
10	30	20

Table 1 - Extension cord amperage ratings.

The rating for the cord type (heavy, medium or light duty) should be printed on the cord's jacket (Figure 1). If it is not, assume that it is a light duty cord (not suitable for most power tools).

NOTE
Avoid cords not rated for exterior use. **Never** use an extension cord as a replacement for a rope.

Figure 1 - Extension cords. (Courtesy Totem Building Supplies)

NOTES

Cords for construction purposes should be three-wire (positive, neutral and a ground). Cords are made with several different types of ends. Twist lock ends keep cords from disconnecting from one another (Figure 2). The locking device helps keep a positive connection.

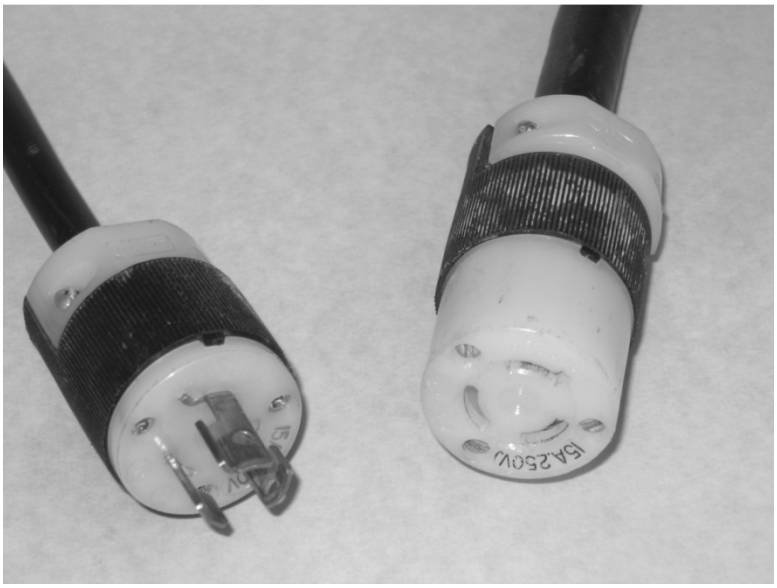


Figure 2 - Twist lock ends.

The typical colour code (Figure 3) for the wires is:

- red or black for positive,
- white for neutral and
- green for ground.

Figure 3 - Extension cord ends.

DANGER
Do **not** use electrical cords that have damaged ends or that are in poor condition. **Never** use a cord that has the ground prong removed.

NOTES

Circular Saws

Circular saws are probably the most common power tools used by carpenters (Figure 4). The maximum diameter blade that can be safely used in the saw determines the size of the saw; the 7¼" (184 mm) and 8¼" (210 mm) models are most common.

Figure 4 - Circular saws. (Courtesy Dewalt)

The circular saw has a housed motor that turns a circular blade in an upward rotation, which means that when you are cutting, the good face of the material being cut should be placed down in order to minimize chipping (Figure 5).

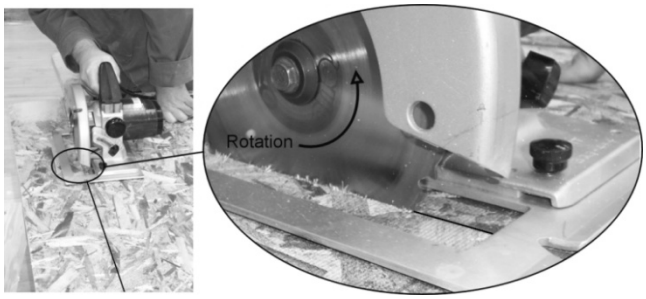


Figure 5 - Cutting to a chalk line. The blade cuts on the upward rotation.

A fixed guard shields the upper half of the blade and a retractable guard shields the lower half Figure 6A. The retractable guard is automatically pushed back as the saw cuts into the material. The spring-loaded guard automatically swings back into place to cover the blade when the cut is complete. For safety, the guard should always be maintained in good smooth working condition. The only time the guard should be manually raised while the motor is running is when you are *plunge cutting* or making a *pocket cut* Figure 6B.

Always wait for the blade to stop turning before you set down the saw. Ignoring this practice has caused many injuries when the guard unexpectedly sticks open and the spinning blade contacts a surface. Most new circular saws are equipped with an electric brake that stops the blade rotation as soon as the trigger switch is released.

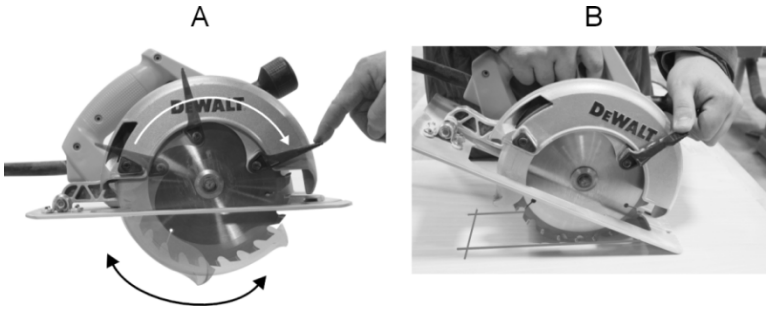


Figure 6 - Circular saw guard. (Courtesy Dewalt)

NOTES

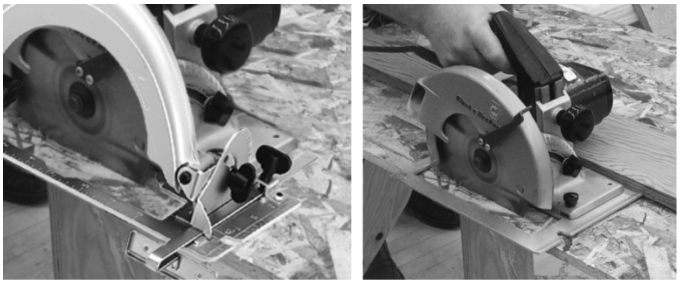
CAUTION
To plunge cut, tilt the saw on the front edge of the base plate (table), retract the guard, start the motor, slowly plunge the blade down into the wood with a downward motion. Stop the blade before removing it from the wood.

Raising or lowering the base increases or decreases the depth of cut, while tilting the base allows bevel cuts to be made (Figure 7). The base should be adjusted so the blade projects no more than 6 mm (¼") below the material being cut.

Figure 7 - Circular saw base. (Courtesy Dewalt)

DANGER
Do **not** use a circular saw with a guard that does not function properly or that has been disabled.

Most circular saws have an attachment called a rip fence or edge guide; these allow you to make narrow parallel cuts in long material. A straight edge clamped to the material can be used for wider parallel cuts (Figure 8).



A B

Figure 8 - Cutting with the aid of an edge guide and straight edge.

A saw guide protractor can be used to guide the cut when you are making accurate angled cuts across the face of stock (Figure 9).

Figure 9 - Cutting with the aid of a protractor.

Avoiding Kickback

If the wood binds on the blade while cutting, the circular saw may kick back towards the operator. Always support the work piece in such a way that the off-cut falls away after the cut. If you must cut in the middle of large sheet materials, support both parts of the material so that they cannot move during and after the cut. Do not cut the middle of material supported between two sawhorses as the material will drop and jam the blade, causing a kickback.

Kickbacks are often the result of attempting to back up or cut backwards with a portable circular saw. If the cut is not following the intended line, do not back up with the saw. Instead, reposition the saw at the start of the cut and begin again (Figure 10).

Figure 10 - Avoiding kickback.

DANGER
Never place your hand on the cut line behind the saw while you are cutting. If the saw kicks back, your hand will be in the blade's path. **Never** attempt to cut backwards.

Power Mitre Saws

Power mitre saws are used mostly for trim and finishing work (Figure 11). They allow you to crosscut, mitre cut and bevel cut. Power mitre saws are faster, more accurate and better able to withstand job site abuse than traditional mitre boxes.

The size is designated by the recommended blade diameter that fits the saw. Always use the recommended blade size. A blade that is too small, will not cut all the way through the material; a blade that is too large will cut into the housing or table of the saw.

Various blades are available that allow you to use your power mitre saw to cut wood, wood composites, plastics and lightweight aluminum extrusions.

Power mitre saws have *detent* settings (positive angle stops) that allow for fast, accurate set-up of the most commonly cut angles (0°, 22.5° and 45°). The positive angle stops can be overridden and the saw blade angle set by clamping a handle/knob to any left or right angle from 0° to 45° or more, depending on the saw.

Figure 11 - Power mitre saw and use. (Courtesy Dewalt)

When cutting with the power mitre saw, your arms should be straight in front of you. Hold the material firmly against the fence with one hand. With the other hand, grip the handle of the saw and press the trigger switch. Allow the saw to reach full operating speed, then guide it slowly through the material. If you allow the blade to stop while the saw is depressed at the bottom of the cut you will eliminate the tendency of the spinning blade to catch and kick out the small piece you have cut off.

DANGER
Never have your arms crossed when cutting with a power mitre saw. Always keep your hands a safe distance away from the blade.

The table on most mitre saws moves with the blade when the angle is changed so the blade always goes into the same slot in the table. However, if you attach a wooden auxiliary table to your saw or have an older model mitre saw with a fixed table you will need to replace the table when it gets worn. As these tables become cut away from use at various angles, they should be replaced in order to provide adequate support to the material at the point of blade contact.

To assist in cutting longer material, many mitre saws have extension tables or arms that help support the material being cut so that it does not fall after it is cut (Figure 12).

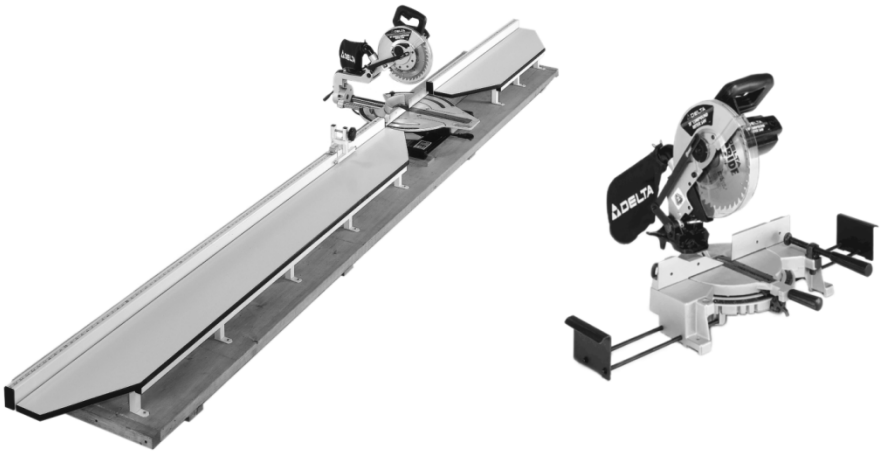


Figure 12 - Mitre saw extension tables. (Courtesy Porter-Cable • Delta)

Perfectly flat and straight material is rare. Care must be taken when cutting material with the mitre saw to ensure that you place any curve in the material so that it touches the table and/or fence at the point where the blade cuts. Setting material up this way ensures that the *kerf* does not close or bind on the blade as the cut progresses, preventing possible harm to the machine and operator.

Some models provide more positive angle stops and slightly greater angles; other models also allow the blade to tilt, making it possible to cut compound angles. This is very useful if you are doing crown mouldings and other finishing trim (Figure 13).

Figure 13 - Compound mitre saws. (Courtesy Dewalt)

Sliding Compound Mitre Saws

The *sliding compound mitre saw* has a sliding head that extends the cut of the saw from approximately 140 mm wide to 305 mm wide (5½" to 12"), making it perform like a lightweight portable radial arm saw without the ability to rip materials (Figure 14). Sliding compound mitre saws are capable of much wider cuts than regular power mitre saws and are becoming very popular for a wide variety of carpentry jobs. They are used for everything from detailed finish work to framing.

When cutting wide material with the sliding compound mitre saw, rather than pulling the blade towards you as you would with a radial arm saw, *push* the saw through the material towards the back of the saw. This avoids the tendency of the blade to climb the material and jump towards you. For smaller material, this saw is used the same as other mitre saws: the blade is simply lowered through the material.

Figure 14 - Sliding compound mitre saws. (Courtesy Dewalt)

Jigsaws

The *jigsaw* is also called the *sabre* saw and is used to make straight or curved cuts in wood and wood products or light metal. The blade cuts on the upstroke with an orbital movement; therefore, splintering will take place on the top side of the work. Place the good face of the material being cut down in order to have a smooth finish cut.

Most jigsaws have a tilting base for making bevel cuts and come with a fence and circle cutting attachments. Pre-drilling a hole or plunge cutting with the jigsaw easily makes pocket cuts Figure 15A.

When using the jigsaw, place the front of the base firmly on the material to be cut and start the saw before touching the material with the blade. Guide the saw along the cut line while pushing down to control the tendency of the saw to move up and down with the blade strokes. Reduce the cutting pressure near the end of the cut to avoid breaking or splintering the material. Reducing the blade speed when cutting curves will give better results Figure 15B.

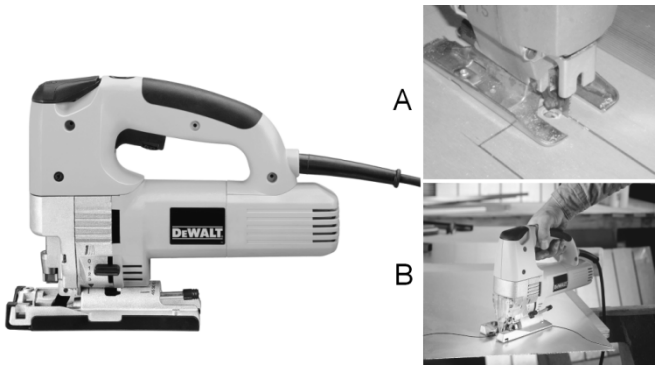


Figure 15 - Jigsaws. (Courtesy Dewalt)

NOTES

Assorted blades are available for cutting different materials. Always select a blade that, at all times, has at least two teeth in contact with the edge of the material being cut. Make sure the blade you are using is suitable for the material being cut. Several styles of blade attachment are used for various brands of Jigsaws, Figure 16A, so select the blades to fit your saw.

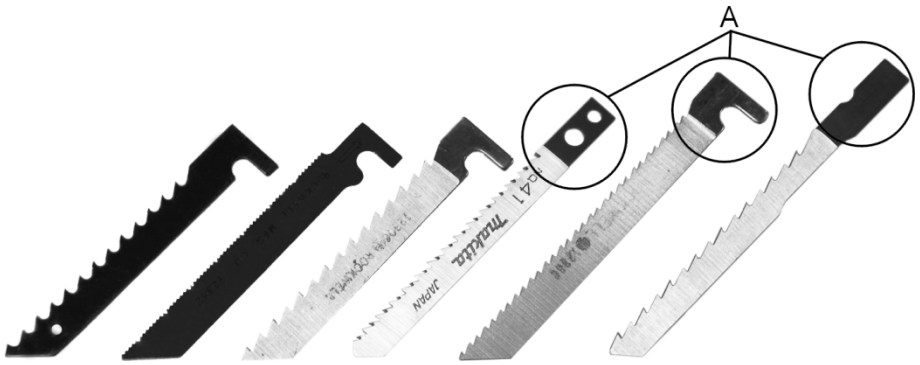


Figure 16 - Jigsaw blades.

NOTE
Specialized blades with the teeth designed to cut on the down stroke are available for use when the top surface must be free of chips.

Universal or neutral cut jigsaw blades can be used for materials that benefit from splinter free cuts, such as laminate flooring (Figure 17).

Figure 17 - Universal (neutral) jigsaw blade.

NOTES

Reciprocating Saws

The reciprocating saw is basically a large jigsaw with the blade mounted in the nose. (Figure 18) The reciprocating (straight back and forth) action of the tool gives it its name. To a large degree, reciprocating saws have replaced hacksaws, keyhole saws and handsaws on many construction sites.

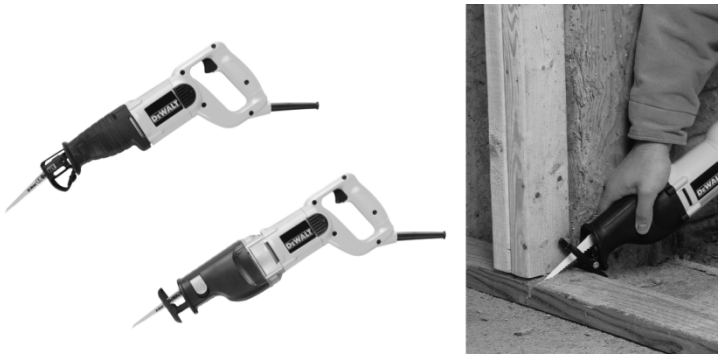


Figure 18 - Reciprocating saws. (Courtesy Dewalt)

The reciprocating saw may not be the tool of choice for precision work, but its long blade makes it particularly useful for remodelling work. It has an assortment of blades available for cutting different materials and for a variety of cutting operations (Figure 19).

Figure 19 - Reciprocating saw blades.

DANGER
The long blades of the reciprocating saw can easily reach wires and pipes deep inside a wall. Make sure you know what you are cutting into.

NOTES

Objective Two

When you have completed this objective, you will be able to:

Describe the operation and maintenance of portable planing and shaping equipment.

Routers and Laminate Trimmers

The *router* consists of two major parts: a motor and a base (Figure 20). Although it is a simple machine, the router is extremely versatile because of the vast array of cutters available.

The motor turns at high speed, up to 30 000 rpm, which accounts for its exceptionally smooth cuts along and across the grain of wood. Some routers are equipped with a variable speed adjustment that allows you to adapt the cutting speed to the material. The size of the motor generally designates the size of the router. Full size routers with 1¼ to 3¼ horsepower motors are common.

Figure 20 - Routers. (Courtesy of House of Tools)

The vertically mounted motor, with its rotating shaft and attached collet-type chuck, fits into the base and can be adjusted up and down to control the amount the cutter protrudes below the base.

The mechanism used to control the motor's vertical adjustment varies between tools. One system uses a *rack and pinion* arrangement (Figure 21). The rack is attached to the motor and a gear is attached to the base. As the knob attached to the gear turns it moves the motor up and down in the base.

Figure 21 - Rack and pinion base router.

Another system incorporates a *helical (spiral)* action that works like a screw thread (Figure 22). As the motor is turned clockwise it threads into the base, lowering the chuck and cutter. Turning it in the opposite direction raises the chuck and cutter.

Figure 22 - Screw base router.

The *plunge router* is another adjustment system that uses two columns to raise and lower the chuck and cutter (Figure 23). This type of router has adjustable depth stops that make it useful for repetitive cuts and accurate depth changes. The plunge base also lets you start in the middle of a piece of material without tilting the base. This makes it useful for doing accurate lettering, sign work and mortises.

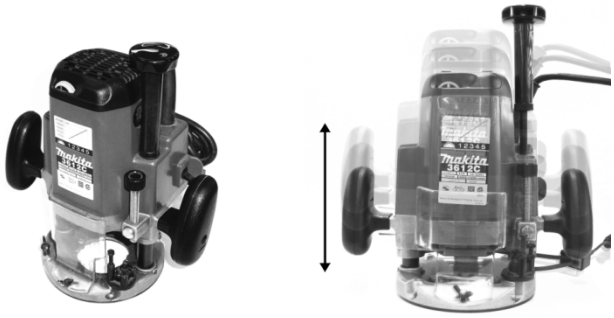


Figure 23 - Plunge base router.

DANGER
Regardless of the type of router used, the cutter is open and unguarded in the base. Always wait for the cutter to stop. Rotate the base away from you when you are returning the router to the table.

NOTES

Collets

Most routers have a *collet*-type chuck to tightly hold the shaft of the router bit or cutter. The collet for a router consists of a split tapered sleeve that holds the bit (Figure 24). As this sleeve is forced into a tapered hole in the end of the motor shaft on the router, it tightens on the shaft of the bit. The collets are usually specific to each brand of router and are generally not interchangeable.

Many routers are equipped with both 6 mm (¼") and 12.5 mm (½") collets. The bits with the larger (½") shafts are less prone to breakage due to vibration and heavy usage.

Figure 24 - Collet-type chucks with bits.

Cutter Rotation

In normal use, (when viewed from above) the cutter in the router rotates in a clockwise direction. The clockwise rotation tends to pull the router to the side, as shown in Figure 25.

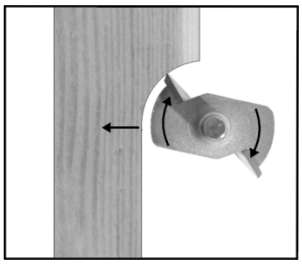


Figure 25 - Cutter rotation.

CAUTION
Start the router and allow it to reach full speed before the cutter touches the material. Keep the router moving. The spinning cutter will burn the material if the router is moved too slowly.

NOTES

Direction of Feed

When using a bit with a pilot bearing on it, or when using a guide or bushing, you can use the sideways force caused by the cutter rotation to your advantage. If you follow these two guidelines, the cutter will help hold itself against the material or guide being used.

1. When cutting around the inside edge of an opening in the project or template the router should travel in a *clockwise* direction.
2. When cutting around the outside edge of a project or template the router should travel in a *counter-clockwise* direction (Figure 26).

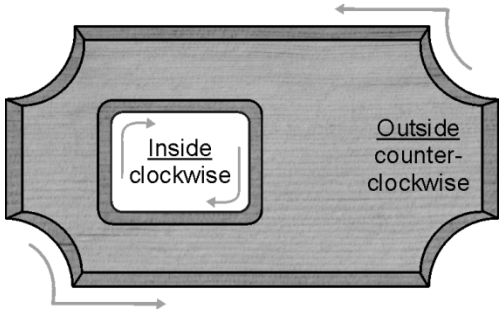


Figure 26 - Inside and outside feed direction.

NOTE
Some materials tend to splinter badly when routed. Try taking several light cuts and reversing the feed direction to produce a smooth cut in these materials.

Guides

There are many methods of guiding a router so that the cuts are accurate and/or straight. Clamping a straight piece of material to the project can make a simple base guide. The router is held against the straight edge and a straight cut is accomplished (Figure 27).

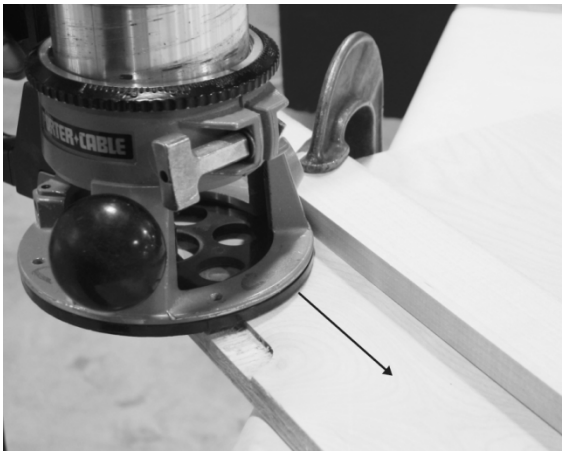


Figure 27 - Edge and base guides.

Manufactured guides are available to guide the router for cutting edges, arcs, circles and various other shapes. They usually attach to the base or housing of the router and may be adaptable for use with various sizes and brands of routers (Figure 28).

Figure 28 - Manufactured guides. (Courtesy of House of Tools)

Guide bushings fit into the base plate of the router and extend below the base to ride along the edge of a shop or commercially made template (Figure 29). Various sizes are available to accommodate different sizes of bits and depths of the templates. Using a guide bushing allows you to accurately follow a template and to produce the desired cut time after time.

Figure 29 - Guide bushings.

Templates are typically used to guide a router that is equipped with a guide bushing. Many templates are made for cutting letters, pictures and other designs with the router. Router templates are commonly used by carpenters for:

- routing stair stringers to receive treads and risers (Figure 30A) and
- routing hinge and striker plate gains for installing doors (Figure 30B).

A B

Figure 30 - Stair and hinge templates. (Courtesy Porter-Cable • Delta)

NOTES

Router Tables

A *router table* can increase the range of use of your router by turning it into a miniature, portable version of a shaper. By mounting the router upside down into a table and moving the material over the cutter you can gain better control over smaller pieces of material and easily keep the cuts perpendicular to the material surface. A *fence* is used on top of the router table to control the path of the material over the cutter. It is usually clamped or bolted to the table and is adjustable (Figure 31).

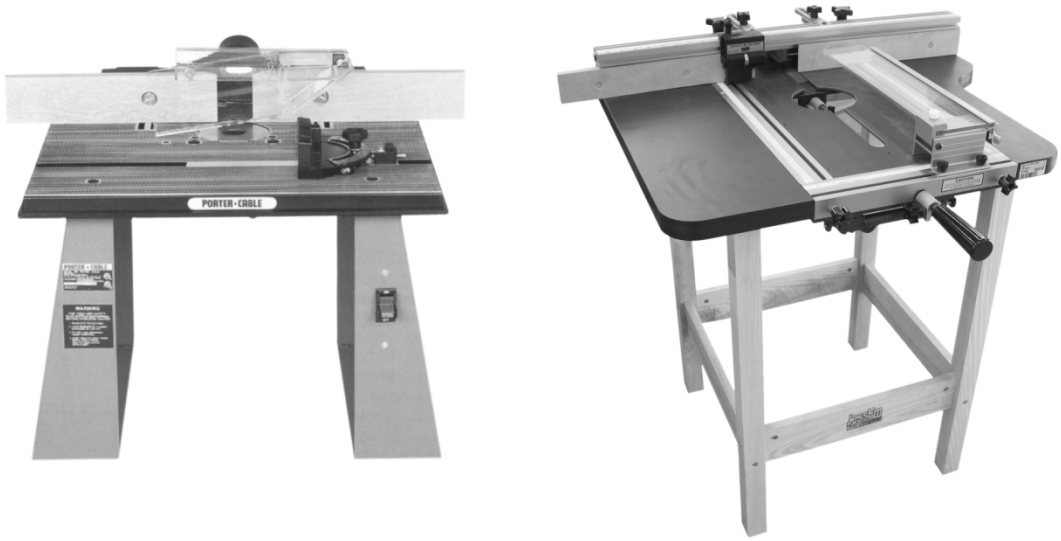


Figure 31 - Router tables. (Courtesy of House of Tools)

When using a router table, feed the material against the rotation of the cutter and hold it against the fence. Because the router is mounted upside down, the rotation of the cutter is counter-clockwise; therefore, the material will be fed from right to left for most operations (Figure 32).

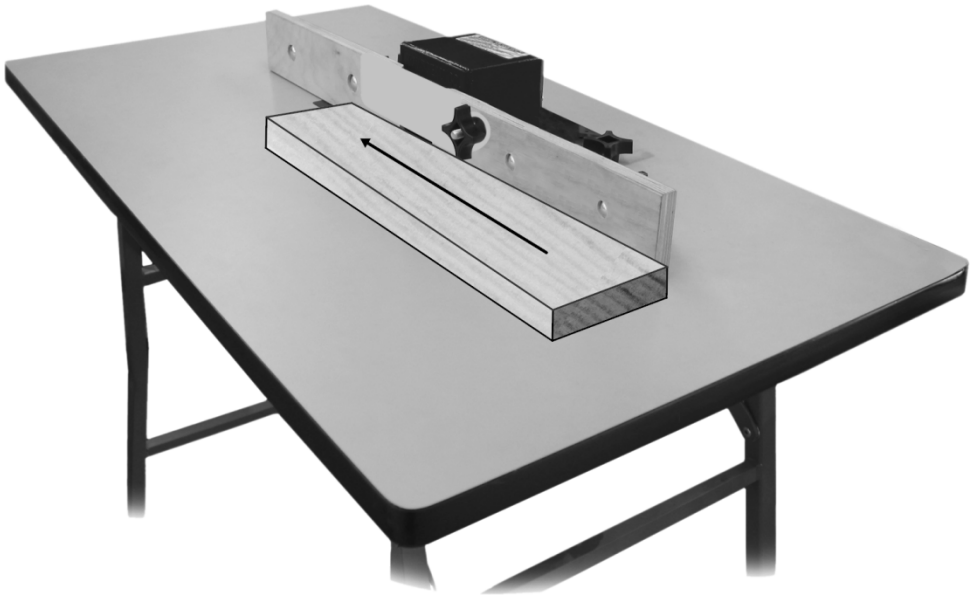


Figure 32 - Router table fence and direction of feed.

NOTES

Laminate Trimmers

With its small size and a motor speed of up to 30 000 rpm the *laminate trimmer* is basically a compact router designed for flush and bevel trimming of plastic laminates and similar materials (Figure 33).

Figure 33 - Laminate trimmers. (Courtesy of House of Tools)

Many laminate trimmers can be used with other speciality bases. The *Tilt-Base* allows trimming into corners that are inaccessible to standard base trimmers and trimming of laminated surfaces joining at angles of 45° to 90° (Figure 34), thus eliminating the need for hand-trimming in these areas. The *Offset Base* model trims into corners and trims narrow ledges that are already mounted against a wall or other surface.

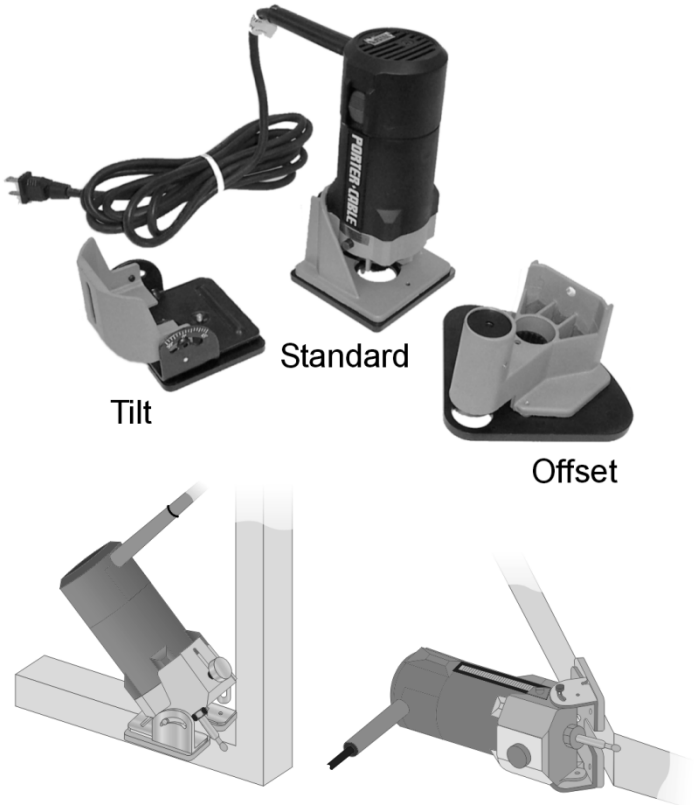


Figure 34 - Laminate trimmer bases. (Courtesy Porter-Cable • Delta)

NOTES

Rotary Cut Out Tool (Spiral Saw)

The *Rotary Cut Out Tool* can be equipped with various spiral carbide bits for cutting out the openings in drywall, wood, plastic, ceramic tile and other materials Figure 36. Some of the bits look like twist drill bits and are for free hand cutting while others have a pilot end for following the outside of a pipe or outlet box when cutting an opening.

Figure 35 - Rotary cut out tool. (Courtesy Porter-Cable • Delta)

NOTES

Power Hand Planes

These tools are the power version of traditional hand planes and can remove large quantities of shavings quickly (Figure 36). They can also be set up for specialized tasks such as rabbeting and chamfering. The size is designated by the maximum cut width of the cutter.

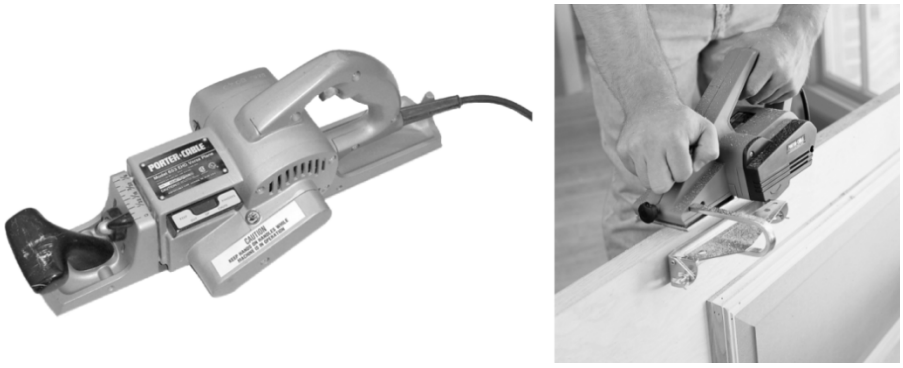


Figure 36 - Power planes. (Courtesy Porter-Cable • Delta)

There are two different cutter head styles: the spiral cutter head and the two-blade cutter head (Figure 37). Both cutter head styles are available in high-speed steel and carbide steel.

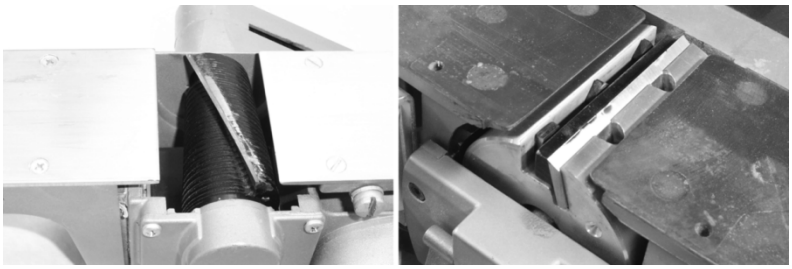


Figure 37 - Spiral cutter head and a two-blade cutter head.

NOTES

Objective Three

When you have completed this objective, you will be able to:

Describe the operation and maintenance of portable drilling and fastening equipment.

Portable Drills

The power version of the traditional hand drill is manufactured in many sizes and styles. The size of a drill is determined by the capacity of the chuck. Common models have 6 mm (¼"), 9 mm (⅜") and 12 mm (½") chuck capacities. Generally speaking, the larger the chuck capacity, the lower the rpm and the higher the torque. The 6 mm (¼") and 9 mm (⅜") drills are normally considered light duty. Most light-duty tools have a reversing feature and a variable speed switch (Figure 38).

Figure 38 - Light duty drills.

In response to conventional keyed chucks and the accompanying lost key frustration, many light-duty drills now feature a *keyless chuck*. Some keyless chucks have two sleeves that are turned in opposite directions to engage and disengage the grip on the bit. Others have a single sleeve that tightens against the drill shaft, which locks automatically when the trigger is released. These chucks tend to have higher gripping power than conventional chucks (Figure 39).

Figure 39 - Drill chucks.

Heavy-duty drills usually have a chuck capacity of 12 mm (½") and larger. Because heavy-duty drills turn slower and develop much higher *torque* (tendency to twist drill out of operator's hands), they are usually equipped with a second handle (Figure 40).

Figure 40 - Heavy-duty drill.

Right-angle drills are specialty drills designed for close-quarter drilling. The reduced distance from the tip of the bit to the back of the tool body makes it especially useful in confined spaces. This shape gives you better leverage against the twisting forces exerted by the drill than you would get with a conventional heavy-duty drill design (Figure 41).

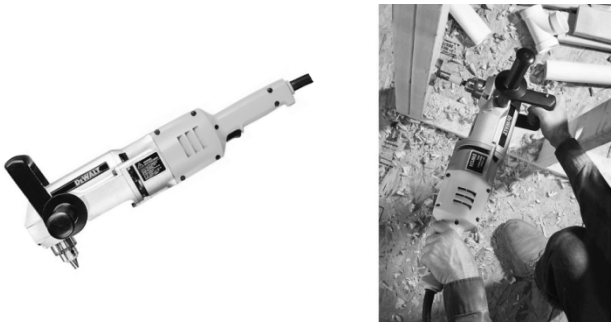


Figure 41 - Angle drill. (Courtesy Dewalt)

Hammer Drills

Hammer drills are available in wide range of sizes and are used primarily for drilling holes in masonry, concrete and other hard materials. Hammer drills add a pounding or hammering action to the rotation of the bit to pulverize the material under the drill tip as it rotates. The hammering action can be switched off on most models if you want to use it as a conventional drill (Figure 42).

Figure 42 - Hammer drills. (Courtesy Dewalt)

Concrete and Masonry Drill Bits

Hammer drill bits or *concrete and masonry* drill bits are different from regular drill bits. These bits have a carbide tip that is strong enough to take the scraping and hammering action of drilling into hard materials without chipping or shattering (Figure 43).

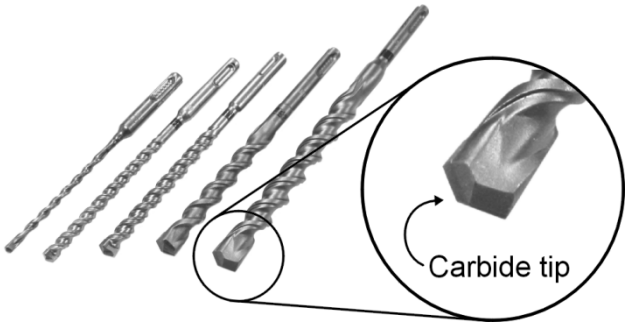


Figure 43 - Concrete and masonry drill bits.

In addition to drilling, hammer drills can be fitted with accessories to adapt them for many other tasks, including jack hammering, chiselling, grooving and roughing of concrete surfaces (Figure 44).

Figure 44 - Hammer drills in use. (Courtesy Dewalt)

Screw Guns

The type of chuck distinguishes a *screw gun* from a drill. Instead of a chuck, screw guns have a hexagon shaped bit holder that is usually covered by a sleeve (nosepiece). The nosepiece projects over the screw bit and is used to adjust the depth of screw penetration. Screw guns also have an adjustable clutch mechanism that disengages the drive mechanism when the screw drive depth has been reached. The trigger switch can be locked in the on position then, with the motor running the screws can be placed on a driver bit. This is possible because the bit will not rotate until the clutch is engaged by depressing the screw against a surface.

Drywall screwdrivers are specialized screw guns that revolve at much higher speeds (up to 6000 rpm, compared to 2500 rpm for a regular screw gun) (Figure 45).

Figure 45 - Drywall screwdriver. (Courtesy Dewalt)

Collated auto-feed screwdriver attachments are used primarily for fastening decking and sub-floor sheathing Figure 46. This attachment is designed to automatically feed screws into the driver bit, which makes this tedious job faster and easier.

Figure 46 - Collated auto-feed screwdriver attachments. (Courtesy of Senco Products)

Biscuit Joiners

The *biscuit or plate joiner* is used to cut slots for compressed hardwood biscuits. The machine's die cast shoe is attached to the motor body and automatically returns to conceal the cutter blade when not in use (Figure 47).

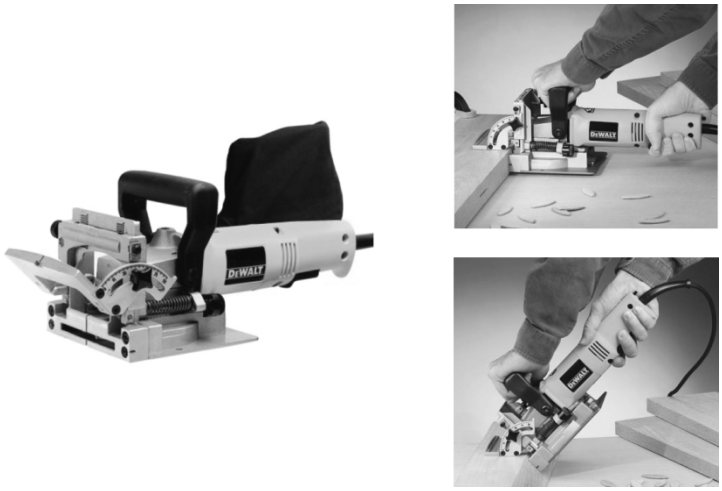


Figure 47 - Biscuit joiner. (Courtesy Dewalt)

The spring-loaded motor body has adjustable depth stops for all common biscuit sizes. Biscuits are formed from compressed hardwood that expands when glue is applied and are used to join stock at almost any angle. The three most common sizes of biscuits are #0, #10 and #20; other specialty sizes are also available (Figure 48).

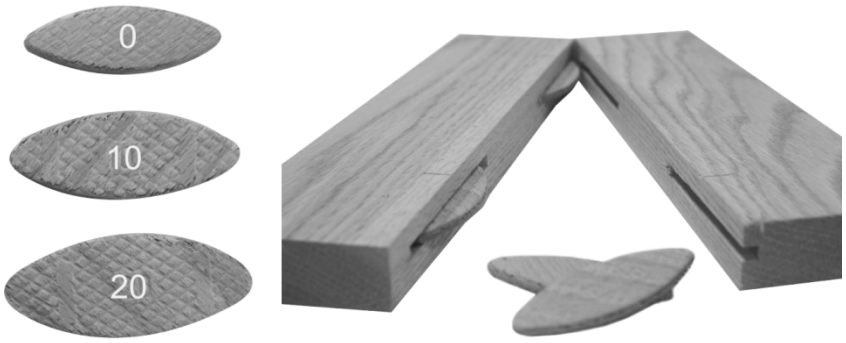


Figure 48 - Biscuits.

Objective Four

When you have completed this objective, you will be able to:

Describe the operation and maintenance of portable abrasive tools.

Sanders

Portable Belt Sanders

The belt sander is a very versatile tool that can be used to quickly remove material, shape contours or provide a smooth, flat surface. All belt sanders work much the same way. The motor powers the rear roller through a gear reduction drive. Most light-duty belt sanders are belt-driven, but the better, heavy-duty sanders are chain-driven. The front roller rotates freely and is spring-loaded to maintain tension on the sanding belt.

Between the rollers is a flat shoe section, called the *platen.* The platen provides solid backing for the sanding belt. The wider the platen and the belt the faster the sanding action. The width and length (circumference) of the belt designates the size of these machines (Figure 49).

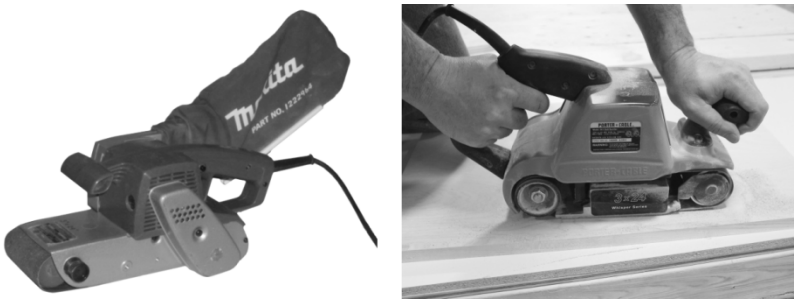


Figure 49 - Portable belt sanders.

Belt sanders typically require two hands to operate them safely. Start the sander before you place it flat on the material. Keep the sander moving parallel to the grain over the area you wish to sand. The sander will quickly sand a depression in your material if it is allowed to remain in one place too long. Avoid tipping the belt sander, as it will sand an unsightly gouge in your work if you do. Dust bags are a valuable accessory, but they do not pick up all the dust; wearing a dust mask is recommended.

DANGER
A dust mask, eye protection and ear protection are highly recommended when using belt sanders. Ensure the material is fastened down and will not moving during sanding.

NOTES

Sanding Belts

Sanding belts are available with various grits and abrasive materials. They are made by adhering the abrasives to a flexible cloth base and then fastening the ends together to form a continuous belt. Because the ends are often just lapped and glued together, an arrow is printed on the inside of the belt (Figure 50) to indicate the proper direction of travel when installed on the sander. If the belt is installed backwards, the outside edge of the lap will catch on the material and tear the belt open.

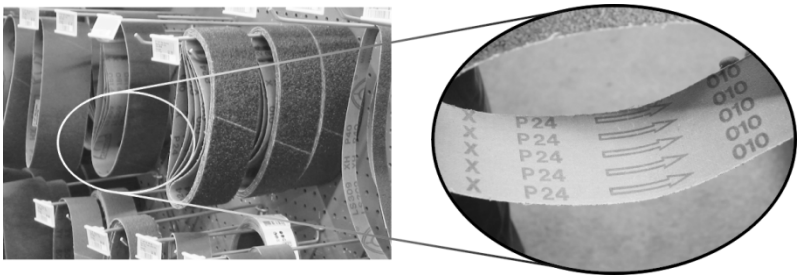


Figure 50 - Sanding belts. (Courtesy of House of Tools)

A lever releases the tension whenever the belt must be removed or installed. Turning an adjustment knob swivels the crowned front roller, allowing the belt to track correctly (Figure 51). After installation, the belt must be *tracked*. Tracking is normally done by adjusting the tracking adjustment knob while operating (running) the sander upside down. This allows you to see the position of the belt on the platen. When properly tracked the belt should run in the centre of the platen without drifting to one side or the other.

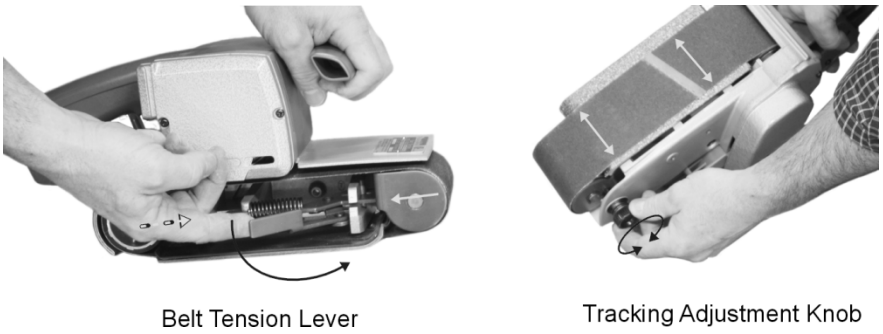


Figure 51 - Belt installation and tracking. (Courtesy of House of Tools)

Finishing Sanders

Finishing sanders are often referred to as *pad sanders* because the sandpaper is stretched taught over a flat, resilient pad of material. The pad size differs in sanders. The smallest, usually called a *palm* sander, is designed to take a one-quarter of a sheet of sandpaper while other models take one-third of a sheet or half a sheet (Figure 52).

Figure 52 - Finishing sanders. (Courtesy Makita Canada Inc.)

NOTE
The flexible pad on the base of most finishing sanders can cause a wavy surface in some wood grain, leaving the harder grain lines higher than the rest of the surface.

Finishing sanders are designed with different types of pad motion. They should be started before placing them flat on the work and always lifted off the work before they are shut off to avoid scratching the material.

The *oscillating* motion moves the pad in a straight line, back and forth movement. This motion is recommended for the finest finishes (Figure 53).

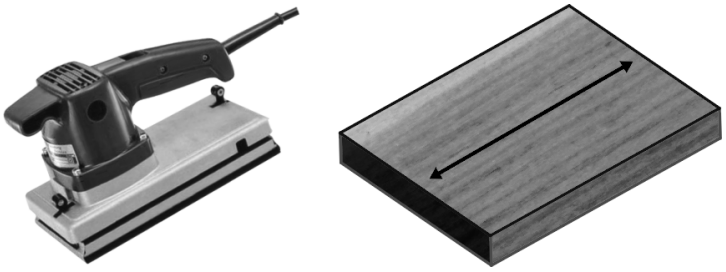


Figure 53 - Oscillating sander. (Courtesy Makita Canada Inc.)

The *orbital* motion moves the pad in tiny circles, while this motion cuts quickly and produces a smooth finish it tends to leave circular scratches that can become very pronounced when a stain is applied to the wood surface (Figure 54)

Figure 54 - Orbital sander. (Courtesy Makita Canada Inc.)

Many models now have a multi or *random orbital* motion and these also cut quickly but minimise the circular scratching and still develop a very smooth finish (Figure 55).

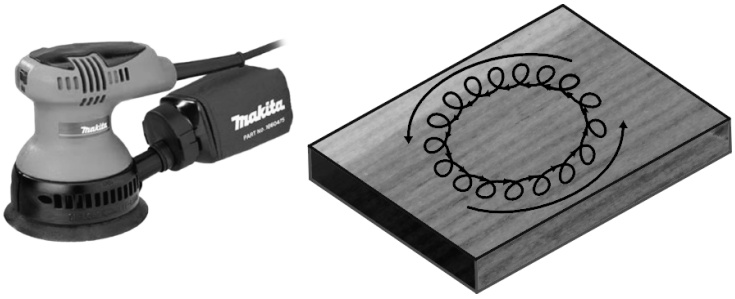


Figure 55 - Random orbital sander. (Courtesy Makita Canada Inc.)

NOTES

Disc Sanders and Grinders

A variety of small portable disc sanders and *grinders* are available (Figure 56). These use abrasive disks for such things as preparing wood and metal surfaces prior to painting, removing paint, rust and grinding uneven metal and concrete surfaces. The sanding discs are designed to cut on the surface or on the edge.

Models that have slower RPM can be fitted with a polishing pad and used to polish lacquered surfaces on wood and metal products.

Figure 56 - Angle disc sander/grinder. (Courtesy Dewalt)

DANGER
Never use the angle grinder without the wheel guard in place. When grinding metal, always look to see where the sparks may fall. A full face shield is recommended when using the angle grinder.

Portable Cut-Off Saws

These machines use abrasive cutting wheels to cut a variety of construction materials such as tubing, conduit, angle iron, sheet and corrugated metal, concrete, masonry blocks and bricks, reinforcing rods and welded wire mesh (Figure 57).

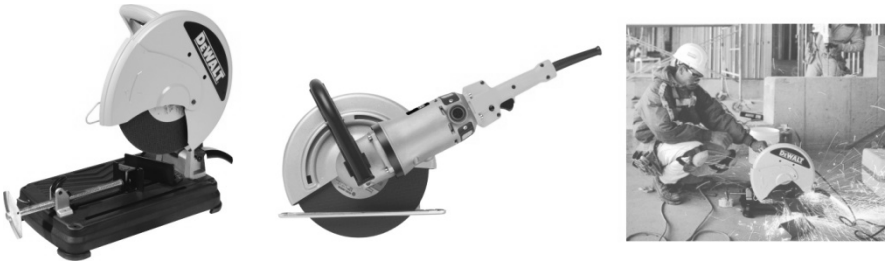


Figure 57 - Portable cut-off saws. (Courtesy Dewalt)

NOTES

Cordless Portable Power Tools

Many of the portable power tools discussed in this module are also available in a *cordless* model. Many of the features and functions of these tools are the same as the corded models and are not repeated here. This section highlights the products available so you can make informed choices when choosing to use or purchase cordless power tools. These tools are powered by rechargeable batteries and are gradually replacing corded models as the preferred choice for many operations such as drilling and installing fasteners and hardware (Figure 58).

Figure 58 - Cordless power tools. (Courtesy Makita Canada Inc.)

NOTE
Cordless power tools have limitations. They generally lack the power and torque of the corded models and are not intended to replace them for sustained heavy usage.

Batteries and Chargers

The *batteries* and *chargers* needed to power cordless tools vary as much as the tools (Figure 59). Most batteries give extended service if cared for properly, but none of them last forever and they all have a limited number of recharges or *cycles.* The batteries must be matched to the tool and the charger must be matched to the batteries. There is no standard format and every brand has its own design. Generally, the higher the voltage, the greater the power of the tool.

Batteries have a better chance of extended life if you follow the manufacturer's precautions for their use. Some of the manufacturer's precautions are as follows.

1. Charge the batteries fully before the first use and, when recharging, recharge fully.
2. Discharge the battery fully before recharging to avoid limiting the charge it will take.
3. Choose a tool with enough power to do the intended jobs.
4. Do not subject the batteries or charger to extremes in temperature or abuse.

NOTE
Spent batteries should have the cells replaced at a qualified battery repair shop or be recycled where facilities exist.

Figure 59 - Batteries and chargers. (Courtesy Dewalt)

NOTES

Drills

There are many sizes and voltages to choose from, to suit many jobs, including hammer drill models. Carpenters typically use cordless drills for installation jobs and most drills have torque settings to control the power when used for driving screws (Figure 60).

Figure 60 - Cordless drills.

Circular Saws

With the evolution of cordless tools into higher voltage ranges and increased power, some traditionally corded tools, such as circular saws, became available in a cordless version. These saws have proven their worth as trim saws on roofs and for small jobs in other areas where power is not available (Figure 61).

Figure 61 - Cordless circular saws.

Reciprocating Saws

The reciprocating saw (the carpenter's favourite saw for renovations, rough cutting and trimming) is also available in cordless (Figure 62).

Figure 62 - Cordless reciprocating saws.

Jigsaws

Cordless jigsaws are a great addition to your tools if you are involved in a lot of service and installation work, but may not be the best choice for sustained or constant use (Figure 63).

Figure 63 - Cordless jigsaws.

NOTES

Routers

Routers are a recent addition to the cordless line. Their greatest value is for small jobs and installations where a short set-up time is desirable. For sustained use in a shop work situation, a corded model may have the advantage (Figure 64).

Figure 64 - Cordless routers. (Courtesy Porter-Cable • Delta)

Nailers

A few models of cordless nailers are available. Those that use batteries either have an electric solenoid to drive the nails or an on-board compressor pump that runs on the battery power to recharge the air chamber and drive the nails (Figure 65).

Figure 65 - Cordless nailers. (Courtesy Porter-Cable • Delta)

PORTABLE POWER TOOL INFORMATION QUESTIONS

1) What simple thing can help eliminate many safety concerns, but cannot be included in a list of rules?
    a. All possible safety issues
    b. All machine safety rules
    c. Common sense
    d. Being careful
2) What are the risks of using under sized or poorly maintained extension cords?
    a. Shock hazard
    b. Burn out your machines
    c. Fire hazard
    d. All of the above
3) As the length of an extension cord increases, what type of cord should you use?
    a. A darker coloured one
    b. One with higher resistance
    c. A heavier gauge one
    d. A better conducive material
4) What type of cord should you use for construction?
    a. 2 wire (ground and the “hot” wire
    b. 3 wire (ground, neutral, and “hot “ wire
    c. 4 wire (ground, neutral, red “hot” and black “hot”
    d. None of the above
5) The blade guard on the portable circular saw should be raised manually only when doing which types of cuts?
    a. When making a plunge cut
    b. When making a rip cut
    c. When making a dado cut
    d. When cross cutting
6) How far should the saw blade project through the material when the base of the portable circular saw is adjusted properly?
    a. No more than 1 mm
    b. No more than 6 mm (1/4 inch)
    c. No more than 12 mm (1/2 inch)
    d. Any distance just as long as it cuts through
7) Why should you never back up with a portable circular saw while it is running?
    a. You might make a wrong cut
    b. The teeth might get ruined
    c. The saw might kick back
    d. It could ruin the motor

8) Which common safety issue do people often ignore when using a power mitre saw?
    a. Crossing their arms
    b. Forgetting to stand to the right
    c. Forgetting to close the guard
    d. Cutting on the wrong side of the line
9) What advantage does a sliding compound mitre saw have over a regular compound miter saw?
    a. Easier to use because it slides
    b. Cuts much faster
    c. Is much more accurate
    d. Can cut wider material
10) What must you be aware of when cutting with the long blades of a reciprocating saw?
    a. You might get cut more easily
    b. You might cut further than you intend
    c. They might bend awkwardly
    d. They last much longer
11) What happens to the material if the router is moved too slowly while cutting?
    a. Material will splinter
    b. Material will burn
    c. The motor will wear out quicker
    d. The depth of cut may change
12) If the material being cut with the router tends to splinter, what can you do?
    a. Take a lighter cut
    b. Take a thicker cut
    c. Push harder
    d. Push softer
13) In which direction should you feed the material when using the router in a router table?
    a. From left to right
    b. From right to left
    c. Straight in
    d. In reverse
14) How can you adjust the depth of cut for different size biscuits when using the biscuit jointer?
    a. Push the jointer to the depth you need
    b. Use the millimeter guide to know when to stop
    c. Use the spring loaded depth stop
    d. Use a clamped stopping board
15) How can you tell if you have the belt tracking adjusted properly on the belt sander?
    a. It will sand your material quickly
    b. It will guide your material perfectly
    c. It will ride in the center of the platen
    d. The machine will sand your material in the proper direction