Introduction to Carpentry Power Tools

Description
Carpenters use power tools every day, and the ability to use these tools correctly and safely is paramount. In this Activity Plan, students will become familiar with the correct usage of the portable circular saw and the compound mitre saw.

Lesson Outcomes
The student will be able to:

- Identify the parts of the portable circular saw and compound mitre saw
- List the key safety considerations for each tool
- Define the basic purpose and correct steps in using each tool

Terminology
Bevel: a cut or angle where the edge of the material is not perpendicular to the face of the material. Common uses include edges of tabletops and legs of furniture.

Compound mitre saw: a portable saw that is used to make accurate crosscuts and angle cuts in materials. It consists of a large blade attached to a mechanism that can be adjusted to cut at different angles or at different bevels.

Crosscut: a cut across the grain of a length of wood at a 90° angle

Mitre: a cut across the grain of a length of wood at an angle other than 90°

Personal protective equipment (PPE): protective equipment and clothing designed to shield the worker from injury. Types of PPE include eye, ear, and body protection against workplace hazards such as projectiles, fumes, and excessive noise.

Portable circular saw: a hand-held electrically powered saw used for cutting common wood materials in a straight cut. The saw consists of a small circular blade housed in a guarded case with a baseplate that rests on the material being cut.

Estimated Time
2–4 hours

The time for this activity will depend on the familiarity of students with tools and the scope of project (e.g., size of wall, access to tools—number of saws available, etc., and numbers of students).

Recommended Number of Students
20, based on the BC Technology Educators’ Best Practice Guide; ideal is 16.
Facilities
Technology education shop facility required. Secure space to work outside is advantageous.

Tools
• Aprons
• Eye protection and hearing protection (PPE)
• Compound mitre saw
• Portable circular saw
• Extension cord (if necessary)
• Sawhorses for supporting material being cut

Materials
2 × 4” or 2 × 6” scraps for practice cutting

Resources
HEADS UP! For Safety—A Safety Handbook for Technology Education Teachers—Ministry of Education
• Portable Power Tools Safety Information Sheet, page 49
• Portable Power Tools Safety Quiz, page 50
• Portable Circular Saw Information Sheet, page 61
• Portable Circular Saw Safety Quiz, page 62

Compound Mitre Saw Safety Sheet
Demonstration: Portable Circular Saw

1. Outline the purpose of the activity and review the importance of general safety on the job site.

2. Have students read through the Heads Up! For Safety – Portable Power Tools Safety Information Sheet. This can be preceded or followed by a short introduction to portable power tool safety.

3. Students should complete the Heads Up! – Portable Power Tools Safety Quiz. Students can group mark the quiz or the teacher can collect and mark them.

4. The teacher should begin the activity with a demonstration of the parts of the saw. It should consist of:
   - Type of blade used and method of removing and attaching the blade
   - Arbor nut holding the blade in position
   - Saw base
   - Guard
   - Blade depth adjustment
   - Blade angle adjustment
   - Electrical cord (or battery pack if cordless)

Figure 1—Circular saw nomenclature
5. Have the students read the Heads Up!—Portable Circular Saw Information Sheet.

6. Then demonstrate the use of the saw. Have the students wear PPEs as they watch.

7. Have the students individually complete the Heads Up!—Portable Circular Saw Safety Quiz. As this is a legal safety requirement, students must be thorough and complete all aspects of the quiz in the allotted time.

8. Collect and mark the safety quiz (to be given back the following day).
Demonstration: Compound Mitre Saw

1. Begin the compound mitre saw activity with a demonstration of the parts of the saw. It should consist of:
   • Type of blade used and method of removing and attaching blade
   • Arbor nut holding the blade in position
   • Saw table
   • Saw fence
   • Guard
   • Mitre adjustment mechanism (varies from saw to saw)
   • Bevel adjustment mechanism (varies from saw to saw)
   • Electrical cord

2. Have the students read the Compound Mitre Saw Safety Sheet (on the next page).

3. When the students have completed their reading, demonstrate the use of the saw. Have the students wear PPEs as they watch. The teacher should demonstrate a variety of 90° cuts, mitre cuts and bevel cuts.

Emphasis should be on clamping material if possible, hands away from the blade path, letting the blade reach top speed before cutting, and moving out and down in with the actual cut. The saw should not be lifted from the bottom of the cut until the blade is fully stopped or the material may catch and kick away from the machine.

Evaluation Guidelines

The student:

• Successfully completes the Heads Up! Portable Power Tools Safety Quiz
• Successfully completes the Heads Up! Portable Circular Saw Safety Quiz
Compound Mitre Saw Safety Sheet

1. Be sure all guards are in place and working properly before each use.
2. When changing a blade, always match the direction of the arrow on the blade with the direction of the arrow on the tool. The teeth at the bottom of the blade should point down and in toward the fence.
3. Be sure the arbor nut is tight to prevent slipping.
4. Place the saw on a flat and level surface.
5. Always wear safety glasses or a face shield. Hearing protection is recommended.
6. Remove loose-fitting clothing and jewellery, and tie back long hair.
7. Always place the material securely on the table and against the fence when making cuts.
8. Whenever possible, use clamps to secure the material to the table to avoid injuries.
9. Never make freehand cuts without holding the material tightly against the fence.
10. Never cut small pieces that would require you to put your fingers within 3" of the cutting blade without a clamping device.
11. Never reach across the saw blade or perform “cross-handed” operation.
12. When starting the saw, allow the blade to reach full speed before cutting; do not force the blade. Let the motor do the work.
13. When using a sliding compound mitre saw, remember to pull the blade out, start the saw, and then push down into the stock and toward the fence.
14. Never raise the blade from the material until the blade has come to a complete stop.
15. Never try to remove or clamp any material to the saw while the blade is rotating.
Appendix: Mitre Saw Information

Types
Carpenters use portable mitre saws to cut mouldings and finish wood as well as to fit and cut framing lumber to length.

There are three basic types of mitre saws:
- Mitre
- Compound mitre
- Sliding compound mitre

A sliding compound mitre saw has a sliding device that allows the motor and blade to slide along a track. This allows the saw to cut much wider boards.

On most job sites, a power mitre saw is simply called a chopsaw. There are a great number of sizes and styles—from standard single-pivot chopsaws through dual compound mitre saws. Figure 4 shows a single-pivot type.

Sizes
The size of a mitre saw is determined by the maximum diameter of the blade that it can use. Most mitre saws are 8, 10, or 12" saws. Twelve-inch diameter blades are not as common.

The power of the saw is determined by the size of the motor. As portable tools, they must use a 120-volt power source. This limits the power of the saw. The 12" saws are usually underpowered and tend to slow when cutting wide or thick boards.
**Compound Mitre Saw**

This saw mitres like a standard chopsaw, but the blade and motor assembly also can flop over to one side, allowing the user to cut a bevel with the face of the board lying flat on the table.

The sliding compound mitre saw can cut mitres, bevels, and compound mitres like a compound mitre saw. But instead of a fixed pivot point, the blade and motor can slide forward and back on a rail. A sliding saw can cut wider stock than a fixed pivot head saw.

![Figure 5—Compound mitre saw](image)

![Figure 6—Single sliding compound mitre saw](image)

**Double-Bevel Compound Mitre Saw**

This saw functions exactly like a compound mitre saw, except that the blade and motor assembly can flop either to the left or to the right, allowing for the cutting of bevels and compound mitres in either direction.

Double-bevel sliding compound mitre saws function the same as double-bevel compound mitre saws, but they also can slide back and forward on a rail.

![Figure 7—Double-bevel compound mitre saw](image)

![Figure 8—Double-bevel sliding compound mitre saw](image)
**Operating Controls**

To turn the saw on, depress the trigger switch (A). Release the switch to turn if off.

**Warning:** The turning blade is dangerous. After completing the cut, release the switch trigger to activate the brake. Keep the saw head down until the blade has come to a complete stop.

The torque developed during braking may loosen the arbor screw. The arbor screw should be checked periodically and tightened if necessary.

**Rotating Table**

The mitre saw shown in Figure 10 will cut any mitre angle from a straight 90° cut-off to 47° right or left. Simply loosen the lock handle (A), depress the index lever (B), and move the control arm to the desired angle. Then tighten the lock handle (A).

The 10" compound mitre saw is equipped with positive mitre stops for the table control arm at the 0, 15, 22½, 30, and 45° right and left positions. Loosen the lock handle (A) and move the control arm until the spring-loaded index lever (B) engages into one of the positive stops (four of which are shown at (C) ). Then tighten the lock handle (A). To disengage the positive stop, depress the index lever (B).

**Important:** Always tighten the lock handle (A) before cutting.

In addition, two triangle indicators (D) are provided on the scale at the 31½° right and left mitre angle, for cutting crown moulding.
**Tilting Arm**

The cutting arm of the compound mitre saw can be tilted to cut at any bevel angle from a 90° straight cut-off to a 45° left bevel angle by loosening the bevel lock handle (A) (Figure 11), tilting the cutting arm to the desired angle, and tightening the lock handle (A).

**Note:** The lock handle (A) is spring-loaded and can be positioned by pulling out on the handle and repositioning it on the nut located underneath the hub of the handle.

Positive stops are provided to rapidly position the saw blade at 90° and 45° to the table. The bevel angle of the cutting arm is determined by the position of the pointer (B) on the scale (C).

In addition, a triangle indicator (D) is provided on the scale at the 33\(^\circ\) bevel angle for cutting crown moulding.

![Figure 11—Bevel cutting](image-url)
Locking Arm
When transporting the saw, the cutting arm should always be locked in the down position. This can be accomplished by lowering the cutting arm (A) (Figure 12) and moving the locking lever (B) to the locked position. Never carry the mitre saw by the switch handle, cutting arm or table control; this may cause misalignment. Always lift the saw by its base.

![Figure 12—Locking cutting arm](image)

Fastening Holes
Fastening holes are provided in the base of the saw casting for mounting. Always secure the saw with screws to prevent movement. A walking saw is always dangerous.

![Figure 13—Fastening holes](image)
Mitre Saw Adjustment

DISCONNECT THE SAW FROM THE POWER SOURCE BEFORE MAKING ANY ADJUSTMENTS.

Two-Position Fence

The fence (A) on your mitre saw can be used in the forward position, as shown in Figure 14, or in the rear position, as shown in Figure 15. The forward position is used for cutting workpieces up to a standard 4×4" and is the most common fence position.

The rear fence position is used when cutting off or bevelling standard 2×6” workpieces.

To change the fence position, loosen the two fence locking screws, one of which is shown at (B). Position the fence (A) in either the forward or rear position and tighten the two fence locking screws (B).

To quickly check to see if the saw is cutting square, cut a 2×6”, flip the cut piece over, and butt it against the edge from which you cut. If the workpiece does not butt squarely, an adjustment is required (Figures 16 and 17).
Adjusting a 90° Bevel Stop

Loosen the bevel lock handle, tilt the cutting arm all the way to the right, and tighten the bevel lock handle. Place one end of a square (A) (Figure 18) on the table and the other against the blade. Check to see if the blade is at 90° to the table. If an adjustment is necessary, loosen locknut (B) (Figure 19) and turn screw (C) until the other end of screw (C) contacts the casting (D) when the blade is 90° to the table. Then tighten locknut (B).

Adjusting a 45° Bevel Stop

Loosen the bevel lock handle, tilt the cutting arm all the way to the left bevel position, and tighten the bevel lock handle.

Use a combination square (A) to check if the blade is at 45° to the table (Figures 20 and 21). If an adjustment is necessary, loosen locknut (E) and turn screw (F) until other end of screw (F) contacts casting (G) when the blade is at 45° to the table. Tighten locknut (E).

These positive stops enable you to rapidly position the blade at 90° and 45° to the table.
Adjusting Blade Parallel to Tabletop Insert Opening

Before adjusting the blade parallel to the blade insert opening in the mitre saw tabletop, **DISCONNECT THE SAW FROM THE POWER SOURCE.**

**Note:** This adjustment should be checked with the cutting arm moved all the way to the right (blade 90° to the table).

Lower the cutting arm. The saw blade (A) should be parallel to the left edge (B) of the table insert opening (Figure 22). If an adjustment is necessary, loosen two screws (C) and move the cutting arm until the blade is parallel with the left edge (B) of the table insert opening. Then tighten two screws (C).

![Figure 22—Blade parallel to blade insert opening in tabletop](image)

Adjusting Fence 90° to Blade

Before adjusting fence 90° to blade, **DISCONNECT THE SAW FROM THE POWER SOURCE.**

**Note:** This adjustment must be made twice, once with the fence in the forward position and again with the fence in the rear position.

Loosen the two fence locking screws, one of which is shown at (A), and move the fence (B) all the way to the forward position (Figures 23 and 24). Then tighten the two fence locking screws (A).

Lower the saw blade and lock the cutting arm in the down position. Place one edge of a square (C) against the blade and the other end against the fence, as shown. Check to see if the fence is 90° to the blade.

If an adjustment is necessary, loosen the two fence locking screws (A) and turn the two adjusting screws, one of which is shown at (D), until you are sure the fence is at 90° to the blade when the fence is all the way forward. Then tighten the two fence locking screws (A).

![Figure 23—Fence adjustment 1](image)  
![Figure 24—Fence adjustment 2](image)
For the second adjustment, loosen the two fence locking screws, one of which is shown at (A), and move the fence (B) all the way to the rear position, as shown (Figures 25 and 26). Then tighten the two fence locking screws (A).

Using a square, place one end of the square against the blade and the other end against the table and check to see if the fence is 90° to the blade. If an adjustment is necessary, loosen the two fence locking screws (A) and turn the two adjusting screws, one of which is shown at (E), until you are sure the fence is at 90° to the blade when the fence is all the way to the rear. Then tighten the two fence locking screws (A).

These adjustments enable you to rapidly position the fence in either the forward or rear position making sure that the fence will be 90° to the blade.

Adjusting the Sliding Fit of the Cutting Arm for Vertical Travel

Before adjusting the sliding fit of the cutting arm for vertical travel, **DISCONNECT THE SAW FROM THE POWER SOURCE**.

To adjust the sliding fit between the arm (A) and bracket (B), tighten or loosen the adjusting nut (C) (Figure 27). Correct adjustment is achieved when a good snug sliding fit is obtained without any side movement between the arm (A) and bracket (B). This adjustment should not be so tight that it restricts the sliding movement or so loose that it affects the accuracy of the saw cut.
Adjusting Saw Blade Downward Travel

Before adjusting the downward travel of the saw blade, **DISCONNECT THE SAW FROM THE POWER SOURCE.**

The downward travel of the saw blade can be limited to prevent the saw blade from contacting any metal surfaces of the machine. This adjustment is made by loosening locknut (A) and turning adjusting screw (B) in or out (Figure 28). When making this adjustment, make sure the machine is disconnected from the power source and lower the blade as far as possible. Rotate the blade by hand to make certain the teeth do not contact any metal surfaces.

![Figure 28—Downward travel](image)

Maintenance

Maintenance of a mitre saw is similar to that of most portable power tools. The blade should be replaced when it becomes dull, and all electrical cords and connections must be kept in good condition.

Mitre saws are moved to and from the job site daily. This continual moving loosens screws and bolts. Regularly tighten all bolts and screws. Replace any parts that may have come loose or been lost.

Before using any mitre saw, check that the guard is moving freely and protects the blade fully. Never use a saw with the guard held back or if it is not operating correctly.

Clean the saw weekly. Remove all sawdust and pitch. Lubricate all moving parts with light oil and then wipe clean.
Brush Inspection and Replacement

CAUTION: BEFORE INSPECTING BRUSHES, DISCONNECT THE MACHINE FROM THE POWER SOURCE.

Brush life varies, depending on the load on the motor. Check the brushes after the first 50 hours of use for a new machine or after a new set of brushes has been installed.

The brush holders (A) are located opposite each other on the motor housing (Figures 29 and 30). When the carbon on either brush is worn to \( \frac{3}{4}\) in length or if either spring or shunt wire is burned or damaged in any way, replace both brushes. If the brushes are found serviceable after removing, reinstall them in the same position as before they were removed.

![Figure 29—Brush location](image1)

![Figure 30—Brush inspection](image2)

Changing the Blade

Use only crosscutting saw blades. When using carbide-tipped blades, make sure they have a negative hook angle.

Do not use blades with deep gullets as they can deflect and contact the guard.

DISCONNECT THE MITRE SAW FROM THE POWER SOURCE BEFORE INSTALLING THE BLADE.
Blade Removal

Rotate the lower blade guard (clear plastic) up and out of the way. Loosen screw (B) to free plate (C). This will expose the arbor nut.

To lock the blade from rotating you can use a scrap of wood or push on the arbor lock near the saw handle (Figure 31).

Blade Installation

Reinstall a new blade by confirming rotation, holding the blade from turning, and replacing the washer and nut.

Swing guard plate (C) into position and lock by tightening the screw.